

Hands-On Instruction

Hands-on instruction is a more dynamic forum for training than courses that do not require technological interaction. The participant must be able to grasp the material quickly and retain it because learning microcomputer capabilities and applications is an incremental process. It is rather easy for students to fall behind, so a primary emphasis must be placed on organized instruction and effective learning aids. A detailed course workbook should be prepared, including "cheat sheets" on how to operate the system, load software, file programs, and print hard copies. The applications should also be documented in the workbook along with copies of typical screens if the program is being run successfully. Instructors should also make reference to the workbook, whenever possible, to effectively coordinate their presentation with the written instructional material.

The course structure has been modified to reflect the lessons learned from the pilot course. Additional offerings were subsequently held at Texas Southern University and at Indiana University. Reactions to these courses were extremely positive, and attendance continued to meet enrollment capacity. As a result, additional offerings of the course have been scheduled to serve transit training needs in this area.

CONCLUSION

The introduction of microcomputer technology to the transit environment has been a slow and gradual pro-

cess. The majority of transit professionals has been reluctant to procure microcomputer systems without first obtaining sound, objective advice on functional requirements, system capabilities, alternative hardware and software options, and present uses of the microcomputer in the transit industry. Training is an important element in providing this information and also serves as an avenue for exposing participants to the wide range of uses and benefits of microcomputer technology, particularly if hands-on opportunities are provided.

The course described in this paper provides a good, fundamental exposure to the uninitiated and many additional insights to those with limited previous experience. It is seen as the basic unit of microcomputer training for transit managers from which other more specialized courses can be developed based on market needs.

ACKNOWLEDGMENTS

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Interactive Decision Process for Public-Private Cooperative Projects

G. ROBERT ADAMS, TERRY L. GOTTS, and JON M. WESA

ABSTRACT

Both the public and the private sector can often benefit from the cooperative financing of essential transportation services that neither would undertake alone. In Michigan the question often revolves around jobs--jobs that would be lost if a rail subsidy were discontinued, or jobs that would not be created if a service road to a plant expansion could not be built. Opportunities for cooperative involvement between the public and private sectors have often had to be considered with less information available than decision makers might desire. The calculations of benefits and costs have been so lengthy and time consuming that only a narrow range of alternatives could be considered if the relevant information was to be

timely. The model described permits timely and understandable evaluations of the personal income and tax impacts resulting from employment changes that are outcomes of transportation improvement projects. The model has been designed to be simpler to operate than a multifunction hand calculator. The intent is to allow a decision maker, who knows or cares little about a computer, the opportunity to test a variety of "what if?" questions very rapidly, calculating the balance between public costs and benefits and generating reports and business graphics at will.

Transportation departments in many states face an imminent drop in real revenues. The overall decline

in travel, coupled with a general trend toward lighter, more fuel-efficient vehicles, gives ample warning that the widespread tax restructurings of the last few years serve more as survival packages than as cure-alls. For example, the Michigan Department of Transportation (MDOT) estimates that the tax package passed in December 1982 will only postpone (from FY 1985 to FY 1990) the date at which revenues from the State Trunkline Fund will fall short of the department's fixed costs for debt service, routine maintenance, and administration.

Private industries have not been immune to hard times. Industries with critical transportation requirements have been doubly hurt both by the impact of the recent economic recession and by the inability of state departments of transportation to fund former levels of system upkeep and carrier subsidies. Some service abandonments have resulted.

In such an economic climate, both the public and the private sector can often benefit from the cooperative financing of essential transportation services that neither would undertake alone. In Michigan, the question often revolves around jobs--jobs that would be lost if a rail subsidy were discontinued or jobs that would not be created if a service road to a plant expansion could not be built.

Opportunities for cooperative involvement between the public and private sectors have often had to be considered with less information than decision makers might desire. The calculations of benefits and costs have been so lengthy and time consuming that only a narrow range of alternatives could be considered if the relevant information was to be timely.

Clearly, some uniform mechanism was needed for providing the MDOT management and the Michigan Transportation Commission with accurate and timely information about a variety of requests for funds. The method should also allow for the rapid evaluation of a wide range of state funding alternatives and for an analysis of the sensitivity of results to the underlying employment impact estimates and assumptions reflected in model parameters. That rather complex challenge, posed by Commissioner Rodger D. Young, led to the formulation of the model presented in this paper.

The model has been designed to be simpler to operate than a multifunction hand calculator. The intent is to allow a decision maker who knows or cares little about a computer the opportunity to test a variety of "what if?" questions very rapidly, calculating the balance between public costs and benefits and generating reports and business graphics at will.

ECONOMIC FOUNDATIONS

The measures and evaluations used in the model are presented in terms of a benefit-cost analysis. The objective of a benefit-cost analysis is to determine whether a specific project or reallocation of resources will result in an increase in the value of goods and services produced in the economy. Where transportation projects are to be implemented in conjunction with the construction of a new plant or major economic development, only the costs and benefits attributable to the transportation improvement are considered.

The benefit and cost measures used in this model were developed with specific policy concerns in mind. The economic climate in Michigan, and its degree of dependence on the automobile industry, focused policy interest on economic development and employment issues. Accordingly, benefits are measured and reported in terms of the value of inputs to production, of which employment and wage impacts are a significant part.

The economic climate in Michigan has resulted in declining revenues and increased demands on the state's fiscal resources. To address the policy interest in the state budget impact of a project, the wage component of benefits is reported in terms of both taxes and net income. The state single business tax on business activity is also estimated.

Benefits

The model is based on the premise that public investment in a partnership should yield direct, tangible benefits to the public sector. The change in value added to output in the economy is taken as a measure of total benefits, where value added is defined as the sum of wages, interest, rent, and profits. To reflect the tax impact of employment changes, the wage component of value added is measured as the sum of net personal income, state and federal taxes on personal income, and state taxes on sales. For the nonwage components of value added, only the state tax on business activity is estimated. The estimation of total value added to include all nonwage components is considered an essential extension of the model.

Wage impact calculations are based on estimates of direct employment changes. Employment changes are the principal input to the program and specify the number of jobs directly affected along with corresponding average wage levels by industry. Annual gross income per employee is based on a 2,080-hour full-time work year. The current federal and state income tax tables are maintained as parameters in the program for the calculation of income tax impacts. At present, the model calculations are based on the assumption of a family of four and use the standard deduction to calculate federal income tax estimates. The model does not address the complications introduced by the consideration of two-income families. State sales taxes are calculated using the table values for federal sales tax deductions for Michigan, which are also based on individual income.

The calculation of benefits also includes estimates of secondary impacts. For example, if the project is expected to increase the number of jobs in an automobile manufacturing plant (primary employment), a portion of the additional income will be spent locally on goods and services. These additional expenditures have a secondary job-creating effect. When jobs are lost, the same type of chain reaction occurs in reverse.

Secondary employment impacts are based on total primary income (net of taxes). Net primary personal income is aggregated over individuals to determine total net primary income. An expenditure multiplier is then applied to determine the total secondary income impact. The number of secondary jobs is determined by dividing individual secondary income into total secondary income. Individual secondary income is equivalent to full-time employment at the average secondary wage, which is taken to be the average wage in service industries adjusted for geographic differentials. The tax calculations for secondary impacts are based on individual secondary income in the manner described.

A particularly interesting feature of the model is the treatment of job preservation benefits. Job preservation benefits result when the implementation of a project will prevent the closing of a plant and the resulting unemployment. The model provides for the employment impact to decline over time to account for the reemployment of displaced workers in other industries. The rates of reemployment are based on duration of unemployment statistics ob-

tained from the Michigan Employment Security Commission.

The single business tax estimates are based on employment factors developed from data obtained from the Michigan Department of Management and Budget, Office of Revenue and Tax Analysis. Industry-specific factors relating payroll data to single business tax payments are used to calculate tax estimates from the employment impact estimates. The extension of the model to estimate all nonwage components of value added will also be based on employment inputs.

Costs

Project costs are determined by engineering estimates as input to the program. To permit the evaluation of alternative levels of public sector involvement in a project, the model was developed to be sensitive to alternative methods of financing. The model can accommodate costs in terms of grants, annual subsidies, and low-interest loans. It can also take bond financing into account.

In the case of a project funded by a bond sale, the debt service costs are included. Bond rates are selected from a table of current tax exempt bond yields reported biweekly in the First Boston Transportation Financing Newsletter, which stratifies rates by term and credit rating. For low-interest public sector loan financing, the cost to the state is the difference between the opportunity cost on funds loaned out and interest payments received.

Evaluation

The evaluation of benefits and costs compares the discounted present value of benefits to the discounted present value of costs. The discount rate, taken as a measure of the opportunity cost of public sector resources, is the bond interest rate appropriate to the life of the project.

Information on the distribution of impacts is a

by-product of the measures used in developing the benefit and cost calculations. For example, the distribution of impacts between primary and secondary effects, the distribution between net income and tax effects, and specific information on the number of jobs affected are available from output reports. Of particular policy interest is information on the net tax impact on the state budget. The net fiscal effect on the state is determined by comparing project costs with the sum of single business tax estimates, state income tax estimates, and state sales tax estimates that are developed in the benefit calculations.

MODEL INPUTS

The inputs for the model are entered and stored in a disk file and are treated as default environment parameters during a model run. The format of the input and parameter file is shown in Figure 1.

In the model the benefit calculations are job dependent. Therefore, either the private developer or the department must be able to estimate the number of jobs affected, the industries in which the jobs are found, and the skill levels (as reflected in average salaries) of each job group. Each group of jobs must also be identified as transient or stable; that is, short term or long term. For example, a job related to the construction of a rail siding would be considered transient; a manufacturing job at a company that locates on the siding would be considered stable. These original job estimates may be varied during the model run to test their effect on the evaluation.

To determine a discount rate for the calculation of present values, and to calculate the interest cost of a bond issue, the state's bond rating and project life are necessary inputs to the parameter file. An appropriate interest rate is then selected by consulting the aforementioned First Boston Corporation table, which is also maintained in the parameter file.

```

100 * PARAMETER SET FOR PUBLIC/PRIVATE COOPERATION MODEL
200 *      1      2      3      4      5      6      7
300 *23456789012345678901234567890123456789012345678901234567890
400 *TTTTTXXXXXXXXXXXX
500 *
600 BOND RATING      AAA
700 *
800 * SINGLE-BUSINESS TAX F-FACTORS & G-FACTORS
900 *
1000 *
1100 SBT FACTORS      SECTOR .. F-FACT .. G-FACT .. INDUSTRY NAME
1200      1 .02608      1.365      AGRICULTURE, FOREST
1300      2 .02293      1.403      METAL MANUFACTURING
1400      3 .03736      1.480      CRUDE PETROLEUM
1500      5 .01664      1.304      CONSTRUCTION
1600      6 .01755      1.403      ORDNANCE
1700      ...
1800      ...
1900      ...
2000      ...
2100      ...
2200      49 .02088      1.310      PROFESSIONAL SERVICES
2300      50 .01730      1.387      UNCLASSIFIED
2400 *---END OF SBT FACTORS---
2500 *
2600 BOND YIELDS      RTG 01-YR 05-YR 10-YR 15-YR 20-YR 30-YR
2700      AAA 5.50  7.25  8.25  9.00  9.25  9.40
2800      AA  5.75  7.50  8.50  9.35  9.50  9.70
2900      A   6.00  8.00  9.20  9.70  10.00 10.25
3000      BAA 6.50  8.75  9.75  10.25 10.50 10.70
3100 BOND DATE      03/02/84
3200 AVG. SECONDARY WAGE 5.00
3300 EMPLOYMENT MULTIPL. 2.00
3400 * JOBS -- FULLER-KINNEY SPUR
3500 *TTTTT.....SEC D C NJOBS AVGWG
3600 *      U S
3700 *      R D
3800 *JOBS      23 2 R      40 12.93
3900 * END OF JOBS TEST DATA
    
```

FIGURE 1 Environment parameters.

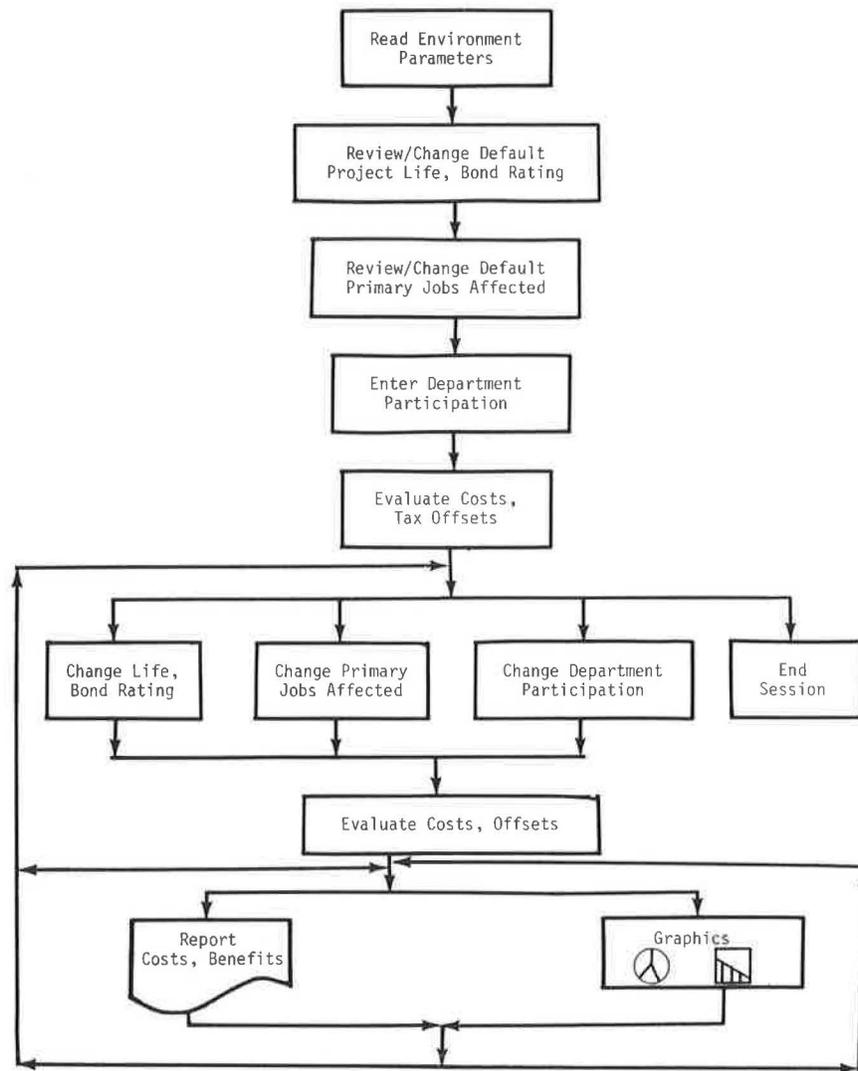


FIGURE 2 Logical path of model session.

Other inputs are the values for the average secondary industry wage level and the secondary impact multiplier. The single business tax factors in the parameter file are industry specific for Michigan's business tax structure and would not be applicable elsewhere.

MODEL OPERATION

The computer model, written in FORTRAN-IV for the Burroughs B-7700, has been designed to be run by a person with little or no computer expertise. Decision makers, in particular, often have little time or patience for learning complicated run instructions or memorizing acronyms that direct the program's flow. With this model, when the user is logged on to the time-sharing system and has started the program, he or she needs only to select an action by pressing a function key. The user then has the option to fill in or change the information on a form displayed on the screen. A flow diagram of the process is shown in Figure 2.

The first task of the program is to read in the environment parameters from a disk file. After the parameters are read in, the menu of available functions is displayed (Figure 3).

PUBLIC/PRIVATE COOPERATION PROJECT ANALYSIS

M E N U
- - - -

FUNCTION KEY

ACTION DESIRED

- | | |
|----|--|
| F1 | REVIEW/CHANGE DEPARTMENT'S BOND RATING |
| F2 | REVIEW/CHANGE PRIMARY JOBS CREATED |
| F3 | REVIEW/CHANGE DEPARTMENT PARTICIPATION |
| F4 | CALCULATE COSTS AND BENEFITS |
| F5 | MAKE PRINTER REPORT OF PRESENT STATE |
| F6 | MAKE EASY-GRAPH FILE OF PRESENT STATE |
| F7 | END SESSION |

. . . Please press appropriate FUNCTION key (FUNCTION keys are the brown row of keys located above the numbers row on the EECO's typewriter keyboard.)

FIGURE 3 Function menu.

The function keys are a row of sixteen special keys located above the regular keyboard on the EECO forms terminal used for program control. Only seven of the keys are presently meaningful to this program; the rest could be used for future enhancements.

By pressing function key F1, the user indicates a desire to review or change the project life, the department's expected bond rating, or both (see Figure 4). This feature may be used to test how sensitive a particular project's viability might be to the department's ability to sell bonds.

The project life and bond rating are easily changed by typing their desired values. (The matrix of interest rates at the bottom of the form comes from the parameter set and is assumed to be constant for the session. It is, therefore, protected from change during the run.) When the project life and bond rating are satisfactory to the user, pressing the XMIT ("transmit") key inputs the values to the program and returns the user to the menu.

By pressing function key F2, one can edit the number and type of jobs to be used in the evaluation. The first time F2 is pressed, a worksheet is presented that contains any information present in the parameter set. Subsequent returns to this form display the current state of the estimates of jobs affected. All that is necessary to add, delete, or change any of the information is to retype and press XMIT.

Function key F3 allows the user to specify the form and degree of the department's participation in the project. As stated previously, participation can take the form of a one-time grant, which could represent the capital outlay necessary for a major infrastructure reinvestment; a low-interest loan; direct annual operating assistance to one or more companies; or any combination of the three. If the department would need to issue bonds to fund the project, this is specified on this form by entering their size and term. Pressing XMIT inputs the contents of the worksheet to the system.

When all information necessary for the cost and benefit calculations is present, pressing F4 displays the first comparison of state cost to state tax offsets for the assumed life of the project (Figure 5). The response time is very good. A wait of more than 3 seconds usually means that the whole computer system is running slowly on that particular day. It should be emphasized that this display does

not include the entire spectrum of benefits; for example, no mention is made of change in personal income or federal income tax. These will be addressed in the discussion on system outputs. The current comparison is designed to give the user a sense of the state fiscal impact of a project.

With the information from the cost-offsets display, the user is now free to test alternatives. One might compare a low-interest loan with a grant. Alternatively, one could change the original estimate of the number of jobs affected until a break-even point is found, or increase state participation until the fiscal impact becomes negative. Or one could test the alternatives of a concrete service road versus its bituminous equivalent by comparing the capital cost of concrete using a 25-year life with the capital cost of a bituminous surface using a 15-year life. A few minutes spent changing the project parameters using F1-F3, and evaluating the change with F4, can give a wealth of information about both the preferred nature of the solution and the recommended boundaries of his or her bargaining position to a decision maker preparing for a meeting or negotiating session.

MODEL OUTPUTS

For any combination of state participation, jobs, bond rating, and project life yielding results of interest, the user may request a printed report by pressing function key F5. The program first asks for identifying data for the report heading and then prints the one-page report shown in Figure 6. At MDOT, the report is printed on a Burroughs page-printer, which allows multiple-character fonts and "portrait" printing (meaning that the short side of a sheet of paper is at the bottom, as it is in most books, instead of at the side, as it is in most computer output). This makes for a very readable report that can be inserted in a briefing paper without re-typing or artwork.

By using function key F6, the results of the calculations can be displayed in eleven optional ways using business graphics. Figure 7 shows the menu of graphics choices as it is displayed to the user.

Because no graphics package is known to exist for the EECO terminal, all graphics are accomplished by writing a file of commands for the Tektronix Easy-Graph program. The graphics are then displayed on a

BOND YIELDS & PROJECT LIFE						

Project Life :	<input type="text"/>	years				
* * * * *						
Department Bond Rating :	<input type="text"/>					
YIELDS	1-YR.	5-YR.	10-YR.	15-YR.	20-YR.	30-YR.
Aaa	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%
Aa	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%
A	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%
Baa	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%	xx.xx%

Source: First Boston Transportation Financing
 Newsletter, mm/dd/yy

. . . Press XMIT key when ready.

FIGURE 4 Bond interest worksheet.

RESULTS OF COST & BENEFIT CALCULATIONS

COSTS:	AMOUNT OF GRANT	: \$500,000
	COST OF LOAN	: 24,289
	COST OF OPERATING ASSISTANCE:	71,825
	COST OF BOND ISSUE	: <u>355,532</u>
	TOTAL COST TO STATE	: \$ 951,646

BENEFITS OVER PROJECT LIFE OF YEARS:

PRIMARY JOBS

0 SHIFTED
0 CREATED
0 DESTROYED
40 RETAINED

SECONDARY JOB IMPACT 131

TOTAL INCREASED TAXES:

	(PRIMARY)	(SECONDARY)
INCOME	\$ 73,570	\$50,894
SALES	\$ 19,063	34,702
SINGLE BUSINESS	\$ 268,109	

TOTAL TAX OFFSET: \$ 446,338

PRESS XMIT TO CONTINUE.

FIGURE 5 Costs and tax offsets.

PUBLIC/PRIVATE COOPERATIVE PROJECT ANALYSIS

Project: EXAMPLE OF SYSTEM ANALYSIS
Prepared for: TERRY GOTTS
Date: 04/05/84
Time: 10:44

DEPARTMENT PARTICIPATION

ASSISTANCE TYPE	AMOUNT	INTEREST	TERM	REAL COST
Grant	\$ 500,000			\$ 500,000
Loan	100,000	@ 3.00 %	for 10 Yrs.	24,289
Operating Asst.	10,000		for 10 Yrs.	71,825
Bond Issue	600,000	@ 8.25 %	for 10 Yrs.	355,532
Total Public Cost (in 1982 \$) \$				951,646

Assumed Project Life = 10 years
Discount Rate = 8.250%

Assumed Department bond rating = AAA.

Bond yields from First Boston Transportation Financing Newsletter, 03/02/84.

PUBLIC BENEFITS

Job Impact: 40 Primary jobs
131 Secondary jobs

Change in Personal Income (Net of Taxes) = \$3,732,415.

Increment in Federal Income Tax = \$371,424.

State Tax Increment (in 1982 \$) over 10 years:
State Income Tax \$ 124,464
Sales Tax 53,765
Single Business Tax 268,109

Total State Tax Increment \$ 446,338

Total Benefits \$4,550,177.

FIGURE 6 Report.

PUBLIC / PRIVATE PROJECT ANALYSIS

GRAPHICS SELECTION

Title of project:

Put an X in the box beside the graphics you want:

- 1. Loan interest/cost stream
- 2. Present value of stream of subsidy payments
- 3. Present value of bond interest stream
- 4. Change in personal income
- 5. Change in Federal Income Tax
- 6. Change in State Income Tax
- 7. Change in State Sales Tax
- 8. Change in Single Business Tax
- 9. Total costs vs. State tax offsets
- 10. Pie chart of present worth of costs
- 11. Pie chart of present worth of benefits

. . . press XMIT when ready.

FIGURE 7 Graphics options menu.

nearby Tektronix 4014 terminal with hardcopy capability. It should be noted that some forms terminals, such as the Tektronix 4020 series, support both business graphics and raster-scan hardcopy, so that the use of two terminals is not necessary.

A sample of graphic output is shown in Figure 8. This is a graphic representation of the time series that was used to derive the output report in Figure 6. It is a cumulative representation of the cost versus tax offset curves so that the break-even year, if there is one, is clearly evident. Note that, in the example, the costs start out high be-

cause of a \$500,000 grant in year 1. Figure 9 shows the change in the cost versus tax offset relationship resulting from conversion of a significant portion of the grant to a low-interest loan of a lesser amount. This example represents an increase in private sector participation in the sample project.

CONCLUSION

The environment that motivated the development of the model described is characterized by increased

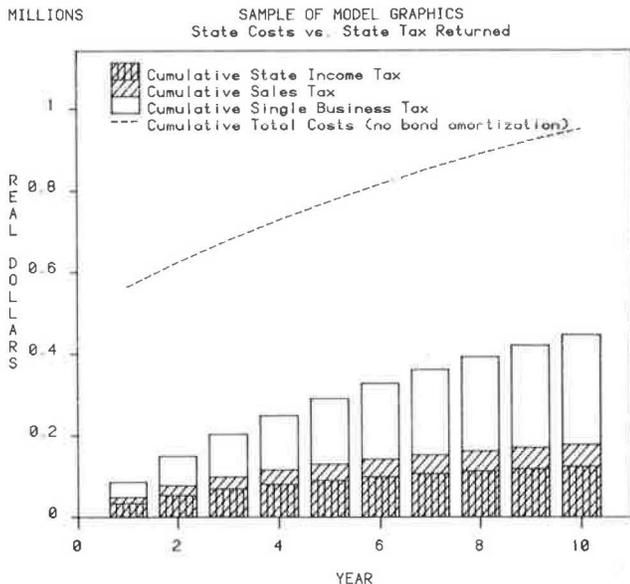


FIGURE 8 Costs versus offsets.

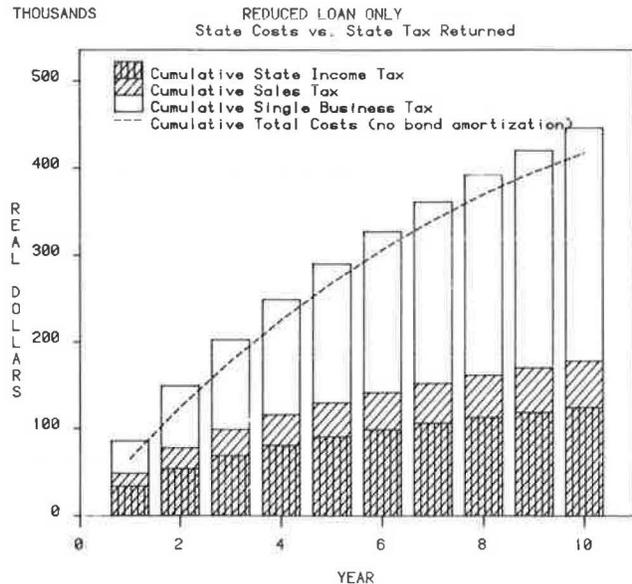


FIGURE 9 Comparison after shift.

concern for the fiscal impact of transportation projects and a high degree of policy sensitivity to the level of employment and economic welfare in Michigan. The model accordingly provides a means of rapidly evaluating the income and fiscal effects of employment changes that are the outcomes or by-products of transportation improvement projects. The model is also quite easy to run and is therefore ac-

cessible to those whose responsibilities will not permit the luxury of becoming acquainted with complicated run instructions or computer jargon.

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Microcomputer Decision Support System

F. MICHAEL TELLER and STUART L. MYERS

ABSTRACT

In the past 2 years the Maryland Department of Transportation has developed a decision support system that provides financial advice to the Secretary of Transportation and to other policy-making officials within Maryland state government. The components and techniques used in developing this system are described. To place the system in perspective, there is a brief comparison of the process before implementation of the system with current practice. General guidelines are given to assist the reader in identifying issues and criteria for development of decision support systems. These criteria are general in nature and may be applied to a wide variety of situations, not just financial planning or transportation-related analysis. Comments, conclusions, and specific hardware and software evaluations based on experience to date are offered.

The purpose of this paper is to inform other professionals in the transportation field about the experiences of the Maryland Department of Transportation (MDOT) in developing and implementing a microcomputer-based decision support system. In order that the reader may better appreciate the nature of work performed by the Financial Planning and Analysis Section at MDOT, a brief description of the department and its funding sources is included. In the balance of the paper, concentration is on the components of the financial decision support system at MDOT, guidelines for developing a decision support system and financial modeling, and conclusions and comments regarding the MDOT experience to date.

BACKGROUND

MDOT is responsible for all state-owned transportation facilities and programs. This responsibility includes the planning, financing, construction, op-

eration, and maintenance of various modes of transportation. In addition, the department carries out various related licensing and administrative functions.

The department is supported by the Transportation Trust Fund, which consists of revenues from motor fuel taxes, motor vehicle taxes, a portion of the state corporation income tax, operating revenues generated from MDOT-owned facilities, transit fares, federal aid, and bonds and notes supported by the trust fund.

The Financial Planning and Analysis Section is part of the Secretary's staff. This section is charged with the responsibility for providing the Secretary with impartial advice on the financial impact of policy-level, program-level, and project-level decisions.

MAJOR ISSUES

The Financial Planning and Analysis Section performs three distinct types of analyses. The first type of analysis is focused on providing revenue and expense forecasts covering 5-year and 20-year planning horizons. The second major area of analysis is the determination of upper and lower limits of the department's bonding capacity given projected levels of revenues, operating expenditures, and capital program spending. The final area of analysis deals with special projects and detailed analyses of a nonroutine nature.

Before the department purchased a microcomputer and financial spreadsheet software package, these analyses were performed using a time-sharing service for the revenue projections and bonding capacity. Special projects were analyzed using hand-held calculators, paper, and pencils. Each of these analyses required a substantial investment in time just to produce the initial results. Any sort of "what if?" or sensitivity analysis required a similar amount of time.

As an example of the amount of effort then required, the 5-year financial projection required about 1 month to complete with the aid of the time-sharing service and two mainframe computers. The output generated was a one-page report focused on a