National Cooperative Highway Research Program

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Summary of Economic Development Research Projects

This staff digest summarizes the scope and status of current or recently completed NCHRP and TCRP research activities associated with economics and economic development.

INTRODUCTION

This digest provides brief descriptions, summaries of objectives, status, and other information on selected current and recently completed NCHRP and TCRP economic and economic development research projects. It is intended to give a quick overview of the range of economic research activities being administered through the Cooperative Research Programs of the Transportation Research Board.

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Project 2-17(3), FY '93
Macroeconomic Analysis of the Linkages Between Transportation Investments and Economic Performance

Research Agency: The Johns Hopkins University
Principal Invest: Michael Bell and Therese McGuire
Funds: $250,000
NCHRP Staff: Kenneth S. Opiela

Analytic work by Aschauer, Munnell, McGuire, and others has indicated that there are positive relationships between investments in infrastructure and economic productivity at the national and state levels. A better understanding of the linkages between transportation investments and economic activity as measured in terms of macroeconomic factors such as employment, expenditures, income, production of goods and services, productivity, and competitiveness is needed. Accurate measures of the capital stock (e.g., the sum of past investments) are important to macroeconomic analysis and indirectly to the development of public policy. The 1974 U.S. DOT report, *Capital Stock Measures for Transportation*, estimated the value of the private and public capital stock in transportation for the period 1950 to 1970. It also estimated the cost of capital services, the rate of depreciation, and capacity in the various transportation modes. Similar estimates for the period 1970 to 1990 are needed to determine whether there has been a significant slowdown over time in the rate of net capital formation in different transportation modes, as well as the impact of government actions on net investments to public transportation capital.

The overall objective of this research was to improve the understanding of the linkages between transportation investments and economic performance. The goal of this research was to develop an improved estimate of the value of the public and private capital stock (structures, equipment, and land) in transportation over time.

Status: The project has been completed. Macroeconomic studies of the contribution of transportation and infrastructure investment to productivity were critically reviewed, and the types of data on transportation capital stock needed to conduct further research were identified. The dataset created in the 1974 U.S. DOT study was assessed to identify its strengths and weaknesses, feasible sources of information for a revised dataset were identified, and mechanisms for routine updates to account for depreciation and the discounted value of capital were described. Processes to isolate divergent trends in transportation investment, to recognize investments made without a major transportation purpose, and to assess the influences of marginal investments were defined. A database of transportation infrastructure investment and capital stock by mode and state was created and documented. The resulting dataset was used in the production functions described in recent literature to validate the linkages between transportation investment and economic productivity. Other refinements to macroeconomic models that would be possible with the updated and expanded data were identified, including use of surrogate variables to account for the productivity effects of nontransportation investments.

Report Availability: The contractor's final report was published as *NCHRP Report 389*, "Macroeconomic Analysis of the Linkages Between Transportation Investments and Economic Performance."

Project 2-17(3)A, FY '94
Update and Enhancement of Dataset for Macroeconomic Analysis of Transportation Investments and Economic Performance

Research Agency: The Johns Hopkins University
Principal Invest: Michael Bell
Funds: $49,990
NCHRP Staff: Kenneth S. Opiela

Quantitative linkages need to be determined between transportation investments and economic activity as measured in terms of employment, expenditures, income, production of goods and services, productivity, and competitiveness. While economists differ in their opinions

concerning the true significance of each factor contributing to productivity, they do agree that productivity and national income are influenced by the amount of capital that labor has to work with; and that the amount of capital at any given time is a result of past levels of savings, investment, and depreciation.

Analytic work undertaken by Aschauer, Munnell, McGuire, and others has indicated that there are positive relationships between investments in infrastructure and economic productivity at the national and state levels. These analyses were based upon commonly available data on economic performance and the extent of the nation's public infrastructure capital stock. One criticism of these studies has been that the capital stock measures used in the analyses do not adequately represent the contribution of infrastructure investments. The initial phase of NCHRP Project 2-17(3) identified opportunities for improvements to the models developed in previous work and established the data requirements for formulating a wider range of fundamental relationships between factors. It resulted in the development of an enhanced set of data related to transportation investments, economic performance, and demography. The data provided the basis for limited investigations into the validity of recently developed models of transportation investments and the derivation of new models. These analyses verified the usefulness of the dataset resulting from this research and provided the impetus and direction for enhancement and update of the dataset to allow continued research in this area.

The objectives of this effort are to update and refine the dataset constructed as part of the initial efforts in NCHRP Project 2-17(3) and to formulate a procedure for future maintenance and updates of the dataset. The updates and refinements will include the addition of new data where available, the updates of values in the dataset to a more current benchmark, and the inclusion of data for new variables that will allow extended use of the dataset.

Status: The project is nearing completion. The dataset update has been completed, and efforts are currently focused on updating the documentation and preparing procedures for future maintenance of the dataset. The PI has left the agency so arrangements are being made to get the final elements of work completed.

Report Availability: No reports are available, but an updated dataset and documentation are being prepared. The Bureau of Transportation Statistics has agreed to distribute these items.

Project 2-17(4), FY '91
Measuring the Relationship Between Freight Transportation Services and Industry Productivity

Research Agency:	Hickling, Lewis, Brod, Inc.
Principal Invest:	David Lewis
Funds:	$250,000
NCHRP Staff:	Kenneth S. Opiela

The demand for freight transportation services is derived from industry needs, and the quality and scope of these services appear to be significant in influencing industrial productivity. Public agencies play an important role in addressing industry needs for moving goods by influencing freight transportation services through infrastructure investments in the various modes, the introduction of advanced technology, and/or changing operational controls and regulations. Research is needed to develop information that can be used to make better decisions relative to freight transportation services and to promote industry productivity at the state, regional, and national levels.

The objectives of the research were to identify for specific industry groups the relative significance of transportation and logistics costs, the relationships among transportation services, infrastructure, operational conditions, and industry productivity.

The potential impacts of future changes in transportation systems and business practices on these relationships were also assessed. This research was intended to demonstrate how the relationships identified could be applied by state, regional, and local agencies to help make decisions on transportation investments which would result in improved industry productivity. The project identified critical variables and parameters associated with the relationship between transportation services and industry productivity and cross-referenced these to the various techniques that have been used to enhance industry productivity (e.g., just-in-time deliveries, strategic alliances). Based upon a carefully designed sampling plan, pertinent information related to freight transportation service factors was obtained to investigate relationships to industry productivity. The information was analyzed to assess (a) the various logistic facets of freight flows, (b) use of public and private infrastructure, (c) market size, and (d) geographic coverage for various industry groups. The sample represented different regions, facility sizes, expanding and mature industries, manufacturing and service sectors, domestic and international scopes of operation, high and low volume and weight freight characteristics, and other aspects. The key components of logistics systems (e.g., inventory costs, distribution patterns, modes used, transport costs, reliability, infrastructure needs, and damage costs) were noted and their relationship to industry productivity assessed. The impacts of current and prospective changes in transportation services and infrastructure on industry productivity were assessed. A generalized process for public agencies to apply the relationships derived to improve decision making on transportation investments and policy was developed.

Status: The project has been completed.

Report Availability: The contractor's final report is available from the NCHRP. Efforts are underway to prepare a research results digest to summarize the findings.

Project 2-17(6), FY '93
Tourism Travel Contributions to Economic Development

Research Agency: Greenhorne & O'Mara
Principal Invest: Lowell B. Jackson
Funds: $299,448
NCHRP Staff: Ronald D. McCready

The relationship between the quality of the surface transportation infrastructure and the future growth of tourism travel must be understood in order to guide statewide planning and transportation investment decisions. States take different approaches to the promotion and facilitation of tourism travel and to the measurement of its impact on economic development. It is critical that an effective approach to the demonstration and measurement of the economic benefits of tourism be developed; and that the states be provided with information and guidelines on how investments in transportation infrastructure and traveler facilities can increase those economic benefits.

The objective of this research is to develop guidelines for promoting economic development derivable from tourism travel by improving transportation system services. This objective will include the following: (1) the development of measurement techniques and common standards for evaluating tourism-related highway transportation investment decisions, (2) the synthesis and evaluation of highway transportation strategies for promoting tourism, and (3) the recommendation of improvements to facilitate traveler use of the highway transportation system.

Status: The project has been completed. The final report will be published as *NCHRP Report 419*. The two-volume revised draft final report was submitted to NCHRP presenting the study findings and recommendations as well as supporting materials and references. A separate annotated bibliography was also prepared and submitted by the research team.

Report Availability: Pending publication, the revised draft final report and annotated bibliography are available for loan. *Research Results Digest 211*, "Current State Practices in the Transportation-Tourism Interface," was published to cover the project's first phase.

Project 2-18, FY '91
Research Strategies for Improving Highway User Cost-Estimating Methodologies

Research Agency: Hickling Corporation
Principal Invest: David Lewis
Funds: $200,000
NCHRP Staff: Kenneth S. Opiela

Planning, evaluating, selecting, and financing highway investments require an understanding of fundamental empirical relationships between the physical and service characteristics of roadways and the associated user costs. Integral to estimating highway needs are accurate measures of the economic costs associated with vehicle maintenance, tires, depreciation, oil, fuel consumption, accidents, emissions, and travel time—each expressed as a function of highway conditions. Further, there is a need to assess the fundamental empirical relationships between highway characteristics (e.g., roughness, alignment, service level) and user costs (e.g., vehicle operation and maintenance, travel time, safety, emissions). New measures are needed for the value of time and operating and safety costs as they relate to congestion and productivity, and to determine the sensitivity of user costs to external changes.

The objectives of this research were (1) to examine the validity of the data, concepts, assumptions, components, and methods currently used to determine highway user costs; (2) to identify methodological improvements that are possible through theoretical or empirical research; and (3) to propose action plans to undertake the identified research opportunities.

Status: The research has been completed. The research reviewed the validity and accuracy of current methods used to estimate highway user costs, considering the critical elements of each component, the realism of assumptions, the rigor of the concepts, the accuracy of the data for the current and future vehicle fleet, and the relative contribution of each component to overall highway user costs. The sensitivity of individual cost estimates, input data, and specification of the empirical relationships was systematically evaluated. Opportunities for improvements in the highway user cost-estimating procedures by using additional components, establishing more accurate and rigorous fundamental relationships, defining more realistic assumptions, and utilizing better data sources were identified. A strategic plan was developed that prioritizes the candidate research opportunities in terms of the general magnitude of cost, length and difficulty of the research effort, and the likelihood that the methodological improvement can have significant decision-making impact.

Report Availability: The contractor's final report is available on request from the NCHRP. Efforts to prepare a research results digest are proceeding.

Project 2-18(2), FY '93
Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation

Research Agency: Hickling, Lewis, Brod, Inc.
Principal Invest: David Lewis
Funds: $149,809
NCHRP Staff: Kenneth S. Opiela

User-cost analysis is a means of assessing the impacts of alternative design and service characteristics of roadways in the planning and evaluation of projects. Accurate measures of the economic costs associated with vehicle operation, travel time, accidents, and emissions for future conditions are essential. User-cost estimates typically derive

most of the benefits from cost savings associated with reduced travel time resulting from facility improvements. Over the past 30 years, research has established values of time, techniques for measuring these values, and analytical frameworks for incorporating this cost factor, but the value of travel time and the time savings associated with roadway improvements are still debated. Growing levels of traffic congestion have, however, led to observations of unusual behavior under congested conditions, which raises new questions about the significance of congestion and the associated unpredictability of travel times on the economic value of travel time. NCHRP Project 2-18 concluded that the valuation of travel time remains a significant source of uncertainty in user-cost analyses. The need exists for research on two important aspects of travel time. First, do travelers and freight carriers place a premium on travel-time savings (or reduced delays) during periods of congestion? Second, is there a value placed on the predictability of travel times? Recent research indicates that modern production and inventory management techniques, such as just-in-time delivery, can cause the reductions in travel-time variability to be even more important to highway users than reductions in the average amount of travel time. A similar premium may be applicable to personal travel, for example when stiff surcharges are incurred for late arrival at facilities such as day care centers.

The objectives of this research are to develop methodologies for measuring the effects of congestion on the values highway users place on travel-time savings and predictability, use the methodologies to generate values for these factors for different degrees of congestion, and define an approach for incorporating these factors in the highway user-cost estimation.

Status: The project has been completed. The research reviewed past studies pertaining to the effects of congestion on the value of travel-time savings and predictability to identify major gaps in theory and information, developed a methodology to measure changes in the value users place on travel-time savings and predictability for different degrees of congestion on a highway facility, gathered and analyzed data to establish congestion effects on the values for travel-time savings and predictability, recommended a strategy for incorporating the travel-time savings or predictability factors in highway user-cost estimation, and documented the effort in a final report.

Report Availability: The revised draft final report has been approved by the panel and publication is pending.

Project 2-18(3), FY '94
Development of an Innovative Highway User-Cost Estimation Procedure

Research Agency:	Hickling, Lewis, Brod, Inc.
Principal Invest:	David Lewis
Funds:	$100,000
NCHRP Staff:	Kenneth S. Opiela

Planning, evaluating, selecting, and financing highway investments require an understanding of the fundamental empirical relationships between the physical and service characteristics of roadways and associated user costs. Integral to estimating highway needs are accurate measures of the economic costs associated with vehicle operation, accidents, emissions, and travel time—each expressed as a function of highway conditions. NCHRP Project 2-17(1) concluded that very few transportation agencies use user-cost or benefit-cost analysis in the appraisal of capital projects. Policy makers and planners need innovative methods to facilitate decision-making, including methods that provide a means of understanding the quantitative significance of uncertainty and risk. NCHRP Project 2-18 analyzed the factors involved in user cost analyses, formulated models to relate these cost components to highway and traffic conditions, identified the key data associated with each, and pioneered in the use of uncertainty or risk analysis in conjunction with user cost estimation. The need exists to document the data and models developed and to translate the methodology into a tool which can be used to address questions related to the strategic selection of projects.

The objectives of this research are to develop an innovative highway user-cost estimation methodology based upon uncertainty analysis and to prepare materials to facilitate the use of this methodology. These efforts are intended to facilitate highway user cost estimation, lay the groundwork for the development and buy-in of more sophisticated models, and provide a benchmark for future research efforts.

The research developed a strategic user-cost estimation model to support agency-wide strategic planning and policy analysis purposes (named StratBENCOST). A simplified form of the model was also developed for hand-calculation. A highway user-cost estimating manual to apply the new user-cost estimation methodology was also developed. The methodology was reviewed and case studies were conducted to validate the effectiveness of the model. A final report, which includes the manual, documentation for the software, and provides recommendations for future research was submitted. Evaluation of the StratBENCOST software and documentation is complete. It was judged to be a potentially useful tool for transportation investment analysis.

Status: The project has been completed.

Report Availability: The contractor's final report and software will not be published, but will be updated and enhanced in Project 2-18(4).

Project 2-18(4), FY '95
Development and Demonstration of StratBENCOST Procedure

Research Agency:	Hickling, Lewis, Brod, Inc.
Principal Invest:	David Lewis
Funds:	$164,930
NCHRP Staff:	Kenneth S. Opiela

Planning, evaluating, selecting, and financing highway investments require (1) an understanding of fundamental empirical relationships between the physical and service characteristics of roadways and the associated user costs and (2) accurate measures of the economic costs associated with vehicle operating costs, accidents, emissions, and travel time, each expressed as a function of highway conditions. NCHRP Project 2-17(1) concluded that very few transportation agencies apply user-cost estimating techniques or benefit-cost analysis in the appraisal of capital projects. Federal mandates require that transportation agencies use more rigorous procedures in making project decisions. NCHRP Project 2-18 systematically analyzed user cost factors using methods which provided a means of assessing the quantitative significance of uncertainty and risk. It formulated models associated with the highway user cost analysis process based upon the current state of the art and it identified the data and relationships associated with each. NCHRP Project 2-18(3) developed an innovative highway user cost estimation methodology based upon the approach used in NCHRP Project 2-18 and prepared draft user materials to facilitate the use of this methodology. These efforts are intended to facilitate highway user cost estimation, lay the groundwork for the development and "buy-in" of more sophisticated models, and provide a benchmark for future research efforts. It was recognized that there is a need to further refine the software developed to facilitate its application. There is also a need to extend the range of applicability of the software and to develop other documents or materials to facilitate the use of this tool. It may also be useful to conduct case study applications to demonstrate the functionality of this tool.

The objectives of this project are to (1) demonstrate the functionality of the StratBENCOST model, (2) refine and extend the capabilities of the StratBENCOST software, and (3) prepare user materials to facilitate use of the model.

Status: The estimated completion date for this project is May 31, 1999. The agency has finished testing the software in case studies of transportation investment analysis. Opportunities for enhancements to the software's capabilities have been identified and the agency is developing an updated, metric version of the StratBENCOST program (Version 2.0) on a standard hardware and software platform. The software documentation is being revised to reflect added functionality and enhancements to the data structures, application procedures, process flow diagrams, and outputs. Efforts are continuing to validate the new version of the program, reanalyze the case studies, and establish an Internet site for the dissemination of StratBENCOST and its documentation. The Final Report from NCHRP Project 2-18(3) will be updated and a brief, applications-oriented primer on using StratBENCOST will be prepared.

Report Availability: No reports are currently available.

Project 2-19, FY '95
Research on the Relationship Between Economic Development and Transportation Investment

Research Agency:	Apogee Research, Inc.
Principal Invest:	Richard R. Mudge
Funds:	$100,000
NCHRP Staff:	Ronald D. McCready

Transportation-infrastructure investment has played a key role in the development of the nation's economy. The manner in which transportation investment affects economic productivity has been the subject of many studies, and although the relationship between these investments and productivity is not well understood, the output of these studies provides decision-makers with the information needed to make choices in determining which transportation investments should be supported. Research efforts by NCHRP, academic institutions, and federal agencies have pursued various approaches to understand the relationship between transportation investment and economic productivity. However, this relationship is difficult to track and there is concern about the ability of this research to meet the needs of transportation decision-makers.

The objective of this research is to develop an appropriate cost-effective, multiyear, multifaceted research plan on the relationship between transportation investment and economic productivity.

Status: The project has been completed. The revised draft final report has been received and publication has been approved. The final report is in the editing process.

Report Availability: The report will be published as *NCHRP Report 418,* "Research on the Relationship Between Economic Development and Transportation Investment."

Project 2-19(2), FY '97
Guidance on Using Existing Analytic Tools for Evaluating Transportation Investments

Research Agency:	Hagler Bailly Services, Inc.
Principal Invest:	Richard R. Mudge
Funds:	$99,990
NCHRP Staff:	Ronald D. McCready

The recently completed NCHRP Project 2-19, *Research on the Relationship Between Economic Development and Transportation Investment* identified a number of specific problems faced by state Departments of Transportation and other practitioners where better and more timely information on economic development and productivity for transportation projects and programs would be valuable. While much of the discussion concerned a combination of basic research and practical extensions of existing techniques, uncertainty over the appropriate use of existing

tools, including their value and usefulness, reliability, and data requirements, was a recurring theme of the findings.

The objective of this research is to develop a "user-friendly," practical guidance on the use of analytical techniques to address typical transportation decision-making problems. The underlying emphasis of this research is to adopt a bottom-up approach to link existing tools to analytical requirements at the state DOT and MPO levels.

Status: The estimated completion date for this project is June 21, 1999. The contract has been signed and work has begun on the initial tasks.

Report Availability: No reports are currently available.

Project 2-20, FY '95
Economic Trends and Multimodal Transportation Requirements

Research Agency:	Louis Berger International, Inc.
Principal Invest:	Isaac Shafran
Funds:	$249,999
NCHRP Staff:	Ronald D. McCready

The U.S. economy is an evolving postindustrial economy. The service sector, which currently accounts for 80 percent of economic activity, is one of the fastest growing sectors and relies more on the movement of people than goods. During this transition, the manufacturing sector has also been restructuring its operations. Manufacturing in general has shifted from heavy industry to lighter manufacturing that requires more frequent and smaller shipments of higher value goods and reliable, timely deliveries. Growth in the manufacturing sector has been centered in high technology, the refinement of processes, and a recommitment to quality. In supporting economic expansion goals, it is important to consider how multimodal transportation investments can sustain development. This is particularly true in light of the opportunities for increasing the market reach of U.S. economic production and the competitiveness of American business in the global economy.

The objective of this research is to develop guidance for use by planning practitioners and other transportation decision-makers based on the relationship between current and future regional, national, and global economic trends and the freight and passenger transportation requirements of American business.

Status: The project has been completed. The final report was submitted and will be published as *NCHRP Report 421*.

Report Availability: Pending publication, the draft final report is available for loan.

Project 2-21, FY '97
Economic Implications of Congestion

Research Agency:	Cambridge Systematics, Inc.
Principal Invest:	Harry S. Cohen
Funds:	$300,000
NCHRP Staff:	Ronald D. McCready

Congested transportation facilities raise the cost of moving people and goods into, within, and out of regions and states. Costs associated with transportation continue to increase in importance as the challenges and opportunities of the global marketplace compel companies to change their business methods. Congestion, especially within metropolitan regions, is perceived to be reaching critical proportions and is imposing costs on business that are detrimental to economic efficiency, productivity, and competitiveness.

The objective of this project is to quantify the impacts of congestion on the costs of production for a range of economic sectors within metropolitan areas. The intent is to estimate the elasticity of business costs with respect to congestion levels within metropolitan areas. Based on these cost relationships, an assessment methodology will be developed which will allow states and metropolitan planning organizations (MPOs) to estimate those direct economic benefits that can be expected to result from various transportation strategies designed to reduce congestion. This research should provide decision-makers with an understanding of the implications of congestion on economic activities and should provide practitioners with the tools to analyze the costs of congestion on businesses.

Status: The estimated completion date for this project is July 31, 1999. The research team has completed the first phase of research and has submitted an interim report for panel review.

Report Availability: No reports are currently available.

Project 2-22, FY '97
Needs in Communicating the Economic Impacts of Transportation Investment

Research Agency:	Hagler Bailly Services, Inc.*
Principal Invest:	Sergio J. Ostria
Funds:	$200,000
NCHRP Staff:	Ronald D. McCready

* Formerly Apogee Research, Inc.

The American Association of State Highway and Transportation Officials (AASHTO), through its Special Committee on Economic Expansion and Development and through its support of NCHRP research, continues to develop a body of knowledge on the relationships between transportation investments and economic vitality. There is little understanding on how to communicate these relationships to decision-makers and the general public. Moreover, there is little understanding of what linkages

decision-makers and the general public perceive between transportation investments and economic performance.

The objective of this project is to use market research to develop a guide to assist state DOTs and other transportation agencies in more effectively and proactively communicating—to decision-makers and the public—transportation's importance and contributions to the economy.

Status: The estimated completion date for this project is December 31, 1998. The research team has completed Phase I work and submitted an interim report for panel review. Phase II is proceeding with focus group sessions in four locations around the nation. The research team completed a technical memorandum for the AASHTO member departments regarding the results of the initial public survey of nearly 1,500 people on general and detailed perceptions of the importance of transportation to economic vitality.

Report Availability: The technical memorandum on the results of the national public survey is available from the NCHRP.

Project 7-12, FY '94
Microcomputer Evaluation of Highway User Benefits

Research Agency:	Texas A&M Research Foundation
Principal Invest:	William F. McFarland
Funds:	$200,000
NCHRP Staff:	Kenneth S. Opiela

Benefit-cost analysis can be used over a broad spectrum of projects and at different levels of detail to provide insights into the relative merits of projects or their features. The 1997 AASHTO Manual for Cost-Benefit Analysis prescribed basic procedures for such analysis, but these procedures typically get data intense and tedious for large-scale projects. Thus, the need for improved tools for cost benefit analysis was determined necessary for highway projects ranging from individual intersection improvements and Transportation Systems Management (TSM) projects to major road upgradings and construction of new roads. Further, comprehensive life-cycle cost evaluation techniques need to be incorporated to ensure robust analysis. **The objective of this project was to develop a comprehensive, user-friendly, portable microcomputer program capable of using new and updatable support data and the best practical procedures for conducting comprehensive highway user benefit-cost analysis.**

The focus of the research effort was directed to analyses at the project level and its immediate area impacts. The project efforts included (1) review of procedures used in highway user benefit-cost and related noise and air pollution emission analyses to identify data required for the determination of vehicle operating costs, accident reduction benefits, travel-time values, and other appropriate factors, (2) limited updating of basic data, (3) development of microcomputer software to facilitate the analysis procedures, and (4) preparation of a users' manual and software documentation. The MicroBENCOST software, which resulted from this project, is capable of performing life-cycle cost analysis for a variety of project types and scopes, using both default values and user-provided data inputs.

Status: This project has been completed.

Report Availability: The MicroBENCOST software is being distributed by the McTrans Software Support Center at the University of Florida. The software will be enhanced under NCHRP Project 7-12(2).

Project 7-12(2), FY '94
Metrication and Enhancement of MicroBENCOST Software Package

Research Agency:	Texas Transportation Institute
Principal Invest:	Jeffery Memmott and Frank McFarland
Funds:	$170,000
NCHRP Staff:	Kenneth S. Opiela

There has been widespread interest in tools to conduct benefit-cost analysis and economic assessments of alternative highway improvements since ISTEA. The 1977 AASHTO Manual on User Benefit Analysis of Highway and Bus-Transit Improvements and *NCHRP Report 133*, "Procedures for Estimating Highway User Costs, Air Pollution, and Noise Effects" presented basic procedures for these analyses and assessments. NCHRP Project 7-12, *Microcomputer Evaluation of Highway User Benefits*, was initiated to computerize these procedures to facilitate their use and allow their application in a more rigorous fashion. NCHRP Project 7-12 led to the development of the MicroBENCOST software and supporting documentation. This software provides the capability to analyze the user costs for eleven types of highway projects considering different economic analysis parameters, traffic growth factors, traffic volumes and mix, impact estimates, and vehicle operating costs. The software package allows convenient user specification of values for each analysis from default tables and permits users to modify the default tables. Reviews of MicroBENCOST indicated that the software is viable and can function effectively to facilitate the computational aspects of user cost analysis for a variety of situations. The reviews have indicated that there are opportunities to enhance this tool to improve its operations, add capabilities, upgrade the procedural algorithms, and expand the default data. It has also been suggested that this software be converted to metric to be consistent with changes to other AASHTO and federal documents.

The objectives of this project are to (1) develop a metric version of the model and (2) refine and extend the capabilities of the MicroBENCOST software to update the fundamental relationships and data embodied in the model.

Status: This project is nearing completion. An enhanced, metric version of MicroBENCOST has been developed and is currently being reviewed by the project panel. The software documentation and user's manual was also revised to reflect the changes. Efforts are expected to continue to implement other improvements and to validate the program to ensure that all calculations are performed correctly, data are adequately checked, and results compare favorably with those generated by other means. The contractor will update the final report from NCHRP Project 7-12 as appropriate and prepare a brief, applications-oriented primer on using MicroBENCOST for benefit-cost analysis and economic evaluation of highway user benefits.

Report Availability: No reports are currently available.

Project 20-5, Topic 30-5, FY `67 and continuing
Assessing Economic Development Benefits from Major Transportation Investments

Research Agency:	In Developmental Stage
Principal Invest:	
Funds:	$20,000
NCHRP Staff:	Donna Vlasak

States, MPOs and local governments measure the development impacts of transportation investments differently. Many unique approaches are used to estimate impacts and many complementary public actions are taken to maximize the economic development potential of transportation projects. Often transportation investments cannot be justified solely on the basis of user benefits. Therefore, societal or "external" benefits such as economic development and economic sustainability must be estimated in order to properly inform transportation investment decisions.

A synthesis of existing practice is needed to better understand economic development impacts, the techniques used to measure them, and how transportation complements other actions to stimulate economic development. The synthesis will focus on the metropolitan process and should consider the impact of rural transit links. Also, this synthesis could help in evaluating the potential of transportation investments in "brownfields" areas. Based on this information, analysts will be in a better position to choose those measures and techniques that are most appropriate for their situation.

FHWA's Office of Policy is attempting to advance the state of the art in estimation of economic development impacts through research in "the establishment levels of productivity impacts of transportation." TRB has recently issued a guidebook on estimating techniques for "economic impacts" (TRB Circular No. 477) which discusses overall economic benefit analysis techniques, including economic development impacts. This synthesis will complement these efforts by providing good practical examples of the application of available techniques.

Project 20-29, FY '92
Development of a Multimodal Framework for Freight Transportation Investment: Consideration of Rail and Highway Trade-offs

Research Agency:	Texas Transportation Institute
Principal Invest:	Stephen Roop
Funds:	$150,000
NCHRP Staff:	Kenneth S. Opiela

Transportation systems and policy in the United States have developed along modal lines with different patterns of ownership. For example, public agencies plan, build, operate, and maintain the highway infrastructure, and private firms plan, build, operate, and maintain rail lines. While there have been some variations on this pattern with the construction of private toll roads and the investment of public funds in rail planning and rehabilitation, public planning and investment decisions are usually made independently by mode. The negative effects of this dichotomy have become apparent, for example, when rail lines are abandoned. With few exceptions, federal and state highway trust funds are invested strictly in roads not rail. Similarly, rail funds under the Local Rail Freight Assistance (LRFA) Act and similar state programs may be used for substitute service, but they are rarely, if ever, invested in highways. Modally oriented planning and investment have been shown to be economically inefficient and generate fewer social benefits than might be achieved under a multimodal approach. For example, research has indicated that the abandonment of rail lines, with the diversion of traffic from rail to truck, can significantly increase highway infrastructure costs. Thus, the investment of public funds in rail branch lines can not only generate shipper benefits, but also reduce future highway and bridge costs.

The objectives of this research are to develop a framework for efficient and effective multimodal investment practices, demonstrate the viability and applicability of the framework, identify obstacles to implementation at the state and local levels, and develop strategies for successfully implementing improved practices. The research will evaluate varied examples of transportation investment trade-offs, focusing on rail-highway trade-offs in state rail program activities.

The research involved (1) identification of sound multimodal transportation investment practices, both domestic and foreign, which have relevance in the United States, (2) identification of areas of suboptimization and inefficiency in multimodal transportation investment practices from regional, state, local, and/or national perspectives, (3) definition of an efficient and effective framework for transportation investment and the factors appropriate for inclusion in the framework (e.g., pavement damage, transportation costs, direct and indirect economic impacts, energy use, productivity, air quality, and safety impacts), (4) case study analysis to demonstrate the

application of the framework, and (5) formulation of a plan to implement the framework within a state agency to improve multimodal investment decision-making. The effort focused on the highway and railroad impacts in rail line abandonment cases to demonstrate the applicability of the analysis framework.

Status: This project has been completed. The final report has been approved and a continuation contract, initiated to prepare software for the application of the analysis framework, is underway in NCHRP Project 20-29(2). A final report covering both projects will be prepared at the completion of the continuation project.

Report Availability: The contractor's final report is available from the NCHRP.

Project 20-29(2), FY '94
Development of a Computer Model for Multimodal, Multicriteria Transportation Investment Analysis

Research Agency:	Texas Transportation Institute
Principal Invest:	Stephen Roop
Funds:	$200,000
NCHRP Staff:	Kenneth S. Opiela

Transportation policy and systems in the United States have developed along modal lines with different patterns of ownership. For example, public agencies plan and maintain the highway infrastructure and private firms build, operate, and maintain rail lines. While there have been some variations on this pattern with the construction of private toll roads and the investment of public funds in rail planning and rehabilitation, public planning and investment decisions are usually made independently by mode. Modally oriented planning and investment have been shown to be economically inefficient and generate fewer social benefits than might be achieved under a multimodal approach. For example, research has indicated that abandoning rail lines with the subsequent diversion of traffic from rail to truck, can significantly increase highway infrastructure maintenance costs. Thus, the investment of public funds in rail branch lines not only generates shipper benefits but also reduces future highway and bridge costs. There is widespread interest in tools to conduct benefit-cost analysis and economic assessments of alternative transportation improvements since ISTEA. NCHRP Project 20-29, *Development of a Multimodal Framework for Freight Transportation Investment: Consideration of Rail and Highway Trade-offs*, completed research that (1) synthesized good economic principles and practices into a framework for multimodal transportation investment, (2) evaluated various examples of transportation investment trade-offs (focusing on rail-highway trade-offs), and (3) developed a framework for better decision making for transportation investments.

The objectives of this project are to (1) expand and adapt the framework developed in NCHRP Project 20-29 for multimodal, multicriteria transportation investment analysis for both freight and passenger transportation, (2) develop a generic software package to facilitate such analysis, and (3) prepare user-oriented materials to facilitate the use of the methodology.

Status: The research is nearing completion. After reviews of new procedures and data applicable to analyzing multimodal transportation investments, a revised version of the software (TRANSDEC) was developed. Validation and verification tests were conducted to ensure that the software performs calculations correctly, default data are adequate, and the results compare favorably with those generated by other means. A user's manual that includes a brief, applications-oriented primer on multimodal, multicriteria transportation investment analysis was drafted. A final report that documents this research effort and includes the user's manual and documentation for the software was also prepared. A case study analysis to demonstrate the software in a DOT is currently underway. After completion of the case study, a revised final report will be submitted.

Report Availability: The agency's draft final report and TRANSDEC software are available from the NCHRP.

TRANSIT COOPERATIVE RESEARCH PROGRAM

Project H-02, FY '92
Measuring and Valuing Transit Benefits and Disbenefits

Research Agency:	Cambridge Systematics, Inc.
Principal Invest:	Arlee Reno
Funds:	$300,000
TCRP Staff:	Dianne S. Schwager

It is generally accepted that public transit produces many benefits and disbenefits that are difficult to measure and value. These are often referred to as intangible, indirect, or external benefits and disbenefits (hereafter simply referred to as benefits and disbenefits). Benefits and disbenefits occur in areas such as social and economic development, employment, air quality, transportation system operations, mobility, urban form, and land use. Transit planning and research studies employ various measures and values to describe these benefits and disbenefits in both quantitative and qualitative terms. TCRP Project H-2 developed a compilation and comparison of the transit benefits and disbenefits found in previous studies and currently used in practice. The results of this research are intended for use by transportation professionals and policy makers responsible for transit-investment decisions.

The objectives of this research project were to (1) compile, define, and compare currently used categories of benefit and disbenefit; (2) compile and evaluate currently used measures and values; (3) develop improved or new benefit and disbenefit definitions, measures, and values; (4) identify innovative concepts from other business sectors that can be applied to the

measurement and valuation of transit benefits and disbenefits; (5) facilitate the application of current, improved, or new benefit and disbenefit definitions, measures, and values; and (6) improve current analysis techniques of measuring transit's long-range, region-wide economic impacts.

Status: The project has been completed.

Report Availability: Two reports were prepared by the research team: the popular summary and the final report. *TCRP Report 20,* "Measuring and Valuing Transit Benefits and Disbenefits—Summary," presents the popular summary. The final report is available for loan.

Project H-07, FY '95
Funding Strategies for Public Transportation

Research Agency:	Price Waterhouse LLP
Principal Invest:	Hensley Evans and Daniel Roth
Funds:	$199,836
TCRP Staff:	Dianne S. Schwager

TCRP Project H-07, *Funding Strategies for Public Transportation,* was initiated to examine and summarize trends in public transportation revenue, expenditures, and funding. **The objectives of this project were to (1) define and assess the current state of funding, in particular operating funding, for public transportation in the United States; (2) examine the performance of public transportation systems in the United States in light of expanding goals, expressed through recent federal mandates (e.g., the Americans with Disabilities Act of 1990, the Clean Air Act Amendments of 1990, Buy America requirements, and welfare to work legislation) coupled with declining federal assistance for transit operations; and (3) identify strategies transit agencies have been pursuing that address the need to identify new sources of funding for operating and capital expenses.**

The results of TCRP Project H-07 have been published as *TCRP Report 31*, "Funding Strategies for Public Transportation." This report addresses the current state of funding for public transportation in the United States, the various circumstances that have contributed to today's funding environment, and specific strategies that transit agencies are pursuing to identify new sources of funding. *TCRP Report 31* indicates that, between 1989 and 1994, total operating and capital funding levels for public transportation kept pace with inflation and overall service levels increased. This occurred despite a virtual freeze in federal operating assistance at about $800 million during a period with 18.8 percent inflation. Many transit agencies in the United States found alternatives to federal operating funding and have reduced costs. Agencies turned largely to the farebox and to dedicated funding sources at the state, local, and jurisdictional levels. Transit agencies that increased service levels during the past decade generally expanded mandated or newer services (e.g., demand response and light rail) at the expense of more traditional modes (e.g., commuter rail, heavy rail, and bus). The casebook presents 17 case studies of financing techniques used successfully by U.S. transit systems to improve their financial conditions. The cases, which address both capital and operating needs, are presented in two main categories: funds generated through external funding sources and transit-agency-generated funds.

Status: This project has been completed.

Report Availability: *TCRP Report 31,* a two-volume report, is now available. Volume 1, the project's final report, provides a national perspective on public transportation funding while Volume 2, a casebook, presents case-level information on innovative methods for generating revenue for public transportation capital and operating costs.

Project H-09, FY '95
Economic Impact Analysis of Transit Investments

Research Agency:	Cambridge Systematics, Inc.
Principal Invest:	Christopher Wornum
Funds:	$200,000
TCRP Staff:	Stephen J. Andrle

The product of this study is a description of 12 methods traditionally used to analyze three categories of economic impacts:

Generative Impacts produce net economic growth and benefits in a region such as travel time savings, increased employment and income, improved environmental quality, and increased job accessibility. This is the only type of impact that results in a net economic gain to society at large.

Redistributive Impacts account for locational shifts in economic activity within a region such that land development, employment, and, therefore, income occur in a transit corridor or around a transit stop, rather than being dispersed throughout a region.

Transfer Impacts involve the conveyance or transfer of moneys from one entity to another such as the employment stimulated by the construction and operation of a transit system financed through public funds, joint development income, and property tax income from development redistributed to a transit corridor.

The objectives of the research were to develop improved methods to comprehensively define and evaluate the economic impacts of transit investments and to recommend guidelines for using the methods. The report describes 12 evaluation methods, and for each method describes when it should be used, the impacts that it measures, advantages and disadvantages, data sources, an example, complementary methods, and a score card on

performance. Although the methods are described separately, the report clearly states that they are typically used in combination. The report suggests criteria for evaluating and presenting the results of an economic impact analysis, offering practical suggestions to assist analysts in improving the clarity and usefulness of the findings.

Two nontraditional methods are also presented, the economic impacts associated with reduced parking requirements (resulting from higher transit usage) and transit-induced accessibility and agglomeration of development.

Status: This project has been completed.

Report Availability: The findings of the study are reported in *TCRP Report 35*, "Economic Impact Analysis of Transit Investments: Guidebook for Practitioners."

Project H-10, FY '95
The Costs of Sprawl—Revisited

Research Agency:	Rutgers University Center for Urban Policy Research
Principal Invest:	Robert W. Burchell
Funds:	$300,000
TCRP Staff:	Dianne S. Schwager

Over the past 50 years, the spatial pattern of urban development in the United States has featured two distinct trends. On the one hand, employment and population growths have heavily favored medium and large metropolitan regions over nonmetropolitan areas but, within metropolitan regions, most have occurred in low-density development at the fringe of urbanized areas. The thinning out of core areas and the extension of the fringe via low-density development have been pervasive.

The Costs of Sprawl was a pioneering research project, conducted by Real Estate Research Corporation (RERC) in 1974. This often-cited study was one of the first to address costs associated with spread-out, lower-density, urban development in comparison to more concentrated development patterns. After more than two decades of continued suburbanization in the United States, the concerns of the RERC study are still current, but the findings are outdated. In addition, the study context needs to be broadened because the RERC study was largely confined to the costs of infrastructure at differing density levels. While RERC acknowledged some environmental and social costs of sprawl, it did not address these matters in depth, nor did it consider the benefits of sprawl that accrue to individuals and communities.

The objective of this project is to produce current and useful information with supporting facts, theory, and analysis on the positive and negative impacts of sprawl on the U.S. economy, environment, and society, with an emphasis on transportation. The results of this project should benefit three audiences: the transportation communities, public officials and decision-makers, and the general public. As a TCRP project, it is important that the role of public transportation policy, programs, and pricing systems be covered.

Status: The estimated completion date for this project is December 31, 1998. Phase II of this project will proceed when a revised workplan is received and accepted by the TCRP panel.

Report Availability: The interim report for this project has been published as *TCRP Report 39*, "The Costs of Sprawl—Revisited."

Project H-11, FY '95
Assessment of the Economic Impacts of Rural Public Transportation

Research Agency:	Ecosometrics, Inc.
Principal Invest:	Jon Burkhardt
Funds:	$250,000
TCRP Staff:	Stephen J. Andrle

This study was conducted because public transportation is an important element of rural infrastructure, but the economic role it plays has not been quantified and is seldom recognized by people outside of the rural transportation community. The social benefits of rural public transportation have long been recognized. Public transit provides access to essential services such as health care, shopping, and community services. However, rural public transportation also provides links between businesses and a widely dispersed rural labor force; retail centers and customers; and health services and patients. In terms of economic theory, transportation supports economies of scale in production, which in turn permits efficiencies for transportation providers such as better use of personnel and equipment.

The objectives of this research were to (1) document linkages between public transportation and economic activities in rural areas; (2) develop recommendations for improved linkages; (3) estimate the national economic impacts of rural public transportation; (4) develop practical methodologies for estimating the economic impacts of rural public transportation at national, regional, and local levels; and (5) develop a primer on the economic impacts of rural public transportation for use by economic development agencies, employers, planners, rural public transit agencies, and policy makers.

The products of this study are a methodology for estimating the benefits of rural transit systems, an aggregate estimate of the nationwide benefit, case studies demonstrating the analytical techniques for estimating benefits, and guidance for maximizing benefits. The case studies show benefit-cost ratios ranging from 4.2 to 1 to 1.7 to 1, with an average of 3.1 to 1. The aggregate analysis yielded a similar benefit-cost estimate of 3.4 to 1. Rural transit systems that provide significant employment travel, contribute to independent living, and provide access to

critical medical services scored highly in the analysis.

Status: This project has been completed.

Report Availability: The study findings are available in *TCRP Report 34*, "Assessment of the Economic Impacts of Rural Public Transportation."

Project H-19, FY '98
Guidebook to Estimate and Present Benefits and Disbenefits of Public Transit

Research Agency: In Developmental Stage
Principal Invest:
Funds: $200,000
TCRP Staff: Dianne S. Schwager

Theoretical and practical research has been conducted by many organizations on the benefits and disbenefits of existing transit services and proposed improvements. Many communities have spent millions of dollars analyzing transportation alternatives to assess their near- and long-term economic, social, and environmental effects. Interest in such analyses was heightened by the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), which required consistent comparisons among transportation options. Such analyses and comparisons are expected to have continued importance in future transportation programs.

The objective of this research is to develop a practical guidebook for use in estimating and presenting transit benefits and disbenefits to decision-makers and the public. The guidebook procedures will be used to estimate and present the economic, social, and environmental effects of existing transit services and proposed improvements.

Status: The agency selection has been completed and contract negotiations have begun.

Report Availability: No reports are currently available.

NOTE: To obtain further information on any of the above-mentioned projects, please call (202) 334-3225 and ask for the NCHRP or TCRP staff member listed.

These **Digests** are issued in order to increase awareness of research results emanating from projects in the CRP. Persons wanting to pursue the project subject matter in greater depth should contact the Cooperative Research Programs Staff, Transportation Research Board, 2101 Constitution Ave., NW, Washington, DC 20418.

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