

Benefit Cost Analysis

A benefit cost analysis involves the calculation of the stream of benefits and costs over the lifetime of the project. In addition to the benefit-cost analysis, non-monetary but quantifiable considerations, and non-quantifiable considerations should be evaluated to determine if a project is economically justified.

The Methodology used for the benefit-cost analysis for this project is based on the procedures outlined in AASHTO's *A Manual on User Benefit Analysis of Highway and Bus-Transit Improvements*, 1977; Office of Management and Budget (OMB) Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of federal Programs; and, National Cooperative Highway Research Program (NCHRP) Project 7-12, MicroBENCOST Software and User's Manual.

Although all input data affects the results of the analysis, the traffic data is probably the most critical. The projected traffic volumes for each year of the analysis period were generated using the 2000 traffic counts obtained from SCDOT and the 2018 projected traffic volumes for the study area network. On existing roadways, the average annual growth rate used in the analysis ranged from 2.5 to 3.0 percent per year. For the proposed routes, a larger growth rate was assumed for the first few years.

MicroBENCOST software contains fifty-one tables with default values that establish the pertinent economic analysis data (i.e. geometric data, fuel costs, value of time, depreciation, etc.). The default dollar values in the tables are used on 1990 costs information. In order to update these costs to 2000 dollars, each value was multiplied by the ratio of the Consumer Price Index for 2000 (172.2) to the Consumer Price Index for 1990 (130.7).

Economic Benefits

In FHWA funded benefit-cost analyses, the most important benefits are the monetary equivalent value of time savings to transportation users and the monetary equivalent value of the reduction in accidents, injuries, and fatalities that would result from the use of a new facility. Another important benefit to consider is the reduction in the vehicle operating costs.

Vehicle Operating Cost

If the proposed project is constructed, there should be savings in the cost of operating a vehicle traveling not only to and from the Airport, but also anywhere within the vicinity of the proposed alignment. These savings would come from reduced consumption of motor fuels and oil, as well as reduced wear and tear on the vehicle itself. Along the Phase II of the John Hardee Expressway, it is clear that these savings would be realized when comparing a higher, constant speed route to the stop-and-go conditions along S.C. Route 302 (Airport Road).

For this benefit cost analysis, the vehicle operating costs (VOC's) were computed using MicroBENCOST. This requires a comparison of traffic assignments with and without the John Hardee Phase II project. The VOC's are calculated by multiplying the projected traffic volumes by speed related unit operating costs. The savings in VOC's are then calculated by subtracting the VOC's with the project from the VOC's without the project.

Travel Time Savings

The FHWA's Procedural Guidelines for Highway Feasibility Studies emphasizes the importance of the benefit of time-savings to transportation users. This benefit is computed by determining how much time motorists might save as a result of constructing Phase II of the John Hardee Expressway. For this study, the value of time corresponding to each class of automobile vehicle (small passenger, medium/large passenger, pickup/van, and bus) and truck vehicle (2-axle/3-axle single unit truck and various types of semi-tractor trailer trucks) is considered. As mentioned above, the vehicle values of time were inflated from 1990 values to 2000 values using the Consumer Price Index.

Accident Savings

In order to consider the safety benefits to society resulting from the construction of the Intermodal Connector, costs must be assigned to the various types of accidents that may occur on the existing routes and the proposed routes. Three types of accident costs are used by MicroBENCOST to determine the monetary value of accidents, injuries, and fatalities. These include costs per incident for fatal, injury, and property damage only accidents. For this benefit-cost analysis, the values in Table 7-1 were used. These values are based on the latest historical information for accidents in South Carolina.

Accident Cost in South Carolina

<u>Accident Type</u>	<u>Cost per Incident</u>
Fatality	\$980,000
Injury	\$44,000
Property Damage Only	\$6,400

Cost for the Project

The costs for the proposed project consist of three main components

- 1) Project Investment Costs;
- 2) Maintenance, Operations, and Administrative Costs; and
- 3) Salvage Value Considerations

These costs have been estimated and included in the economic feasibility analysis in order to provide the basis from which to compare resulting benefits of the project.

Project Investment Cost

After completing the conceptual design, the initial project investment costs were estimated for Phase II of the John Hardee Expressway. These costs include planning, engineering, grading, drainage, paving, pavement markings, signage, bridges and other structures, as well as a 20% contingency for the construction items. In addition, costs were estimated for right-of-way acquisition, utility relocations, and relocation of residential and commercial buildings.

Estimated Project Investment Costs

Estimated costs shown are in 2000 dollars

Phase II	\$43,256,100.00
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Maintenance, Operations, and Administrative Costs

The yearly costs for maintenance, operation, and administrative expenses for the proposed projects have been included in the costs for the analysis to recognize the expense required to operate the facility in a safe and serviceable condition. The values used in MicroBENCOST were based on values given in Highway Statistics 1989 and updated to 2000 costs. The costs range between \$7,300 and \$18,600 per lane-mile, depending on the functional class of the roadway.

Salvage Value Considerations

Since the life of the proposed roadway facility is much longer than the analysis period used in the benefit-cost analysis, the value of the roadway at the end of the analysis should be considered. This residual value at the end of the analysis period should be estimated and the present worth of this value should be included as an offset to the present worth of the project cost.

Economic Feasibility Analysis

As mentioned above, the estimated engineering, right-of-way, and construction costs for this project were computed at the time into 2000 dollars. In addition, the traffic counts obtained from SCDOT for the existing roads in the study area were taken in 2000. Therefore, the base year used for the economic analysis is 2000. The analysis period used is 20 years from the completion of construction.

In any economic analysis, future costs and benefits must be discounted. Discounting refers to the translation of specified amounts of costs and benefits occurring in different time periods into a single amount at a single time period (usually the present.) In accordance with the recommendations in OMB Circular No. A-94, a 7 percent discount rate was used for the base model benefit-cost calculations.

Using MicroBENCOST, three indicators of economic feasibility have been computed:

1. **Net Present Value** – The costs and benefits in future years are discounted back to the base year using the analysis discount rate. The future stream of discounted costs is subtracted from the future stream of discounted benefits. If this difference is a positive number, the proposed project is deemed to be economically feasible.
2. **Discounted Benefit / Cost (B/C) Ratio** – This ratio is computed by dividing the sum of the discounted benefits by the sum of the discounted costs. If the ratio is greater than or equal to 1.0, the proposed project is economically feasible.

For this study, two values of B/C are given:

Gross B/C Ratio: For this ratio, the benefits include the savings in user costs between the existing and the improved alternatives. The Costs represent project investment costs minus the salvage values plus the increase in maintenance and operation costs.

Netted B/C Ratio: The benefits used in computing this ratio represent the savings in user costs between the existing and the improved alternatives plus the salvage value minus the increase in the maintenance and operation costs. The costs represent the project investment costs only.

3. **Internal Rate of Return** – This number represents the discount rate at which the net present value difference between the costs and the benefits is zero. If the rate of return is equal to or greater than the adopted discount rate then the highway improvement is economically feasible.

The benefit-cost analysis for this project is based on the following

1. Without the proposed project, the traffic would utilize the existing S.C Route 302 (Airport Boulevard) interchange on I-26 and would proceed west along S.C. Route 302 (Airport Road) to the intersection of the completed John Hardee Expressway Phase I project; and,
2. With the proposed project, traffic would utilize the new I-26 interchange and would proceed northwest on the new 4 lane divided roadway to the intersection with S.C. Route 302 (Airport Boulevard) and the completed John Hardee Expressway Phase I project

Using the assumptions listed previous the following information summarizes the results of the benefit – cost analysis for Phase II of the John Hardee Expressway.

Summary of Benefits, Costs, and Economic Measures

Total Discounted User Benefits (Million)	\$185.655
Discounted Construction Cost (Million)	\$43.256
Discounted Salvage Value (Million)	\$9.637
Discounted Increase in Maintenance and Rehabilitation (Million)	\$0.151
Fuel Consumption Savings (Million Gallons)	31.119
Fuel Savings, Adjusted for Induced Traffic (Million Gallons)	55.647
Carbon Monoxide Emission Reduction (Million Kilograms)	6.567
Carbon Monoxide Reduction, Adjusted for Induced Traffic (Million Kilograms)	10.358
Net Present Value (Million)	\$151.885
Gross Benefit-Cost Ratio	5.498
Netted Benefit-Cost Ratio	4.511
Internal Rate of Return	30.678%

Sensitivity Tests

In order to verify the reasonableness of the economic analysis and determined how the final results would be affected by variations in the assumptions made to perform the analysis, various sensitivity tests have been performed. The results of these sensitivity test models are compared to the results obtained using the base model conditions that have been described in this section. Three major variables in the model were modified to see the affect on the benefit-cost analysis:

1. The assumed discount rate;
2. The estimated Project Investment Costs; and,
3. The projected growth in traffic

Discount Rate

A seven percent discount rate was assumed for the base condition in all of the benefit-cost analyses summarized above. In accordance with the FHWA's *Procedural Guidelines for Highway Feasibility Studies*, the benefit-cost models have been revised to reflect a five percent discount rate. The results are compared with the base condition results below.

Sensitivity Test Results Comparison of Different Discount Rates Phase II John Hardee Expressway

	Gross B/C	Netted B/C
Base Condition	5.498	4.511
5% Discount Rate	8.534	6.221

Project Investment Costs

In order to determine the benefit-cost ratios that would result in the initial project investment costs were different from the estimates, the base condition analyses have been modified to reflect a 20% and a 50% cost overrun. The economic measures resulting from these projected cost overruns are summarized below.

Sensitivity Test Results Comparison of Initial Project Investment Costs

Phase II John Hardee Expressway

	Gross B/C	Netted B/C
Base Condition	5.498	4.511
20% Cost Overrun	4.585	3.797
50% Cost Overrun	3.671	3.082

Projected Growth

Since the amounts of the projected traffic traveling on the proposed alternatives and the existing routes greatly affects the results of the economic analysis, a sensitivity test was performed to determine the affect of varying traffic volumes in the analysis period. Three different cases were modeled to determine the benefit-cost ratios resulting from changes in the projected traffic: 75%, 90% and 120% of the base condition traffic. The information below provides a comparison of the economic analysis results for these three cases.

Sensitivity Test Results
Comparison of Projected Traffic Growth
Phase II John Hardee Expressway

	Gross B/C	Netted B/C
Base Condition	5.498	4.511
75% Traffic Projection	3.120	2.655
90% Traffic Projection	4.529	3.755
120% Traffic Projection	7.014	5.695

Non-Monetary but Quantifiable Considerations

Other considerations that are benefits of Phase II of the John Hardee Expressway, but can not be translated into monetary, dollar equivalent terms, include:

- The proposed roadway facility would improve access to Midlands Technical College, the Pine Grove Sports Complex, and the newly proposed Lexington County Soccer Complex;
- Providing a more direct access to the Airport from I-26 will assist the Airport in attracting new carriers and other related business; and
- Construction of this project would benefit some of the region's largest employers by providing better access to their businesses for clients and employees;

Non-Quantifiable Considerations

Non-quantifiable considerations are those impacts that can not be stated in dollars or quantified in other understandable measures but are still important to the economic justification of the proposed transportation facility. For the Intermodal Connector, the construction of the proposed roadways would help the local economy by providing employment opportunities and an increase in the construction supply industries.

