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**EARLY STAGE BENEFIT COST ANALYSIS FOR
ESTIMATING ECONOMIC IMPACTS**





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**Research Report
KTC-06-11/SPR306-05-1F**

Early Stage Benefit Cost Analysis for Estimating Economic Impacts

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In Cooperation with
Transportation Cabinet
Commonwealth of Kentucky

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of the University of Kentucky, the Kentucky Transportation Cabinet, or the Federal Highway Administration.

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16. Abstract This study reviewed the various software packages and other methods in use for estimating the economic impacts of proposed transportation projects. A total of 13 economic software packages were examined as potential applications in meeting KYTC's business needs. It was determined that only the TREDIS model from the Economic Development Research Group, Inc. or the TranSight model from Regional Economic Models, Inc. could potentially meet Kentucky's needs as defined in the project. Both the TREDIS model and the TranSight model are comparable in their economic forecasting abilities. They are also similar in that both require the input of data from a travel demand model—usually HERS. The economic benefit outputs for both models are the same including predicted: employment by industry; output by business / industry; wage rates; and gross domestic / regional product. The TREDIS model appears to calculate economic benefits for a wider range of transportation projects, mostly the smaller scale types such as intersection reconstruction. But the REMI-TranSight model will be more economical to acquire and run over the long term and has a longer list of clients.			
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EXECUTIVE SUMMARY

Transportation continues to remain the backbone of our dynamic and vital economy. Each day, millions of commuters and freight haulers utilize the nation's highways and transportation networks to reach their intended destinations. Many of these facilities are so crowded that local economies, like a vehicle in traffic, are slowed to a crawl. New facilities and highway capacity upgrades are needed. But, transportation planners confront a dilemma: the demand for new facilities is rising faster than the tax revenues to pay for them. With limited resources for funding future transportation improvements, local and state officials cannot build all the roads needed to alleviate congestion, eliminate accidents, and meet other transportation needs.

A key transportation question arises: "How can state transportation departments make optimal use of limited highway funds to best serve the transportation needs of their constituents?"

Because of this very relevant question, the Kentucky Transportation Cabinet (KYTC) seeks to determine how best to allocate state highway funds to future transportation projects. Since funds are limited, it is imperative that the Cabinet select the projects that provide the greatest benefit for each dollar spent.

To that end, The Kentucky Transportation Center (KTC) was asked to assist the KYTC with the development of an "Early Stage Benefit Cost Analysis" method for evaluating the economic and other benefits of proposed highway projects. After consultation with the study advisory committee, it was determined that Kentucky possesses a method for measuring the costs of projects as well as the likely benefits to roadway users in regard to improved travel times and reduced accidents. Therefore, the task was narrowed to obtaining the best available measure of the non-user economic impact of projects (i.e., the impact of a project on the local economy in terms of the dollar value of increased economic activity associated with a roadway project.) The study team then reviewed the various software packages and other methods in use for estimating economic impacts to identify the one most suitable for Kentucky.

Two potential software packages were identified and their characteristics and costs are discussed. Each has its advantages. The use of one by the Cabinet to estimate economic benefits will not

take the place of managerial decision making, constituent or political preferences, or engineering/technical expertise in deciding which proposed projects get built and which ones do not. The principle goal of this study was to assist the Kentucky Transportation Cabinet by identifying the best technical tools for evaluating the economic benefits of proposed major state highway projects. It is expected that adoption of either of the recommended software packages would bring increased accountability, objectivity, and transparency to the process of selecting state highway projects for funding.

Many state departments of transportation estimate the economic impact of proposed transportation infrastructure investments. Among the straightforward and readily available measures were the likely effects on unemployment rates, jobs created or retained, cost effectiveness of investment, and improved traffic flow on a strategic corridor. Some states use economic models to assess major transportation projects. The Kentucky Transportation Cabinet reviewed the various models to find an economic software package that could fully and quickly evaluate all the economic benefits stemming from transportation projects.

A cross-examination of the many economic software packages currently on the market revealed many distinct uses depending on the package. A total of 13 economic software packages were examined as potential applications in meeting KYTC's business needs (see Table 1). In the end, it was determined that only the TREDIS model from the Economic Development Research Group, Inc. or the TranSight model from Regional Economic Models, Inc. could potentially meet the Kentucky's needs as defined in the project.

Both the TREDIS model and the TranSight model are comparable in their economic forecasting abilities. They are also similar in that both require the input of data from a traffic model—usually HERS. The economic benefit outputs for both models are the same including predicted:

- Employment by Industry
- Output by Business / Industry
- Wage Rates
- Gross Domestic / Regional Product

Comparing EDR-TREDIS to REMI-TranSight, it initially appears that both EDR and REMI have comparable systems with only a few minor differences. The TREDIS model appears to calculate economic benefits for a wider range of transportation projects, mostly the smaller scale types such as intersection reconstruction. But the REMI-TranSight model will be more economical to acquire and run over the long term and has a longer list of clients. As demonstrated in the cost projections section, either model will require sizable time and budgetary resources from KYTC in order to fully employ the system. As shown in Appendix G, the Cabinet might expect to pay anywhere from an average of \$100,000 to \$300,000 in the best and worst case scenarios, respectively. The Kentucky Transportation Center believes either of these software packages would be a useful tool for predicting economic benefits from proposed transportation projects. But, it is an unavoidable fact that a firm commitment in resources will be needed in order to adopt either model.

I. INTRODUCTION

Background

Transportation continues to remain the backbone of our dynamic and vital economy. Each day, millions of commuters and freight haulers utilize the nation's highways and transportation networks to reach their intended destinations. Many of these facilities are so crowded that local economies, like a vehicle in traffic, are slowed to a crawl. New facilities and highway capacity upgrades are needed. But, transportation planners confront a dilemma: the demand for new facilities is rising faster than the tax revenues to pay for them. With limited resources for funding future transportation improvements, local and state officials cannot build all the roads needed to alleviate congestion, eliminate accidents, and meet other transportation needs.

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To that end, The Kentucky Transportation Center (KTC) was asked to assist the KYTC with the development of an "Early Stage Benefit Cost Analysis" method for evaluating the economic and other benefits of proposed highway projects. After consultation with the study advisory committee, it was determined that Kentucky possesses a method for measuring the costs of projects as well as the likely benefits to roadway users in regard to improved travel times and reduced accidents. Therefore, the task was narrowed to obtaining the best available measure of the non-user economic impact of projects (i.e., the impact of a project on the local economy in terms of the dollar value of increased economic activity associated with a roadway project.) The study team then reviewed the various software packages and other methods in use for estimating economic impacts to identify the one most suitable for Kentucky.

Two potential software packages were identified and their characteristics and costs are discussed. Each has its advantages. The use of one by the Cabinet to estimate economic benefits will not take the place of managerial decision making, constituent or political preferences, or engineering/technical expertise in deciding which proposed projects get built and which ones do not. The principle goal of this study was to assist the Kentucky Transportation Cabinet by identifying the best technical tools for evaluating the economic benefits of proposed major state highway projects. It is expected that adoption of either of the recommended software packages would bring increased accountability, objectivity, and transparency to the process of selecting state highway projects for funding.

Economic Impacts from Transportation

More often than not, decisions regarding public infrastructure projects encompass the belief that potential economic impacts will be realized in the affected area. In a Government Accountability Office (GAO) study analyzing statewide transportation planning, one of the key factors in transportation investment decisions involved the “economic vitality of the metropolitan area, especially for enabling global competitiveness, productivity, and efficiency”.¹ Department of Transportation officials realize that the public demands responsible stewardship of their taxpayer dollars. In almost every instance, the creation of jobs or some other visibly measurable impact on a region’s economy tops taxpayer concerns. Elected officials want to maintain a strong economy. So in many instances, highways are constructed to boost an area’s economy.

Transportation improvements via roadway maintenance improvements and/or capacity expansion (i.e. - new roads or lane additions) may positively impact the economy through a three-stage process known as the “multiplier effect”. The three processes included those economic benefits derived from: direct impacts, indirect impacts, and induced impacts. Direct impacts are the benefits associated with businesses that directly benefit from the transportation improvement. In one example, a manufacturing company is limited in the amount of goods it can ship to the market due to inadequate roadways nearby. A new bypass might shave significant travel times from the route resulting in more efficient just-in-time shipping for overnight delivery (a direct

¹ Surface Transportation: Many Factors Affect Investment Decisions. Report: GAO-04-744. Government Accountability Office. June 2004.

benefit). The cost savings derived from this along with the ability to now get more goods to the market may result in increased hiring of new staff (another direct benefit). This increase in production might also stoke increased demand for raw material goods from local companies in the region. Those inter-industry companies would then benefit from the indirect impact of the roadway with increased business from the initial company (the indirect benefit). Finally, the new employees that have been hired use their newfound salary to go out and spend money in the local economy. This last impact can be referred to as an induced impact.²

While everyone agrees that economic growth and transportation are mutually reinforcing, there remains considerable disagreement as to the degree to which transportation infrastructure investment spurs positive economic growth. Duffy-Deno and Eberts examined the issue of causality to better determine which one precedes the other.³ In their view, the cause-effect linkage runs in both directions since more economic growth will require more roads and more infrastructure leads to increased economic growth. In the following case studies, many academics and economists argue both for and against an increase in public infrastructure investment as a means of promoting economic growth. The work of the “pros” suggests that investment leads to growth and that of the “cons” argues that the relationship no longer holds for spurring additional investments.

Pros

- Numerous studies have demonstrated that investment in public infrastructure correlates positively with employment including those of Munnell (1990), Eberts and Stone (1992), Dalenberg and Partridge (1995), and Dalenberg, Partridge, and Rickman (1995).⁴

² National Cooperative Highway Research Program (NCHRP). Report 290 – Procedures for Assessing Economic Development Impacts from Transportation Investments. Glen Weisbrod, Economic Development Research Group. pg. 14. June 30, 2001.

³ National Cooperative Highway Research Program (NCHRP). Report 389 – Macroeconomic Analysis of the Linkages Between Transportation Investments and Economic Performance. National Transportation Research Board. pg. 4. 1997.

⁴ Public Infrastructure and Wages: Public Capital’s Role as a Productive Input and Household Amenity. Land Economics, Vol. 73, No. 2. pg. 268. May 1997.

- When comparing investment between labor and public infrastructure, Aschauer (1989) found that public infrastructure has higher output elasticity than labor. In other words, a dollar invested in public infrastructure would generate more economic output than one in labor. .

- Weiss (1999) and Horst and Moore (2003) demonstrate in their respective studies that adequate highway access for rural communities resulted in better employment growth rates, reduced poverty rates, and more diversity of industry than occurred in the rural regions without adequate access.⁵

Cons

- Munnell (1990), Duffy-Deno and Eberts (1991), and Costa (1987) all find diminishing rates of return on infrastructure investment. In some regions, once investment reached a certain point it generated negative returns..

- Holtz-Eakin (1992), until recently the director of the Congressional Budget Office, found that investment in infrastructure is not a significant determinant of Gross State Product or GSP. Economic gains from public capital projects are negligible beyond the minimum threshold level of infrastructure needed to support a regional economy..

- Litman (2005), founder of the Victoria Transport Policy Institute, argues that highway investment in the 1950's and 1960's produced sizable gains in economic growth; but such gains from investment have since leveled off. He predicts that diminishing rates of return on highway investment will continue to be the prevailing trend..

⁵ Economic Development Impacts: Evaluating TDM Impacts on Productivity, Employment, Business Activity and Investment. Victoria Transport Policy Institute. pg. 7-8. May 9, 2005.

II. STATE DOT ECONOMIC IMPACT METHODOLOGIES

In order to determine best practices, economic policies in transportation must be evaluated across the spectrum. This typically involves conducting surveys to better understand the “current” state of practice. Two such surveys reviewed in this project attempt to better gauge economic policies in different state departments of transportation. The first survey, consisting of informal interviews, was conducted by the Kentucky Transportation Center. The second survey involved a written survey distributed to nearly all states nationwide by the Texas Transportation Institute.

KTC Survey

The Kentucky Transportation Center (KTC) surveyed by telephone several state departments of transportation. In these personal phone interviews, state transportation officials with intimate knowledge of their respective state DOT policies were contacted. The survey asked whether state DOTs had formal methods for measuring the proposed economic gains from infrastructure investments weighted into their decision-making process. The comparison states were chosen based on their compatibility with the state of Kentucky. Three compatibility factors were used: total population, miles of state-owned highways, and percentage rural population. Those states that were closest to Kentucky on the compatibility factors were chosen for comparison.

Two of the initial states chosen were removed from the study due to information deficiencies. Those states were Alabama and Louisiana, the former being removed due to lack of an adequate DOT contact and the latter due to problems stemming from Hurricanes Rita and Katrina. The states of Tennessee and Indiana were chosen to replace them in our study, because of their geographical proximity to Kentucky. In addition, the Wisconsin DOT was added due to its reputation for having an innovative approach to the economic analysis of transportation projects.

Many of those surveyed listed economic impacts as one component in a broad prioritization process model for evaluating proposed projects. But some did not. In the following lists, the economic criteria of our respective states’ are described:

- Arkansas DOT – There is no formal economic analysis of potential transportation projects. A five member highway commission makes all highway funding decisions.⁶
- Indiana DOT – The INDOT Planning Oversight Committee (IPOC) incorporates economic development into their weighted list of criteria when prioritizing potential highway projects. Jobs created or retained by a potential project as well as economic distress (county unemployment rate) constitute the two factors representing economic development in this process.⁷
- Iowa DOT – There are no formal economic factors considered in state highway project prioritization. A seven member highway commission acts as the decision-making body for all new state highway funding.⁸
- Missouri DOT – The *Missouri DOT 2004 Practitioner’s Guide* for transportation planning and decision-making has economic criteria incorporated into the process. There are two general topics of interest: economic competitiveness and efficient movement of freight. Under economic competitiveness, there are three levels of economic criteria including: the level of economic distress (measured by poverty and unemployment levels in a given area); strategic economic corridors (those corridors that connect major urban/economic centers); and additional district economic factors (preferences expressed by the individual MoDOT districts). The efficient movement of freight measures truck volume along a given corridor.⁹
- Ohio DOT – In this agency, a body of experts and appointees comprise the Transportation Review Advisory Council (TRAC) that acts as the decision-making body for all future projects. TRAC follows the “Major New Project Selection Criteria” section in the protocols and policy manual when evaluating projects. Several factors weigh into economic

⁶ Ort, Randy. Public Relations. Arkansas Highway and Transportation Department. Personal phone interview. 3 November 2005.

⁷ IPOC: INDOT Planning Oversight Committee. Protocols & Policies. Indiana Department of Transportation. 25 July 2005.

⁸ Anderson, Stuart. Office of Systems Planning, Director. Iowa Department of Transportation. Personal phone interview. 30 November 2005.

⁹ Miller, Todd. Office of Planning. Missouri Department of Transportation. Personal phone interview. 10 November 2005.

development in this scoring tool. The five categories include: job creation, job retention, economic distress, cost effectiveness of investment, and level of investment. Job creation and/or retention are based on statements by companies that X number of new staff will be hired or retained through the completion of a proposed project. Economic distress again measures county unemployment rates. The cost effectiveness of the investment is a ratio of the total cost of the project divided by the number of jobs created. Finally, the level of investment looks at the level of investment of non-retail, private sector capital attracted by the project.¹⁰

- South Carolina DOT – There is no formal economic analysis process for highway funding decisions. The South Carolina DOT allocates highway funds in a top-down approach by directly dispensing funds to both Metropolitan Planning Organizations and the various Councils of Government. These local organizations ultimately decide which projects get built and which ones do not.¹¹

- Tennessee DOT – The Tennessee DOT utilizes seven guiding principles in the project evaluation process including “support the state’s economy”. Economic development and goods/freight movement drive this measure. Under the economic development umbrella, criteria to consider include: connectivity to a county seat, service to high growth areas, population or employment center, and high unemployment. The goods/freight movement factor focuses on the percentage of existing traffic that are trucks as well as the service of major freight movements.¹²

- Virginia DOT – Goal Three in Virginia DOT’s prioritization plan states “Improve Virginia’s Economic Vitality and provide Access to Economic Opportunities for all Virginians”. To measure this, Virginia looks at freight movement (average daily truck volume) and economic distress (high unemployment areas) as its primary measures.¹³

¹⁰ Lawrence, Melinda. Division of Finance & Forecasting. Ohio Department of Transportation. Personal phone interview. 24 October 2005.

¹¹ Jordan, Bill. Office of Planning. South Carolina Department of Transportation. Personal phone interview. 16 November 2005.

¹² Houghton, John. Transportation Community Relations. Tennessee Department of Transportation. Personal phone interview. 12 October 2005.

¹³ Tucker, Chad. Transportation and Mobility Planning Division, District Coordination Manager. Virginia Department of Transportation. Personal phone interview. 01 November 2005.

- Wisconsin DOT – Under their current “Corridors 2020” highway prioritization program, the Wisconsin DOT Economic Development and Planning Section meets with the business community and economic development organizations to assist in identifying economic needs and opportunities in the state.

TTI Survey

The Texas Transportation Institute and Texas A&M University jointly conducted a mail-in survey of state DOTs. The main objective of the survey was to determine how individual DOTs were evaluating the economic impacts of transportation. More specifically, they were asked what economic software models they might be using, if any. This study, conducted in October 2004, mailed surveys nationwide with the exceptions of Hawaii, Kentucky, and Texas.¹⁴ The study resulted in sixteen states reporting a formal economic evaluation program: Arizona, Florida, Georgia, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Michigan, Missouri, Oklahoma, Oregon, South Dakota, Vermont, and Wisconsin.¹⁵ Many use the REMI (Regional Economic Models, Incorporated) model. REMI is one of the two software packages recommended in the last chapter. The results from this study are outlined below:

1. Arizona

– Market-Oriented Cost-Benefit Analysis: The MOCB analysis calculates user highway benefits for commuters in order to determine roadway investments.

2. Florida

– HERS, REMI: The Highway Economic Requirements System (HERS) model calculates user highway benefits as input for the REMI model. REMI then estimates economic benefits for the Florida DOT Five Year Work Program.

¹⁴ No reason is provided by the authors of the study for the exclusion of Hawaii, Kentucky, and Texas from the TTI survey.

¹⁵ Transportation and the Texas Economy: Some Interim Results. Burke, Dock; Luskin, David; Rosa, Duane; and Collier, Tina. Texas Transportation Institute and Texas A&M University. June 2005.

3. Georgia

– REMI: Georgia DOT utilizes a forecasting model to determine user highway benefits for interstates. This output is processed by REMI to determine economic benefits for Georgia's Interstates.

4. Indiana

– Major Corridor Investment-Benefit Analysis System: The MCIBAS system includes three components: a travel demand module, user benefit-cost analysis, and an economic analysis system. The economic analysis system calculates user benefits and potential business attraction from the other two separate modules. This information compiles into the REMI model to project economic benefits for major highway corridor projects.

5. Iowa

– Input-Output Model: This internal state model estimates economic impacts from airports only.

6. Kansas

– Benefit-Cost Analysis, Input-Output Model: Kansas utilizes two separate models for transportation economic analysis. The benefit-cost analysis seeks to show return on investment for the highway plan using: HERS, surveys, cash flow models, etc. The input-output model approximates the overall economic impact from the Kansas transportation program. Neither model evaluates economic benefits on an individual project by project basis.

7. Louisiana

– Internal Multiplier Model: This model evaluates economic impacts derived from seaports only.

8. Maine

– REMI: This model was utilized to determine the economic benefits derived from an east-west highway connector project to access Canadian markets.

9. Maryland

– Input-Output Model: Maryland DOT estimates economic benefits across different modes of transportation including highways, airports, seaports, and transit. The input-output model extracts information from: US Bureau of Labor Statistics, Consumer Expenditure Surveys, interviews, census data, and local data as source inputs. Current practice involves using this model on a case-by-case basis and not on all potential transportation projects.

10. Michigan

– REMI: Economic benefits are aggregated from REMI for MDOT's Five-Year Transportation Plan (not project specific).

11. Missouri

– REMI, RIMS, IMPLAN: All three models are currently used on a case-by-case project level to ascertain potential economic benefits stemming from transportation improvements. MoDOT is considering using the REMI model in the future for planning and programming analyses.

12. Oklahoma

– Homeland Security Model: Oklahoma is currently forming a model for use in projecting negative economic impacts that might result from terrorist attacks on state bridges.

13. Oregon

– Oregon Statewide Model: This input-output model, based on the software package IMPLAN, seeks to establish relationships between the state economy, land use patterns, and transportation flows.

14. South Dakota

– REMI: South Dakota DOT has evaluated past transportation projects using the REMI model but none presently.

15. Vermont

– IMPLAN, Input-Output: Both models assist the Vermont DOT in determining public-use airports' effects on the state's overall economy.

16. Wisconsin

– REMI, IMPLAN, HERS-ST: All three models help the Wisconsin DOT assess transportation investments (highway bypass, bridge, aviation, rail, etc.) and their potential economic impacts.

Per the TTI study, the following states did not utilize formal evaluations of economic impacts when assessing proposed transportation projects: Alabama, Alaska, Arkansas, California, Colorado, Connecticut, Delaware, Idaho, Illinois, Massachusetts, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, Nevada, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Virginia, Washington, West Virginia, and Wyoming.

III. ECONOMIC MODELING THEORY

Methodologies

Over the past twenty years, decision makers have become increasingly concerned with the economic impacts of public infrastructure projects. Several methods have been devised to assist in the process of regional economic forecasting. The most common ones in use to date include: surveys, market studies, case studies, and computer models..

Survey methods can include many different formats for data gathering. Common survey formats for obtaining pertinent information include business surveys, expert interviews, corridor inventory methods, and origin-destination logs.² Oft-times, survey methods will serve as inputs into more complex economic models and not as ends unto themselves. One of the key advantages of using survey methods is their ability to systematically gather local insights and expertise. Please refer to the following bullets for a point by point survey definition list.

- Business surveys – attempt to gather expected behaviors or reactions of customers and clients based on the implementation or non-implementation of a project (and thereby predict economic impacts).
- Expert interviews – seek to gain local expertise on the expected impacts from infrastructure project; these interviews are usually conducted with local or state officials or economic development consultants familiar with the area.
- Corridor inventory methods – use the relatively quick and easy “windshield survey” to determine what type of business activities lie along a given corridor.
- Truck origin-destination logs – analyze how businesses currently use the transportation network, the value of goods shipped, and the potential time savings from project improvements.
- Shopper origin-destination logs – seek the input of shoppers (at the point of sale) to determine which transport linkages are utilized to reach a destination

Market studies examine the current supply and demand for business activities in the area of interest. If conditions change in the project area due to a proposed facility, supply and demand factors might change as well. Market studies hope to determine how and to what extent those economic activities might change. From the transportation perspective, market studies are typically site or corridor specific.

Case studies can be used to evaluate the impacts of a potential project when data and resources are limited. This method examines similar projects that have been built in similar towns/cities to provide a basis of comparison. Economic predictions can then be inferred from that case study to one’s own transportation situation. A distinct advantage of this method lies in it being an easily visualized and understood technique for lay people at public meetings.

Computer Models

Computer models continue to grow as a popular tool for economic impact analysis. Oftentimes, these models can be employed by personnel with limited backgrounds in economic modeling. This has helped make them a popular choice for many public agencies. Current computer models incorporate various economic modeling techniques to predict changes that are most likely to occur from a given project. According to the Federal Highway Administration, the different modeling techniques include: econometrics, input-output, macroeconomics, and land usage...¹⁶

Econometric Models: The use of statistical methods such as regression analysis plays a central role in econometric modeling. Once the predictor variables have been determined from previous research, those with statistical significance can be used to predict potential economic impacts from future projects. Examples of predicted impacts include jobs created, increases in income, and changes in property values.

Input-Output Models: Inter-industry relationships remain the focus of this model. In essence, input-output models make a static prediction (one point in time) of how income can ripple throughout the economy from an initial transaction.

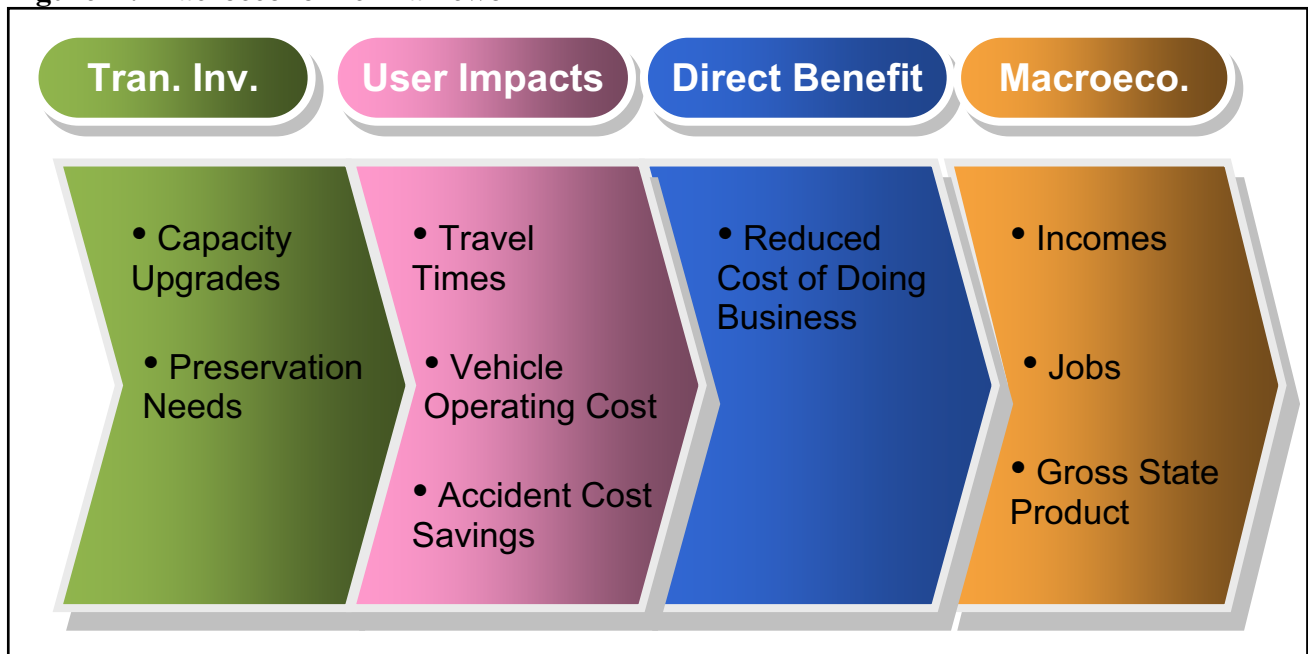
Macroeconomic Simulation Models: Macroeconomic models essentially evaluate how business cost savings can affect future business growth. They have an input-output model component with a production function. This production function evaluates how a proposed project can spur economic changes over time (dynamic component). It performs this function through an examination of user benefits (travel time, vehicle operating cost, and accident savings) to predict the complete cost savings for a business stemming from the project. This cost savings is translated into increased income for that business. At this point, the input-output model invokes the multiplier effect analysis.

¹⁶ http://www.fhwa.dot.gov/planning/toolbox/economic_forecasting.htm. US Department of Transportation, Federal Highway Administration. Impact Methodologies – Economic Development. 01 April 2006.

Land Use Models: These models focus on predicting land use patterns and serve primarily as urban planning tools more than as “pure” economic impact analysis tools.

The majority of economic software models are not stand-alone models in the conventional sense. Many of these models require certain data inputs initially before relevant outputs can be generated. In the case of transportation economic models, typical inputs required consist of user impacts, often defined as reductions in travel times, vehicle operating costs, and accident costs. This directly translates into a reduced cost in conducting business and serves as the basis of economic benefits incurred in the future. The full macroeconomic framework for this process can be seen in Figure A.¹⁷

Figure A: Macroeconomic Framework



¹⁷ Macroeconomic Impacts of the Florida Department of Transportation Work Program. Florida DOT. Cambridge Systematics, Inc. and Glaze Associates, Inc. pg. 3-1. February 2003.

IV. ECONOMIC IMPACT SOFTWARE MODELS

Economic software models seek to incorporate various economic modeling and forecasting methodologies to simulate economic impacts. Although several economic software packages are currently available, the capabilities and functions of these models continue to vary on a number of different levels. The complete array of economic software packages evaluated during this project is shown in table 1 on the following page.

There were thirteen economic models in the original set of software packages. A comprehensive evaluation revealed that only two of these packages met KYTC project scope guidelines—EDR-TREDIS and REMI-TranSight. In the following paragraphs, a brief description is given for each particular model and the rationale for exclusion.

Regional Input-Output Modeling System (RIMS) II, as the name implies, consists of an input-output model to calculate multipliers for a given region.¹⁸ This software package, developed by the Bureau of Economic Analysis in the US Department of Commerce, was principally designed for economic evaluation of large-scale infrastructure projects. Typical projects modeled through this software might include: a sports facility, military base, major industry, or an airport. Since the nature of input-output modeling takes a snapshot of one moment in time (static), there is no production function for future (dynamic) forecasting. Thus, this model does not fit the requirements scope of KYTC.

The IMPACTS model represents a spreadsheet tool to assess potential costs and benefits from urban transportation alternatives. Developed collaboratively between the US Department of Transportation and consultants K.T. Analytics and Cambridge Systematics, this model examines multi-modal transportation systems at the corridor level

¹⁸ <http://www.bea.gov/region/rims/brfdesc.cfm>. Regional Input-Output Modeling System (RIMS) II. Bureau of Economic Analysis, US Dept. of Commerce. 28 March 2006.

Table 1: Economic Software Packages

	Company or Agency	Software Package
1	Bureau of Economic Analysis, US Dept. of Commerce	Regional Input-Output Modeling Systems (RIMS)- II
2	Cambridge Systematics, K.T. Analytics, & US Dept. of Transportation	IMPACTS
3	Economic Development Research Group, Inc.	Transportation Economic Development Impact System (TREDIS)
4	Federal Highway Administration (FHWA), US Dept. of Transportation	Spreadsheet Model for Induced Travel Estimation (SMITE)
5	Federal Highway Administration (FHWA), US Dept. of Transportation	Sketch-Planning Analysis Spreadsheet Model (SPASM)
6	Federal Highway Administration (FHWA), US Dept. of Transportation	Surface Transportation Efficiency Analysis Model (STEAM)
7	Global Insight, Inc.	AREMOS
8	ICF Consulting	Not available*
9	Jakes Associates, Inc.	TransTools
10	Minnesota IMPLAN Group, Inc.	IMPLAN Professional 2.0
11	Regional Economic Models, Inc. (REMI)	TranSight
12	Paramics Microsimulation, SIAS Limited	Programme for Economic Assessment of Road Schemes (PEARS)
13	Texas Transportation Institute (TTI), Texas A&M University System	MicroBENCOST

Potential economic impacts estimated include costs (capital and operating), travel time benefits, induced travel impacts, accident reductions, revenue transfers (tolls, fares or parking fees), fuel changes, and emissions changes. Unfortunately, it does not estimate economic impacts.

The Spreadsheet Model for Induced Travel Estimation (SMITE) evaluates highway capacity expansion in an urban environment. This FHWA model focuses on induced traffic through highway capacity expansion. Net user benefits (travel times, etc.) are calculated from examining the old system, the capacity added, and induced traffic generated.¹⁹ Non-user economic benefits are not calculated.

The Sketch-Planning Analysis Spreadsheet Model (SPASM) provides a “screening” level analysis on multi-modal, corridor projects. This tool basically evaluates user-level benefits but not economic benefits. Estimates tabulated are capital/operating costs, user benefits (travel times, etc.), air impacts (emissions), and cost-effectiveness measures.²⁰

The Surface Transportation Efficiency Analysis Model (STEAM), developed by the Federal Highway Administration (FHWA), assesses investments in urban transportation infrastructure. These projects can be multi-modal and analyzed at both the corridor and regional level. STEAM calculates economic benefits by assigning monetary values to travel times, vehicle operating costs, accidents, and emissions (CO, NO_x, PM₁₀, VOC).²¹ It was eliminated, because economic impacts stemming from multiplier impacts are absent from this model. That is it lacked the required measures of indirect economic impacts.

Global Insight, Inc., international consultants specializing in freight flow, developed the AREMOS model to gauge economic benefits.²² This model examines the shipment of goods on a national and international scale. The primary focus lies with travel patterns and volumes of

¹⁹ <http://www.fhwa.dot.gov/steam/smite.htm>. Spreadsheet Model for Induced Travel Estimation (SMITE). US Department of Transportation, Federal Highway Administration. 06 April 2006.

²⁰ <http://www.fhwa.dot.gov/steam/spasm.htm>. Sketch-Planning Analysis Spreadsheet Model (SPASM). US Department of Transportation, Federal Highway Administration. 06 April 2006.

²¹ http://www.dot.ca.gov/hq/tpp/offices/ote/Benefit_Cost/models/steam.html. California Department of Transportation. Benefit-Cost Models. 06 April 2006.

²² <http://www.globalinsight.com/ProductsServices/ProductDetail418.htm>. AREMOS software. Global Insight, Inc. 25 March 2006.

goods. Since AREMOS is mostly commercially oriented with an emphasis on “pure” freight benefits, this software would appear to have limited usefulness for government planners and decision-makers in considering all stakeholders.

ICF Consultants have conducted transportation studies involving economic benefits derived from various transportation projects.²³ In the initial software screening process, it was believed that ICF had its own patented economic software model. Upon further review, the economic benefit models utilized by ICF in their transportation studies rely on existing software packages. During consultation with Sergio Ostria (Transportation Practice Leader), it was determined that ICF does not have a software tool for economic impact analysis.²⁴

TransTools specializes in mass transit projects (buses, rail) for potential realized benefits. This software model was developed by the California transportation consulting firm Jakes Associates, Inc.²⁵ The scope of this software only involves transit systems and not conventional highways.

The Minnesota IMPLAN Group developed another input-output model labeled IMPLAN Professional 2.0.²⁶ As in the previous situation, this static model provides an economic evaluation of existing scenarios, not future forecasting. Through consultation with Doug Olson (IMPLAN Cofounder), the study team concluded that this model is designed to evaluate a project’s economic effects on a region if a known business moves into the area.²⁷ It will not calculate all the economic effects from a potential highway project (i.e., it does not forecast all future economic changes).

Paramics Microsimulation primarily performs a comprehensive traffic flow analysis. The British consulting firm SIAS Limited developed this tool to be used in conjunction with their economic analysis models. One such model includes the Programme for the Economic Assessment of

²³ <http://www.icfconsulting.com/Markets/Transportation/trans5.asp>. Economic Development Highway Corridors Study, U.S. Highway 2, Roosevelt County/Fort Peck Indian Reservation, for U.S. Federal Highway Administration. ICF Consulting. Ongoing study. 25 March 2006.

²⁴ Ostria, Sergio. Personal phone interview. 10 March 2006.

²⁵ http://jakesassociates.com/pdf/TransTools_brochure.pdf. TransTools. Jakes Associates, Inc. 06 April 2006.

²⁶ <http://www.implan.com/software.html>. IMPLAN Professional 2.0. Minnesota IMPLAN Group, Inc. 27 March 2006.

²⁷ Olson, Doug. Personal phone interview. 16 March 2006.

Road Schemes or PEARS.²⁸ PEARS seeks to assess economic impacts on a local scale. The exact methodology is unknown due to limited information obtained.

Developed by the Texas Transportation Institute (TTI) with NCHRP funding, MicroBENCOST calculates both the benefits and costs of highway improvement projects. Benefits calculated are essentially user benefits including: travel times, accidents, and vehicle operating costs. Costs are shown through total initial cost, salvage (residual) value, and rehabilitation and maintenance costs. Through a benefits and costs framework, MicroBENCOST can determine economic measures in the forms of: net present worth, benefit-cost ratios, and internal rate of return for the project. It can evaluate seven types of projects such as: capacity enhancement, bypass construction, intersection or interchange improvement, pavement rehabilitation, bridge improvement, highway safety improvement, and railroad grade crossing improvement.²⁹ It does not estimate economic benefits beyond user benefits.

The previous software models do not meet the original project needs. We turn now to the two software packages that meet the criteria of this study. As a quick reminder of the original project scope, the goal of this project was to determine the most feasible and practical software package to estimate the economic benefits of transportation projects. Per a meeting between KTC and KYTC members on February 14, 2006, several key points were established for evaluating potential software applications.³⁰ The economic benefits method should be an analysis method:

- That can be quickly implemented
- Is able to evaluate a large set of possible projects on the scale of 500 to a 1,000
- Does not require complete sets of data inputs (default values and educated assumptions are viable option)
- Uses data readily available and already existing in KYTC datasets.

²⁸ <http://www.sias.com/sias/s-paramics/PEARS/pears.html>. Programme for the Economic Assessment of Road Schemes (PEARS). SIAS- Paramics Microsimulation. 06 April 2006.

²⁹ http://www.dot.ca.gov/hq/tpp/offices/ote/Benefit_Cost/models/microbencost.html. California Department of Transportation. Benefit-Cost Models. 06 April 2006.

³⁰ This meeting included members from the Kentucky Transportation Center's Planning Group and Kentucky Transportation Cabinet's Division of Planning. A complete list of those in attendance may be obtained by request from the author.

While no model currently available on the market can rapidly evaluate an extremely large project dataset (500-1000), there are two models that can perform the necessary economic evaluations given sufficient personnel and time resources. The two companies with software packages able to estimate the full economic benefits, not just user benefits, include: Regional Economic Models, Inc. and the Economic Development Research Group. Further review and a detailed discussion of both models continues in the following section.

V. EDR-TREDIS SOFTWARE

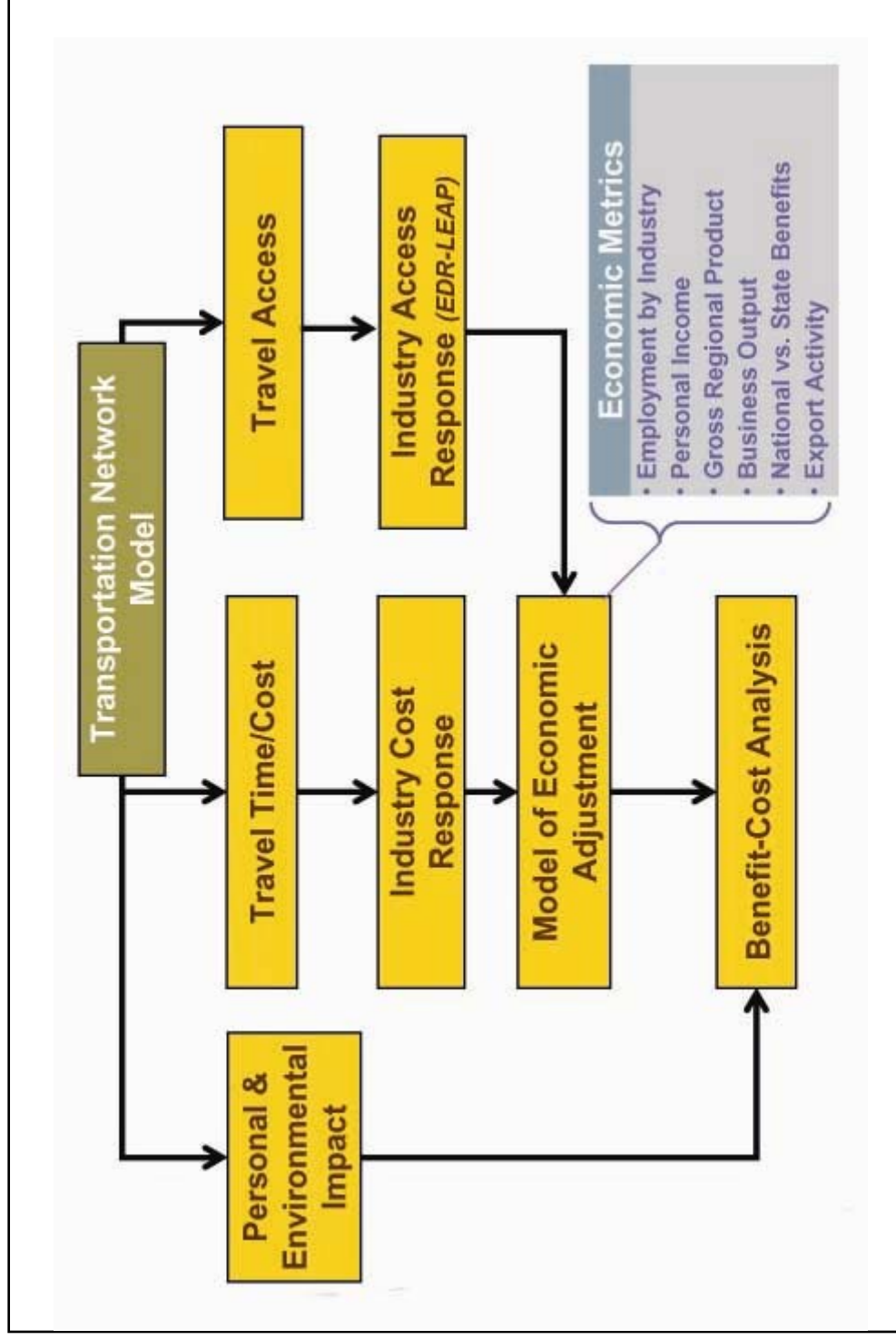
The Transportation Economic Development Impact System, better known as TREDIS, serves the end user by assessing the full economic development impacts associated with potential transportation projects. This software package developed by Economic Development Research Group, Inc. or EDR can evaluate economic impacts from either the freight cargo or individual passenger frame of reference. Furthermore, economic impacts may be derived across all modes of transport projects including: road, rail, air, or marine projects.

From the KTC survey response for TREDIS, the size of the focus project does not make a difference in assessing the potential economic benefits derived from it.³¹ For example, TREDIS can estimate the economic benefits of such projects as the addition of turning lanes or intersection reconstruction. In other words, the scale of the project does not make a difference. TREDIS can provide evaluation of either small- or large-scale projects.

The primary component that provides TREDIS with its economic forecasting capabilities is the Regional Dynamics (REDYN) model. This core module serves as the economic and demographic forecasting and analysis engine. REDYN tracks goods and services as commodities within counties and between all county pairs by transport mode. From these geographic linkages, it proceeds to generate the model output such as the overall net change in business sales, jobs, and payroll by industry over a given time period. The TREDIS internal logic model demonstrating internal processes is shown in Figure B on the following page.

³¹ Weisbrod, Glen. "Response to questionnaire about benefit-cost." E-mail from EDR Group, President. 14 March 2006. Source references available from author upon request.

Figure B: TREDIS Internal Logic Model



The application of TREDIS remains relatively straightforward. The project is initially defined by its location and time period for construction. Scenarios are then projected based on a description of the project cost and the expected travel conditions for future years. Travel conditions might include, but are not limited to, the number of vehicle-generated trips and vehicular speeds. After the scenarios have been established, comparison cases are set up by comparing a “base” case to one or more “alternative” cases. As with any computer model, there are a set of inputs and outputs associated with TREDIS. Inputs required before the model can proceed with calculations include:

- Vehicle-hours traveled savings
- Vehicle-miles traveled savings
- Capacity or congested hours of operation
- Accident rate savings

These inputs do not rely on any one specific traffic model. The Highway Economic Requirements System State system or HERS-ST represents one frequently used traffic model that generates these inputs. However, any traffic model capable of generating vehicle-miles traveled (VMT) or vehicle-hours traveled (VHT) will provide the sufficient input needed for economic analysis. To assist with expediting the evaluation of projects, TREDIS has allowed for default values in the process. This would typically be applied to common variable values and remains at the discretion of the user. Inputs can be put into the system either through manual data entry or directly uploaded into the system as a data file (if in the proper format). After inputs have been uploaded into the model, TREDIS gives the user the outputs they need to compare the given projects. There are ten output reports possible. These reports include:

1. Direct Travel Impact – Base Scenario
2. Direct Travel Impact – Project Scenario
3. Direct Travel Benefit from Completing the Project
4. Direct Travel Cost Savings – by Industry
5. Direct Market Access Benefit – by Industry
6. Summary of Direct Project Impact – by Industry

7. Summary of Long-Term Economic Impact of the Project – by Industry
8. Summary of Short-Term Economic Impact of Construction – by Industry
9. Summary of Overall Economic Impact – by Year
10. Benefit-Cost Analysis

For a complete description of each one of these types of reports, please refer to Appendix D. For the purpose of this project, reports 7, 8, and 9 will be of most interest in assessing highway projects. These outputs are shown in dollar values of business output, gross domestic product, wage income, and jobs created. According to the TREDIS spokesperson, The TREDIS model requires no formal economic expertise or prerequisite staff qualifications in order to run the model. The EDR Group developed the model with this in mind. They assume that the users of this system are typically planners or engineers, not economists.

In terms of resource requirements, staff can expect 1-2 hours of data entry per project based on EDR's survey response. This assumes that all necessary inputs have previously been calculated. Since the model is web-based, up to 3 users can utilize the system at one given time.

VI. REMI-TRANSIGHT SOFTWARE

The TranSight model, developed by REMI, provides a comprehensive evaluation of transportation projects to determine economic benefits. The functionality of this model incorporates forecasting capabilities across various modes of transport including: roadway (car or bus), rail or marine travel. It evaluates economic benefits from both individual or “personal user” cost savings as well as accumulated business benefits. Various sized projects can be evaluated through the model.

The REMI economic forecasting and simulation component represents the driving force behind the TranSight model. This primary tool of analysis incorporates the following four functions to derive economic benefits:

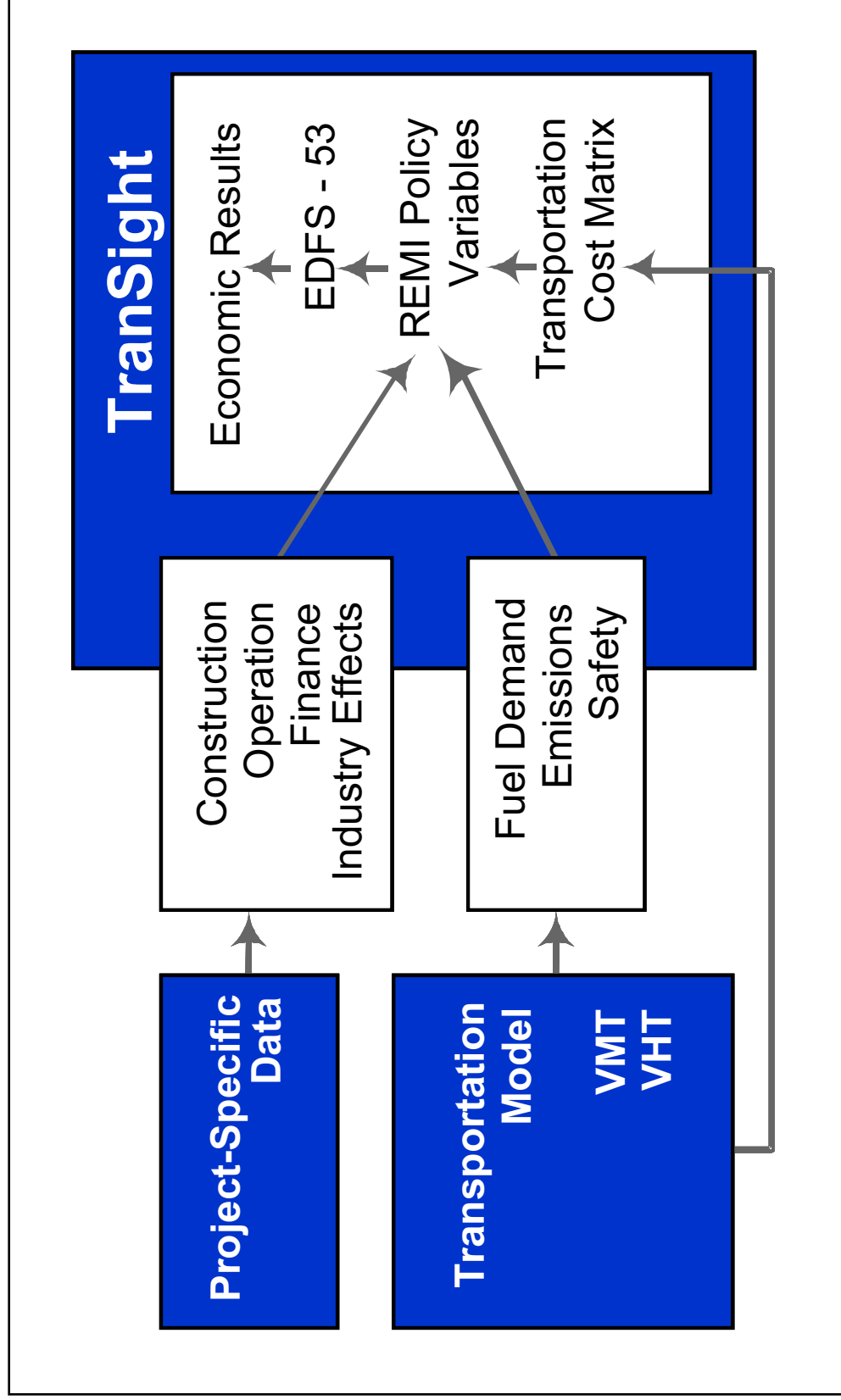
- Forecasting
- Economic competitiveness analysis
- Population migration analysis
- Input-output

Per REMI’s response to the KTC survey, this model will estimate the full range of economic benefits for highway projects including lane additions and new roads.³² It will not, however, estimate economic benefits for small-scale projects such as the addition of turn lanes, intersection reconstruction, and exit ramps. The full internal logic model for the REMI TranSight process can be found in Figure C.

As before, REMI needs certain inputs to proceed with internal calculations. Any standard traffic model can generate the necessary inputs although HERS-ST remains the most commonly used. The two main factors included as inputs into the TranSight model are vehicle-miles traveled and vehicle-hours traveled. The data sets used for inputs should be broken down by different

³² Cooper, Adam. “RE: Kentucky questionnaire.” E-mail from REMI Consultant. 27 March 2006. Source references available from the author upon request.

Figure C: TransSight Internal Logic Model



parameters for a more detailed and thorough evaluation. The following parameters are recommended for these inputs if they are available:

- Baseline versus adjusted (i.e.- build option)
- Model region (county, multi-county, etc.)
- Transport mode (car, bus, train, etc.)
- Time-of-day travel (peak / non-peak)
- Road type (freeway, arterial, etc.)
- Trip-parameter data – percentages by non-commercial, heavy commercial, light commercial, and weekday / weekend.

These inputs are processed through the TranSight model to produce various economic outputs of interest to the user. The outputs generated with this model include:

- Employment by industry
- Output by industry
- Wage rates and personal income
- Population by demographic group
- Gross regional product

With the exception of “population”, all factors are displayed in monetary terms. Much like TREDIS, the REMI model has been designed for simplicity and to be straightforward to the end user. This model assumes a non-economist as the operator. The user should expect to receive only a modest amount of training to be able to fully operate the model. This training is provided to all clients who purchase the REMI software. Data entry takes approximately two hours per project.

VII. COST PROJECTIONS

Staffing Requirements

In the event that either the EDR TREDIS or REMI TranSight models are purchased in the future, there remains the implicit need for qualified staff to operate the software. While the staff does not need to be economic experts in the literal sense, the sheer number of potential projects (500-1,000) necessitates that dedicated staffing be in place solely for this activity. As such, the first step in coming up with full cost projections stems from a determination of the number of staff needed.

A sequence of relevant variables must be systematically calculated to successfully predict future staffing requirements. Since traffic flows and other travel data remain necessary input into either software package, the first time allocation will be to a traffic model such as HERS. From KYTC estimates, the average time spent per project to generate the necessary HERS output should be approximately 2 hours per project.³³ The KTC Survey results demonstrated a 1 to 3 hour timeframe for each potential project in economic analysis.³⁴ The summation of these model time resources result in a 3 to 5 hour window dedicated to the average project. From the key points discussion on February 14, 2006 with KYTC, the projected number of projects to be evaluated in any given year should fall somewhere in the range of 500 to 1,000.³⁰ Multiplying the total software hours needed per project by the annual number of projects results in the total project hours needed per year. This range goes from minimum of 1,500 hours all the way to 5,000 possible hours per year.

The second step in estimating staffing needs is determining the total working hours per employee per year that can be devoted to estimating the economic benefits of proposed projects. This number can be found from the system of equations shown in Table 2 on the following page:

³³ Sanders, Brandon. Personal phone interview. 18 April 2006.

³⁴ EDR's TREDIS estimate for data entry will be used as the time input for both the TREDIS and TranSight Models. REMI did not fill in the time requirement for this particular question on the KTC survey response.

Table 2: Total Working Hours per Employee per Year

- | |
|---|
| (A) 52 weeks per year x 5 business days per week = 260 business days per year |
| (B) 260 - 12 annual leave days - 11.5 holidays = 236.5 real working days per year |
| (C) 236.5 x 7.5 hours per day = 1773.75 hours per year |
| (D) Round 1773.75 hours to approximately 1774 hours per year |

* The number of annual leave days and holidays was obtained from the Kentucky Personnel Cabinet – Employee Benefits Schedule as shown at <<http://personnel.ky.gov/stemp/benefits.htm>>.

Although the 1774 hours represents the total possible hours available to each Cabinet employee over the course of a year, there are bound to be additional duties and tasks that constrain this number. To include for this contingency, an “Efficiency Rating” variable set at 0.75 estimates that only about 75% of the work day will be available strictly for software operations. The efficiency rating takes into account time exclusions over the course of a day for meetings, citizenry consultations, breaks, and other additional duties. By multiplying the total working hours available with the efficiency rating, the working hours available specifically for project needs is 1330.5 hours.

Finally, the total project hours needed per year found in the first step can be divided by the working hours available for software operation shown in the second step. Each calculated number in decimal format is subsequently rounded up to the nearest integer to give actual staffing needs. This process leads to the conclusion that anywhere from 2 to 4 staff workers are required to effectively operate a TREDIS or TranSight system. Please refer to Appendix E for the complete table of calculations in determining our staffing requirements.

KYTC Positions

Now that the staffing requirements have been determined, the next logical step involves determining which class titles or positions will be used to fill them. To meet this need, a

comprehensive list of KYTC authorized jobs was provided courtesy of the Kentucky Personnel Cabinet.³⁵

A thorough examination of all job listings possible revealed only eight plausible positions for running the economic software models. These class titles included the following:

- Engineering-in-Training I, 7025
- Engineering-in-Training II, 7026
- Transportation Engineer I, 7094
- Transportation Engineering Technologist I, 7096
- Graduate Engineering Assistant, 7099
- Research Specialist, 9644
- Geoprocessing Specialist I, 9780
- Geoprocessing Specialist II, 9781

Although much smaller than the original number of positions available, a smaller and more feasible job list was still needed. Per feedback from KYTC, the final focused list of class titles were chosen as the positions most likely to be employed for such a program.³⁶ These KYTC positions are shown in Table 3 on the following page.

³⁵ Collins, Anita. "FW: Scanned Document and FW: April 2006 Change Report". E-mail from Transportation Personnel Administrator, Kentucky Personnel Cabinet. 13, 18 April 2006. Source references available from the author upon request.

³⁶ Siria, Bruce. "RE: BC Project – Cost Scenarios". E-mail from Project Manager, Division of Planning (KYTC). 19 April 2006.

Table 3: KYTC Positions

KYTC Job Titles					
	Class Title	Title Code	Pay Grade	Minimum Salary	Education Requirements
1	Engineering-In-Training II*	7026	14	\$3,304.00	BS in Eng. & EIT
2	Transportation Engineer I*	7094	15	\$3,635.00	BS in Eng. & PE
3	Transportation Engineering Technologist I	7096	12	\$2,290.28	See below - a
4	Geoprocessing Specialist I	9780	12	\$2,290.28	Bachelors degree
5	Geoprocessing Specialist II	9781	14	\$2,771.28	Bachelors degree

a- Bachelors degree in engineering technology, engineering science, engineering mechanics, geology, earth science, industrial technology, industrial drafting, design technology or construction technology

*All salaries per latest Personnel Cabinet compensation guidelines including the "Classification and Compensation Change Report" - April 14, 2006

Staff Scenarios

Based on the staffing requirements and positions allowed described above, there are several staffing scenarios that can be extrapolated. It can be postulated that hires for these newly created positions would most likely fall in the entry-level to mid-point salary level. These salary fluctuations across time-in-grade levels will also vary across the various positions (as described previously in Table 3). Furthermore, the salary of an employee does not equate with the “true” cost of the employee for an agency. The cumulative employee benefits package “adds more than 30% to the real value of...salary” as noted by the Kentucky Personnel Cabinet.³⁷ So a 30% benefit factor is added to each potential salary to indicate the total “real” costs incurred by hiring an employee.

Salary levels, positions, and staffing requirements all contribute to the bottom line of total staffing costs. Using a combination of these various factors, there are 30 possible projections for total staffing costs. The comprehensive table detailing each of these potential cost options can be found in Appendix F. For a listing of these cost ranges, please see Table 4 shown below:

Table 4: Staffing Cost Projections

<i>Entrance Salary Costs</i>			<i>Midpoint Salary Costs</i>		
Staffing	Minimum	Maximum	Staffing	Minimum	Maximum
2	\$71,457	\$113,412	2	\$94,662	\$126,005
3	\$107,185	\$170,118	3	\$141,993	\$189,007
4	\$142,913	\$226,824	4	\$189,324	\$252,010

It should be noted in this project analysis that all future positions for each of the 30 options are assumed to have identical class titles. There are no scenarios with varying combinations of positions (class titles) bound together in one office. Under this assumption, all staff would report to an outside supervisor not budgeted into the cost projections.

³⁷ <<http://personnel.ky.gov/info/emphb/emplben.htm>>. Employee Benefits webpage. Kentucky Personnel Cabinet. 18 April 2006.

Total Project Costs

Incorporating the staffing requirements analysis with the known capital infrastructure costs, the potential total project costs associated with an economic analysis program office can be found. Per the KTC surveys information, the estimated costs of installing the EDR-TREDIS or the REMI-TranSight package are shown in Tables 5 and 6 below:

Table 5: TREDIS Capital Costs

<i>Year 1</i>	Cost Range
Subscription Service (w/ training and support)	\$40,000 - \$60,000
<i>Year 2 and onward</i>	
Subscription Service (w/ support)	\$30,000 - \$50,000

* Capital costs obtained from EDR submittal on TREDIS courtesy of the KTC survey

Table 6: TranSight Capital Costs

	Single Area Model	Three-Area Model
<i>Year 1</i>		
Secondary User Fee	\$9,200	\$9,200
TranSight Add-On	\$40,000	\$54,000
Total	\$49,200	\$63,200
<i>Year 2 and onward</i>		
Secondary User Fee	\$9,200	\$9,200
Annual Maintenance	\$8,000	\$10,800
Total	\$17,200	\$20,000

* Capital costs obtained from REMI submittal on TranSight courtesy of the KTC survey

Each total project cost option may vary in annual costs based on the previous factors discussed including: year of service, staffing requirement, positions employed, and entrance to midpoint salary ranges. Based on this information, the total project costs for both models may be found across several ranges of variables. Please see Tables 1 and 2 in Appendix G for total project costs.

From the total cost projections shown in the tables, there are a wide range of potential costs incurred to run either the TREDIS or TranSight system. In the case of TREDIS, the cost projections for the initial year run from a low of \$111,457 with a minimum-base salary staff of two all the way to \$312,010 for a maximum-base salary of four staff members. In subsequent years, capital costs remain slightly lower resulting in a cost variation from \$101,457 to a potential maximum of \$302,010. TranSight system costs are slightly elevated from that of TREDIS in the initial year but come in slightly lower in subsequent years. In the first year, TranSight costs range from \$120,657 (minimum salary, 2 staff members) all the way to \$315,210 (maximum salary, 4 staff members). Subsequent years of operating the TranSight system will cost anywhere from a low of \$88,657 to \$272,010 per year.

VIII. CONCLUSION

Many state departments of transportation estimate the economic impact of proposed transportation infrastructure investments. Among the straightforward and readily available measures were the likely effects on unemployment rates, jobs created or retained, cost effectiveness of investment, and improved traffic flow on a strategic corridor. Some states use economic models to assess major transportation projects. The Kentucky Transportation Cabinet reviewed the various models to find an economic software package that could fully and quickly evaluate all the economic benefits stemming from transportation projects.

A cross-examination of the many economic software packages currently on the market revealed many distinct uses depending on the package. A total of 13 economic software packages were examined as potential applications in meeting KYTC's business needs (see Table 1). In the end, it was determined that only the TREDIS model from the Economic Development Research Group, Inc. or the TranSight model from Regional Economic Models, Inc. could potentially meet the Kentucky's needs as defined in the project.

Both the TREDIS model and the TranSight model are comparable in their economic forecasting abilities. They are also similar in that both require the input of data from a traffic model. The economic benefit outputs for both models are the same including predicted:

- Employment by Industry
- Output by Business / Industry
- Wage Rates
- Gross Domestic / Regional Product

Comparing EDR-TREDIS to REMI-TranSight, it initially appears that both EDR and REMI have comparable systems with only a few minor differences. The TREDIS model appears to calculate economic benefits for a wider range of transportation projects, mostly the smaller scale types such as intersection reconstruction. But the REMI-TranSight model will be more economical to acquire and run over the long term and has a longer list of clients. As demonstrated in the cost projections section, either model will require sizable time and budgetary resources from KYTC in order to fully employ the system. As shown by the tables in Appendix G, the cabinet might expect to pay anywhere from an average of \$100,000 to \$300,000 in the best and worst case scenarios, respectively. The Kentucky Transportation Center believes either of these software packages would be a useful tool for predicting economic benefits from proposed transportation projects. But, it is an unavoidable fact that a firm commitment in resources will be needed in order to adopt either model.

IX. APPENDICES

Appendix A: Benefit-Cost Questionnaire

B/C General Questionnaire

The Kentucky Transportation Cabinet is looking for a method to estimate the economic benefits of proposed highway projects. We need to assign dollar values to potential economic benefits. These can then be used to compare the benefits of alternative highway projects. On a related note, the KYTC already generates estimated benefits of improvements in travel time, accident reduction, and vehicle operating cost savings with the HERS-ST. Primarily we need a way to estimate the dollar value of the increased economic activity and jobs expected to arise from specific projects.

We need to ask you a few questions to see if your product fits our needs.

1. What kind of projects is your software designed to make projections of economic benefits for? Does it apply to:
 - A. adding turn lanes ___ YES ___ NO
 - B. intersection reconstruction ___ YES ___ NO
 - C. lane additions ___ YES ___ NO
 - D. new roads or highways ___ YES ___ NO
 - E. exit ramps ___ YES ___ NO
 - F. Other ___ YES ___ NO If, yes, please describe.
2. Is it better at predicting the economic benefits of a large project like a widening from two lanes to four lanes than for a small project like a turn lane at an intersection?
3. What size projects is it best suited for?
4. Why?
5. Is it possible for this software to evaluate the economic impact of a large number of projects (e.g., 500-1000) for a quick analysis? In other words, can we score projects even when we have limited time?
6. Furthermore, can the software run without a complete, exhaustive set of data? In other words, are standard defaults and/or educated assumptions viable to fill in information gaps to expedite the process?
7. We need a detailed list of information requirements, both inputs and outputs.
8. Can your economic model run sufficiently with our existing personnel resources after adequate training? KYTC consists primarily of engineers and geographers. Or will an in-house economist be needed to operate the system?

9. I realize that some projects are more complicated and time-consuming than others. But, on average, how long does it take a researcher to input data and create an estimate of economic impact for one project:
- A. 1-2 hours
 - B. 3-8 hours
 - C. 2-3 days
 - D. a week
 - E. more than a week
10. Please submit all available information on software capabilities and background information on your product. This can include the user's guide, example runs, past projects, etc.
11. Which transportation organizations (federal transportation agencies, state DOT's, local transportation organizations) are currently using your software?
12. Please submit potential costs associated with the software, training, technical support, and any other associated fees. Also, what are the costs for updates and how often is that needed?

Appendix B: TREDIS Responses

B/C General Questionnaire -- ANSWERS FOR TREDIS-REDYN

The Kentucky Transportation Cabinet is looking for a method to estimate the economic benefits of proposed highway projects. We need to assign dollar values to potential economic benefits. These can then be used to compare the benefits of alternative highway projects. On a related note, the KYTC already generates estimated benefits of improvements in travel time, accident reduction, and vehicle operating cost savings with the HERS-ST. Primarily we need a way to estimate the dollar value of the increased economic activity and jobs expected to arise from specific projects.

We need to ask you a few questions to see if your product fits our needs.

1. What kind of projects is your software designed to make projections of economic benefits for? Does it apply to:

- | | | | |
|--------------------------------|---|--------|---------------------------|
| A. adding turn lanes | . <input checked="" type="checkbox"/> YES | ___ NO | |
| B. intersection reconstruction | . <input checked="" type="checkbox"/> YES | ___ NO | |
| C. lane additions | . <input checked="" type="checkbox"/> YES | ___ NO | |
| D. new roads or highways | . <input checked="" type="checkbox"/> YES | ___ NO | |
| E. exit ramps | . <input checked="" type="checkbox"/> YES | ___ NO | |
| F. Other | . <input checked="" type="checkbox"/> YES | ___ NO | If, yes, please describe. |

TREDIS has the most comprehensive set of inputs available in any economic model, which makes it applicable for any form of road project as well as bus, rail, air or marine project. All it needs is basic information on one or more of the following factors:

- (a) the time or VHT saved (in the case of turn lanes or intersection reconstruction) or
- (b) the distance or VMT saved (in the case of new roads or new exit ramps) or
- (c) the change in capacity or congested hrs of operation (in the case of lane additions), or
- (d) the change in accident rates (in the case of upgrading road type, signalization, etc.), or
- (e) the value of those changes if derived from HERS-ST.

Default averages are available for accident rates, vehicle occupancy, car/truck vehicle mix, value of time, operating cost and congestion levels, and information on the regional economy and freight flow are also provided as part of the system.

2. Is it better at predicting the economic benefits of a large project like a widening from two lanes to four lanes than for a small project like a turn lane at an intersection?

TREDIS works equally well for small projects and large projects because it calculates user impacts as well as broader effects on the economy (jobs, income, etc), and both measures are scalable in precision.

3. What size projects is it best suited for?

TREDIS can work equally well for any size project from \$10,000 to \$10 billion or more in cost.

4. Why?

TREDIS calculates user benefits as well as broader effects on the economy. However, the broader effects on the economy are often no larger than the user benefits for small projects (under \$200,000). The extent of broader economic benefits will also depend on the size of the study area.

5. Is it possible for this software to evaluate the economic impact of a large number of projects (e.g., 500-1000) for a quick analysis? In other words, can we score projects even when we have limited time?

Yes. TREDIS is a new form of web-based database system which allows users to quickly develop and save records for up to 1,000 projects (or more, if desired). Input can be made via online web forms or uploaded spreadsheets.

6. Furthermore, can the software run without a complete, exhaustive set of data? In other words, are standard defaults and/or educated assumptions viable to fill in information gaps to expedite the process?

Yes. TREDIS provides a very wide set of input variables (as listed in the answer to question #1), but only requires that the user show a change in one of those variables. The others can be left blank, or rely on default values.

7. We need a detailed list of information requirements, both inputs and outputs.

See separate documentation materials.

8. Can your economic model run sufficiently with our existing personnel resources after adequate training? KYTC consists primarily of engineers and geographers. Or will an in-house economist be needed to operate the system?

TREDIS does not require any economic training. It assumes that the user is a planner or engineer.

9. I realize that some projects are more complicated and time-consuming than others. But, on average, how long does it take a researcher to input data and create an estimate of economic impact for one project:

TREDIS usually takes around 1-2 hours per project for data calculation and data entry. This assumes that the required measures of facility usage and travel improvement are either calculated via travel model or sketch planning methods.

10. Please submit all available information on software capabilities and background information on your product. This can include the user's guide, example runs, past projects, etc.

See separate documentation materials.

11. Which transportation organizations (federal transportation agencies, state DOT's, local transportation organizations) are currently using your software?

TREDIS is a new product that has been recently applied for metropolitan area studies in Chicago (IL), Portland (ME) and Vancouver (BC). It builds upon an earlier product called LEAP that was recently used for Appalachian highway studies in Tennessee, Mississippi and New York. Its use by several other state DOTs is pending.

12. Please submit potential costs associated with the software, training, technical support, and any other associated fees. Also, what are the costs for updates and how often is that needed?

TREDIS is sold as a web-based subscription service that is automatically updated in capabilities and baseline data at no additional cost. Annual subscription for a state with 120 counties is \$40,000 to \$60,000 for the first year and \$30,000 to \$50,000 for subsequent years. This provides unlimited access to the system for as many projects as desired, and it can be used by up to three users at a time. The system also allows users to define multiple study areas or regions, and those regions can be redefined by users as often as desired to show local or corridor impacts as well as statewide impacts for each project. The price range varies depending on the maximum number of regions that are desired for any one project. All prices include one-day of in-house training plus additional telephone support as needed.

Appendix C: REMI Responses

B/C General Questionnaire

The Kentucky Transportation Cabinet (KYTC) is looking for a method to estimate the total economic benefits of proposed highway projects. Specifically, we are seeking a method for assigning dollar values to potential economic benefits arising from new jobs and new business produced by the highway improvement. These can then be used to compare the benefits of alternative highway projects. In other words, we need more than the economic benefit to drivers of improved travel times and safety, which we can compute with HERS-ST or your program.

At this time, the KYTC can already estimate benefits of improvements (cost savings) in travel time, accident reduction, and vehicle operating costs. But we need to add a way to estimate the dollar value of the increased economic activity and jobs expected to arise from specific road improvement projects.

We need to ask you a few questions to see if your product fits our needs.

13. What kind of projects is your software designed to make projections of economic benefits for? Does it apply to:

- A. adding turn lanes ___ YES ___ NO
- B. intersection reconstruction ___ YES ___ NO
- C. lane additions _X_ YES ___ NO
- D. new roads or highways _X_ YES ___ NO
- E. exit ramps ___ YES ___ NO
- F. Other _X_ YES ___ NO If, yes, please describe.

TranSight is capable of analyzing transit (light rail, assisted fixed guideway, etc.).
TranSight can also incorporate freight movement by rail through a detailed interface.

14. Is it better at predicting the economic benefits of a large project like a widening from two lanes to four lanes than for a small project like a turn lane at an intersection?

It is better at predicting the economic impact of larger projects like a two to four lane widening project than a small project like a turn lane investment.

15. What size projects is it best suited for?

The model is capable of analyzing any project of any size. It captures impacts, not only relative to the size of a project (be it capital expenditure size or lane miles), but also to the usage of the network. For instance, holding capital expenditures constant, a 5-mile stretch of road in a highly urbanized area will capture more trip, VMT, & VHT activity and should generate larger economic impacts than a 5 or 10-mile stretch in a more rural area.

16. Why?

Our model captures the net economic effects of changes in access to businesses and individuals through road network alterations. The simple concept behind the detailed model is that distance is a cost to business activity and when you enhance the mobility on the road network you shrink the effective distance between regions (and businesses within those regions) and provide cost and productivity advantages to the affected industries. Capital expenditures and project finance are a large factor in a common transportation analysis. REMI TranSight takes the standard analysis method and advances it by quantifying benefits to businesses through our economic geography concepts. Given this background information, the ability to see an impact does not depend on project size (magnitude of \$s or length, e.g (lane) miles), but use of the tool should be limited to larger projects since they will be more significant for comparative cases.

17. Is it possible for this software to evaluate the economic impact of a large number of projects (e.g., 500-1000) for a quick analysis? In other words, can we score projects even when we have limited time?

Yes. We preload all of the necessary travel data into the TranSight model during the build phase so that a quick analysis can be done if the user has two pieces of information:

1. Capital Expenditures by year and economic region.
2. Finance Information by Source: e.g. taxes (if applicable) as well as local, state, or federal funds.

18. Furthermore, can the software run without a complete, exhaustive set of data? In other words, are standard defaults and/or educated assumptions viable to fill in information gaps to expedite the process?

Yes. We supply standard regional and national defaults for all model parameters—emissions, safety, and fuel consumption. Additionally, the model comes with a complete economic and demographic forecast that extends out to 2050.

19. We need a detailed list of information requirements, both inputs and outputs.

(PLEASE SEE ATTACHED INFORMATION REQUIREMENTS)

20. Can your economic model run sufficiently with our existing personnel resources after adequate training? KYTC consists primarily of engineers. Or will an in-house economist be needed to operate the system?

Non-economists can operate the model with a modest amount of training, which we provide to all of our clients, regardless of academic or career background.

21. We realize that some projects are more complicated and time-consuming than others. But, on average, how long does it take a researcher to input data and create an estimate of the jobs and business economic impact for one highway project:

- A. Less than an hour.
- B. 1-2 hours
- C. 3-8 hours
- D. 2-3 days
- E. a week
- F. more than a week

22. Please submit all available information on software capabilities and background information on your product. This can include the user's guide, example runs, past projects, etc.

(PLEASE SEE ATTACHED USER'S GUIDE and STUDIES)

23. Which transportation organizations (federal transportation agencies, state DOT's, local transportation organizations) are currently using your software?

Louisiana Department of Transportation and Development
Los Angeles Metropolitan Transportation Authority
New Jersey Transit
Virginia Department of Transportation
Pennsylvania Department of Transportation
Florida RPCs
Texas Transportation Institute
Merrimack Valley Planning Commission
New Mexico Department of Transportation

24. Please submit potential costs associated with the software, training, technical support, and any other associated fees. Also, what are the costs for updates and how often is that needed?

The cost to acquire REMI TranSight software package is based on a reduced fee schedule since there is already an active REMI Policy Insight user in the State of Kentucky. Kentucky Legislative Budget Review holds the primary license to both a single-area State model and a three-area model. REMI will provide training and software support at no additional fee. An annual maintenance fee is incorporated in the first year and itemized in the subsequent years. This maintenance fee provides for annual model updates such as new years of data and enhanced features.

PRICE SCHEDULE

	Single Area Model	Three-Area Model
(Year 1)		
Secondary User Fee	\$9,200	\$9,200
TranSight Add-On	<u>\$40,000</u>	<u>\$54,000</u>
Total	\$49,200	\$63,200
(Year 2 and onward)		
Secondary User Fee	\$9,200	\$9,200
*Annual Maintenance	<u>\$8,000</u>	<u>\$10,800</u>
Total	\$17,200	\$20,000

Appendix D: TREDIS - Output Reports*

(1) Direct Travel Impact - Base Scenario

Audit Report for the “No Build” or “Base” Scenario. Values are shown to verify user inputs and display calculated values of vehicle-miles, vehicle-hours, passengers, tons, speeds, access, cost, safety and environmental effects. All values are shown by region and mode for the future target year.

(2) Direct Travel Impact - Project Scenario

Audit Report for a given “Project” Scenario. Values are shown to verify user inputs and display calculated values of vehicle-miles, vehicle-hours, passengers, tons, speeds, access, cost, safety and environmental effects. All values are shown by region and mode for the future target year.

(3) Direct Travel Benefit from Completing the Project

Calculated travel cost savings plus values of non-money impacts realized by adopting the “Project” scenario instead of the “Base” Scenario. Values are calculated as the difference in impact between the two scenarios, and represent the benefit in time, expense, access, safety and environmental impacts. Overall benefits are shown by region and mode for the future target year, and distinguish the direct travel cost savings for locally-based residents and businesses.

(4) Direct Travel Cost Savings - by Industry

Calculated breakdown of the direct travel cost savings for existing locally-based residents & businesses. The breakdown distinguishes benefits by economic sector – including local households and categories of local business (based on the North American Industrial Classification System). Benefits by sector of the economy are shown separately by region and mode for the future target year.

(5) Direct Market Access Benefit - by Industry

Calculated breakdown of the direct market access benefit resulting from the “Project” scenario instead of the “Base” Scenario. For road travel, the access benefit is measured as the percentage expansion of population coverage for labor and truck delivery markets. For rail, air and water dependent travel, the access benefit is measured as the percent improvement in road access time to intermodal terminals and frequency/breadth of travel available at those terminals. Benefits by sector of the economy are shown by region and mode for the future target year.

(6) Summary of Direct Project Impact– by Industry

Summary of direct, long-term (target year) impacts that are input to the regional economic model. This includes the direct travel cost savings for existing business and industry (from Report 4) and the direct market access benefit for new business delivery markets (from Report 5), plus user-reported dollar valuation of other social and environmental benefits. All values are shown by region and are broken down by sector of the economy for the future target year. Impacts of construction and ongoing operations and maintenance are also shown.

(7) Summary of Long-Term Economic Impact of the Project - by Industry

Results of economic model analysis on long-term economic impacts of project completion. Impacts are measured as business output, gross domestic product, wage income and jobs. All

values are shown by region and are broken down by sector of the economy, for the future target year.

(8) Summary of Short-Term Economic Impact of Construction - by Industry

Results of economic model analysis on short-term economic impacts of project development spending. Impacts are measured as business output, gross domestic product, wage income and jobs. All values are shown by region and are broken down by sector of the economy for the peak construction year.

(9) Summary of Overall Economic Impact - by Year

Summary of economic model analysis of changes over time, from construction to after project completion. Impacts are measured as business output, value added (GDP), wage income and jobs. All values are shown by region and are shown year-by-year.

(10) Benefit-Cost Analysis

Summary of total project impact/cost and benefit/cost ratios, using five ways of measuring impacts or benefits: (1) transport system efficiency, (2) transport user cost savings, (3) total transport user benefit, (4) total social benefit, and (5) regional income benefit. All ratios are shown calculated on the basis of a discounted net present value of the benefit and cost streams. The components of these different measures are also shown.

*<http://www.edrgroup.com/edr1/Products/TREDIS/tredis-output-reports.shtml>

Appendix E: Staffing Requirements

	Hours per project (HERS-ST input)	Hours per project (EDR/REMI input)	Annual Number of Projects	Total Project Hours needed per year	
1	2	1	500	1500	
2	2	1	1000	3000	
3	2	2	500	2000	
4	2	2	1000	4000	
5	2	3	500	2500	
6	2	3	1000	5000	
	Total working hours	Efficiency	Working hours available	Project hours/	Staffing Req'ts (rounded up)
	per employee per year*	Rating**	for project input needs	Working hours	
1	1774	0.75	1330.5	1.127395716	2
2	1774	0.75	1330.5	2.254791432	3
3	1774	0.75	1330.5	1.503194288	2
4	1774	0.75	1330.5	3.006388576	4
5	1774	0.75	1330.5	1.87899286	2
6	1774	0.75	1330.5	3.75798572	4

* This category does not include weekends, holidays, or 2-week annual leave over the course of a year

** Efficiency rating denotes amount of daily work time available for actual project input; Exclusions might include specific times for meetings, citizenry consultations, breaks, etc.

Appendix F: Staffing Costs
Entry-Level Position Costs

	Entry-level Monthly Salary	Title Codes	Staffing Requirements	Total Annual Salaries	KYTC Employee Benefit Factor	Total Staffing Costs
A	\$2,290.28	7096, 9780	2	\$54,966.72	30%	\$71,456.74
B	\$2,771.28	9781	2	\$66,510.72	30%	\$86,463.94
C	\$3,304.00	7026	2	\$79,296.00	30%	\$103,084.80
D	\$3,635.00	7094	2	\$87,240.00	30%	\$113,412.00
A	\$2,290.28	7096, 9780	3	\$82,450.08	30%	\$107,185.10
B	\$2,771.28	9781	3	\$99,766.08	30%	\$129,695.90
C	\$3,304.00	7026	3	\$118,944.00	30%	\$154,627.20
D	\$3,635.00	7094	3	\$130,860.00	30%	\$170,118.00
A	\$2,290.28	7096, 9780	4	\$109,933.44	30%	\$142,913.47
B	\$2,771.28	9781	4	\$133,021.44	30%	\$172,927.87
C	\$3,304.00	7026	4	\$158,592.00	30%	\$206,169.60
D	\$3,635.00	7094	4	\$174,480.00	30%	\$226,824.00

Mid-Point Position Costs

	Mid-point Monthly Salary	Title Codes	Staffing Requirements	Total Annual Salaries	KYTC Employee Benefit Factor	Total Staffing Costs
A	\$3,034.04	7096, 9780	2	\$72,816.96	30%	\$94,662.05
B	\$3,671.38	7026, 9781	2	\$88,113.12	30%	\$114,547.06
C	\$4,038.62	7094	2	\$96,926.88	30%	\$126,004.94
A	\$3,034.04	7096, 9780	3	\$109,225.44	30%	\$141,993.07
B	\$3,671.38	7026, 9781	3	\$132,169.68	30%	\$171,820.58
C	\$4,038.62	7094	3	\$145,390.32	30%	\$189,007.42

A	\$3,034.04	7096, 9780	4	\$145,633.92	30%	\$189,324.10
B	\$3,671.38	7026, 9781	4	\$176,226.24	30%	\$229,094.11
C	\$4,038.62	7094	4	\$193,853.76	30%	\$252,009.89

Appendix G: Total Costs

Table 1: TREDIS Total Costs

	Entrance Salary Costs		Midpoint Salary Costs	
	Minimum	Maximum	Minimum	Maximum
<i>First Year</i>				
Staff = 2	\$71,457	\$113,412	\$94,662	\$126,005
Capital Costs	\$40,000	\$60,000	\$40,000	\$60,000
Total Costs	\$111,457	\$173,412	\$134,662	\$186,005
<i>Subsequent Years</i>				
Staff = 2	\$71,457	\$113,412	\$94,662	\$126,005
Capital Costs	\$30,000	\$50,000	\$30,000	\$50,000
Total Costs	\$101,457	\$163,412	\$124,662	\$176,005
<i>First Year</i>				
Staff = 3	\$107,185	\$170,118	\$141,993	\$189,007
Capital Costs	\$40,000	\$60,000	\$40,000	\$60,000
Total Costs	\$147,185	\$230,118	\$181,993	\$249,007
<i>Subsequent Years</i>				
Staff = 3	\$107,185	\$170,118	\$141,993	\$189,007
Capital Costs	\$30,000	\$50,000	\$30,000	\$50,000
Total Costs	\$137,185	\$220,118	\$171,993	\$239,007
<i>First Year</i>				
Staff = 4	\$142,913	\$226,824	\$189,324	\$252,010
Capital Costs	\$40,000	\$60,000	\$40,000	\$60,000
Total Costs	\$182,913	\$286,824	\$229,324	\$312,010
<i>Subsequent Years</i>				
Staff = 4	\$142,913	\$226,824	\$189,324	\$252,010
Capital Costs	\$30,000	\$50,000	\$30,000	\$50,000
Total Costs	\$172,913	\$276,824	\$219,324	\$302,010

Table 2: TranSight Total Costs

	Entrance Salary Costs		Midpoint Salary Costs	
	Minimum	Maximum	Minimum	Maximum
<i>First Year</i>				
Staff = 2	\$71,457	\$113,412	\$94,662	\$126,005
Capital Costs	\$49,200	\$63,200	\$49,200	\$63,200
Total Costs	\$120,657	\$176,612	\$143,862	\$189,205
<i>Subsequent Years</i>				
Staff = 2	\$71,457	\$113,412	\$94,662	\$126,005
Capital Costs	\$17,200	\$20,000	\$17,200	\$20,000
Total Costs	\$88,657	\$133,412	\$111,862	\$146,005
<i>First Year</i>				
Staff = 3	\$107,185	\$170,118	\$141,993	\$189,007
Capital Costs	\$49,200	\$63,200	\$49,200	\$63,200
Total Costs	\$156,385	\$233,318	\$191,193	\$252,207
<i>Subsequent Years</i>				
Staff = 3	\$107,185	\$170,118	\$141,993	\$189,007
Capital Costs	\$17,200	\$20,000	\$17,200	\$20,000
Total Costs	\$124,385	\$190,118	\$159,193	\$209,007
<i>First Year</i>				
Staff = 4	\$142,913	\$226,824	\$189,324	\$252,010
Capital Costs	\$49,200	\$63,200	\$49,200	\$63,200
Total Costs	\$192,113	\$290,024	\$238,524	\$315,210
<i>Subsequent Years</i>				
Staff = 4	\$142,913	\$226,824	\$189,324	\$252,010
Capital Costs	\$17,200	\$20,000	\$17,200	\$20,000
Total Costs	\$160,113	\$246,824	\$206,524	\$272,010