into a common information flow. Through this information flow decisions must be anticipated, communication with decision makers effected, and, most important, illusions of certainty avoided. In times of uncertainty it is appropriate to acknowledge the limitations of the process.

On the receiving end, decision makers must understand the planning process. By direct participation in planning activities, decision makers can provide the strong leadership necessary to shape planning so as to make it more relevant to decision making while at the same time learning from planning and gaining a better sense of uncertainty.

The key is a hand-in-glove relationship between planning and decision making. It is suggested that such a relationship can be accomplished through an integrated planning/political/decision-making process and that this may well be the answer to increased planning efficiency in the 1980s.

REFERENCES

1. E.M. Whitlock. Current Issues Facing Transportation Policy Makers. Traffic Quarterly, July 1981.
2. G.J. Fielding. Presentation to Joint Conference, Board of Directors and Board of Consultants, Enc Foundation, Westport, Conn., Oct. 1978.
3. R. Robertson. Changes in Transportation Planning. Presented at meeting of AASHTO Standing Committee on Planning, Scottsdale, Ariz., May 27, 1982.
4. H. Haack. Transportation Planning for the 80's: A Case Study in Pennsylvania. Pennsylvania Department of Transportation, Harrisburg, Sept. 1980.
5. Evaluation Criteria and Priority Setting for State Highway Programs. NCHRP, Rept. 84, Nov. 1981.
6. D.J. Forkenbrock. Improving the Transit Development Planning Process. Traffic Quarterly, July 1981.
7. J.L. Schofer and P. Stopher. Specification for a New Long-Range Urban Transportation Planning Process. Transportation, Sept. 1979.

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Revenue Versus Needs: An Analytic Approach

KAREN R. HOWE AND RICHARD E. ESCH

To examine the difficult choices created by growing transportation needs and decreasing revenue, the Michigan Department of Transportation developed a comprehensive State Transportation Plan. Within the plan, matching transportation needs in order of priority with available revenue was accomplished by using a planning process called the Transportation Revenue Investment Plan (TRIP). TRIP begins with the need that has the highest priority and continues retiring needs until all allocated revenue is spent or all needs are met. Accurate costs for the needs are determined by inflating the base-year cost to the year of revenue that is attempting to retire it. TRIP contains decision rules by transportation mode that regulate the way in which needs are retired and needs not met. TRIP output can be summarized in reports by transportation mode, year, and various other factors. Its highest utility can be seen when these summaries are displayed by means of bar charts, CALFORM maps, or network plotting. The ease with which the graphic display and summarized output of TRIP can be analyzed is beneficial in the State Transportation Plan and within the strategic planning process. In both cases, TRIP can help in evaluating the effects of alternative revenue levels and spending patterns.

Growing transportation needs in Michigan have been evident for some time. A 1977-1989 needs study reported Michigan's needs to be $30 billion. Decreasing transportation revenues in Michigan have become a reality the past few years. This combination of growing needs and decreasing revenues has made difficult choices for the people trying to provide the best transportation system possible in Michigan. To examine these choices, the Michigan Department of Transportation (DOT) developed a comprehensive State Transportation Plan (see Figure 1). Within the plan, available revenue is generated by using a fiscal forecasting model. The fiscal model uses current issues when generating revenue at the state, city, and county levels. An inventory of deficiencies is stored by transportation mode.

Matching available revenue with needs was accomplished within the plan by using a planning process called the Transportation Revenue Investment Plan (TRIP). TRIP has a twofold purpose within the Michigan DOT. TRIP was first used in the State Transportation Plan to match available revenues with needs. The process is also useful as an early warning system within the strategic planning process. In daily strategic planning analysis, it can help decision makers to evaluate the effects of alternative revenue levels and spending patterns. Describing TRIP is the purpose of this paper.

SYSTEM OPERATION

The workings of TRIP are summarized in Figure 2. The major driving force of the program is the revenues available and the needs identified. Computer files for each were created, and both are categorized by mode and program element. The modes are aviation, highway, intercity bus, intercity rail passenger, local transit, marine, nonmotorized, and rail freight. The program elements are service continuation, service relocation, service improvement, new service, mobility disadvantaged, economic development, safety, and energy conservation.

Revenue is assigned to the year in which it will become available. In a similar manner, the needs are identified by the year in which they will become deficient. Deficiencies are also assigned a priority within each mode and program element based on highest need. These files are taken into TRIP and matched by mode and program element. Beginning with the highest priority for a given mode and program element, needs are retired or "bought" until either all the allocated revenue is spent or all the needs are met. If no state revenue remains for a given year, TRIP will not attempt to buy any more needs that year.

Figure 1. Michigan State Transportation Plan.

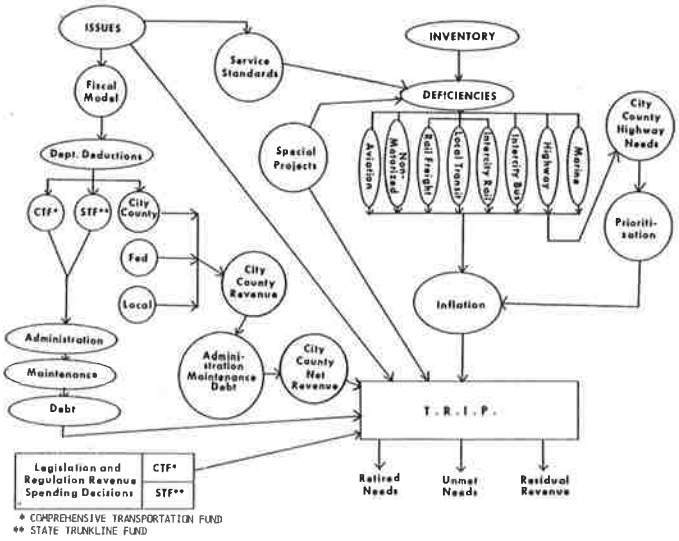
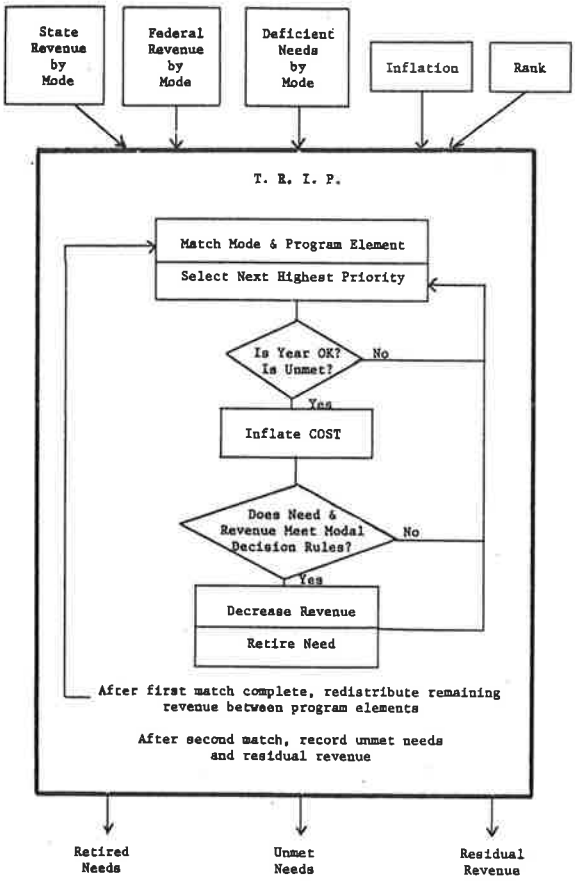


Figure 2. TRIP.



Revenue for any given year can only be used to retire needs that are of the same year or are backlogged. To determine an accurate cost of the need, base-year costs are inflated to the year of the revenue that is attempting to retire the need. Each mode also has its own set of decision rules that regulate the method by which a need may be retired. These rules are based on the type of need and the federal-state-local revenue split unique to that mode. After the first match of revenue and needs is completed, a second matching may be attempted to adjust the distribution of remaining revenue among program elements. When all matching is finished, the needs are reviewed to determine which have been retired and which were not met. TRIP can also be run for the limit case, in which needs are retired from one program element until all available needs have been met. If any revenue remains, the procedure is repeated on the next program element. The order in which program elements are retired is based on a given ranking.

INPUT AND OUTPUT

The input and output files for TRIP are described in the next paragraph. Figures 3 and 4 and Tables 1 and 2 present a portion of the actual data for each file.

Input Files

Needs

In the needs file, each need is entered as a separate record. The data on each record that are used by TRIP are mode, program element, subprogram element, cost in 1980 dollars, priority, year, and funding type. Other information about the need, such as identification and description, is also on the record. There is a separate file for each mode.

State Revenue

The state revenue file has a record for each year, program element, and funding source. The data on each record are mode, program element, year, funding source, and revenue available. There is a separate file for each mode.

Federal Revenue

The federal revenue file has a record for each year, program element, and funding source. The data on each record are program element, year, funding source, and revenue available. There is a separate file for each mode.

Inflation

The inflation file has a record for each mode-year combination. Each record contains mode, year, dif-

ferential inflation rate for capital-type projects, differential inflation rate for operation- and maintenance-type projects, and a base inflation rate. One file is used for all modes.

Rank

The rank file has a record for each mode-year combination. Each record contains mode, program element, and rank. This file is used in running the limit case. The program elements are ranked within each mode.

Output Files

Retired Needs

The retired needs file has a separate record for each need. The data on each record are mode, program element, priority, subprogram element, year in which the deficiency occurs, funding type, cost in 1980 dollars, cost inflated to the year the need was retired, dollars used to retire the need by the federal-state-local split, money funding source, and money year. There is a separate file for each mode.

Figure 3. Input files.

DEFICIENT NEEDS

```
2 0900001090350000010    01  05 01    294000 001    02  1982 0000010000360000001309000000100000000100
2 4700001470650000010    01  05 01    303000 001    02  1982 0000020000360000001309000000100000000100
2 5800001581510000012    01  05 01   2310000 001    12  1982 0000030000360000001304000000100000000100
2 5800001581510000011    01  05 01   2310000 001    12  1982 0000040000360000001304000000100000000100
2 5800001581510000010    01  05 01      9000 001    02  1982 0000050000360000001309000000100000000100
2 6300001630220000010    01  05 01    303000 001    12  1982 0000060000360000001309000000100000000100
2 8200001820220000013    01  05 01    605000 001    12  1982 0000070000360000001304000000100000000100
2 8200001820220000013    01  05 01    165000 001    12  1982 0000080000360000001304000000100000000100
2 8200001821910000010    01  01 01     26000 001    12  1982 0000090000360000001304000000100000000100
2 8200001821950000010    01  05 01    110000 001    12  1982 0000100000360000001309000000100000000100
```

STATE REVENUE

```
82  1    1244 1199
83  1    1240 1199
84  1    1218 1199
85  1    1195 1199
86  1    1160 1199
87  1    1129 1199
88  1    1099 1199
89  1    1070 1199
90  1    1041 1199
82  1      22 1299
83  1      22 1299
84  1      22 1299
85  1      21 1299
86  1      21 1299
87  1      20 1299
88  1      20 1299
89  1      19 1299
90  1      19 1299
```

FEDERAL REVENUE

```
4 3 82   48532
4 3 83   55000
4 3 84   53400
4 3 85   53400
4 3 86   55000
4 3 87   59900
4 3 88   59900
4 3 89   59000
4 3 90   59000
6 1 82   12349
5 1 82   15679
6 1 83   13177
5 1 83   18596
6 1 84   30202
5 1 84    6310
5 1 85   36511
5 1 86   42113
5 1 87   42113
5 1 88   42113
5 1 89   42113
5 1 90   42113
6 2 82     752
```

INFLATION

```
81 0 0.000 0.000 0.080
81 1 0.000 0.000 0.080
81 2 0.000 0.000 0.080
81 3 0.000 0.000 0.080
81 4 0.000 0.000 0.080
81 5 0.000 0.000 0.080
81 6 0.000 0.000 0.080
81 7 0.000 0.000 0.080
81 8 0.000 0.000 0.080
81 9 0.000 0.000 0.080
82 0 0.000 0.000 0.080
82 1 0.000 0.000 0.080
82 2 0.000 0.000 0.080
82 3 0.000 0.000 0.080
82 4 0.000 0.000 0.080
82 5 0.000 0.000 0.080
82 6 0.000 0.000 0.080
82 7 0.000 0.000 0.080
82 8 0.000 0.000 0.080
82 9 0.000 0.000 0.080
83 0 0.000 0.000 0.080
83 1 0.000 0.000 0.080
83 2 0.000 0.000 0.080
```

RANK

```
1 1   1
1 2   2
1 3   3
1 4   4
1 5   5
1 6   6
1 7   7
1 8   8
2 1   9
2 2  10
2 3  11
2 4  12
2 5  13
2 6  14
2 7  15
2 8  16
3 1  17
3 2  18
3 3  19
3 4  20
```

Figure 4. Output files.

UNMET NEEDS

```
1 1     3  3 81  0   2500000 0    3
1 1     5  3 81  0   4000000 0    5
1 1    10  3 81  0   2500000 0   10
1 1    14  3 81  0   2500000 0   14
1 1    15  3 81  0   4000000 0   15
1 1    18  3 81  0   4000000 0   18
1 1    19  3 81  0   2500000 0   19
1 1    32  3 81  0   1500000 0   32
1 1    35  3 81  0   4000000 0   35
1 1    65  3 82  0   2500000 0   65
1 1    90  3 83  0   1500000 0   90
1 1    91  3 83  0    500000 0   91
1 1    92  3 83  0   1500000 0   92
1 1    93  3 83  0    500000 0   93
1 1    94  3 83  0    500000 0   94
1 1    95  3 83  0    500000 0   95
```

RESIDUAL REVENUE

STATE MONEY NOT SPENT

FUNDING SOURCE	YEAR		APPROPRIATION $	RESIDUAL $
2	82	8	74988000	321
2	83	8	114021000	43
2	84	8	135562000	36
2	85	8	164800000	456
2	86	8	199303000	889
2	87	8	63209000	1004
2	88	8	60303000	404
2	89	8	62735000	470
2	90	8	62884000	105
4	82	8	16472000	1431
4	83	8	15612000	12881633
4	84	8	14251000	17949
4	85	8	12842000	1371
4	86	8	11439000	155
4	87	8	10626000	2
4	88	8	9545000	602
4	89	8	8031000	1256
4	90	8	6548000	687

FEDERAL FUNDS NOT SPENT

FUNDING SOURCE	YEAR		APPROPRIATION $	RESIDUAL $
4	82	1	48532000.00	32894775.04
4	83	1	55000000.00	87880036.41
4	84	1	53400000.00	141280036.41
4	85	1	53400000.00	193848249.79
4	86	1	55000000.00	248841108.85
4	87	1	59800000.00	306789919.92
4	88	1	59900000.00	366668919.92
4	89	1	59000000.00	425675527.09
4	90	1	59000000.00	484659982.83
5	82	1	66951000.00	0.00
5	83	1	81424000.00	0.00
5	84	1	96247000.00	0.00

RETIRED NEEDS

```
11  38 182  0  4691000  5471582  4924424      0      0      0  0  0  0  0  0  /
    / 0      0        0        0   273579   273579  182     38
11  39 182  0   815000   950616   855554      0      0      0  0  0  0  0  0  /
    / 0      0        0        0    47531    47531  182     39
11  40 182  0  1461000  1704110  1533699      0      0      0  0  0  0  0  0  /
    / 0      0        0        0    85206    85206  182     40
11  41 182  0  1535000  1790424  1611382      0      0      0  0  0  0  0  0  /
    / 0      0        0        0    89521    89521  182     41
11  42 182  0    67000    78149    70334      0      0      0  0  0  0  0  0  /
    / 0      0        0        0     3907     3907  182     42
11  43 182  0  4395000  5126328  4613695      0      0      0  0  0  0  0  0  /
    / 0      0        0        0   256316   256316  182     43
11  44 182  0   383000   446731   402058      0      0      0  0  0  0  0  0  /
    / 0      0        0        0    22337    22337  182     44
11  45 182  0   871000  1015934   914341      0      0      0  0  0  0  0  0  /
    / 0      0        0        0    50797    50797  182     45
```

Table 1. File formats.

File	Data Name	Beginning Column	Size
Needs	1 - Mode number	1	1
	2 - Subprogram element	37	2
	3 - Program element	40	2
	4 - 1980 cost	43	9
	5 - Funding type	53	3
	6 - Year (2-digit)	70	2
	7 - Priority	73	6
State revenue	1 - Year (2-digit)	1	2
	2 - Funding source code	4	2
	3 - Revenue ($1,000)	7	12
	4 - Mode	20	1
	5 - Program element	21	1
	6 - Subprogram element[a]	22	2
Federal revenue	1 - Federal source code	1	2
	2 - Program element	4	1
	3 - Year (2-digit)	6	2
	4 - Revenue ($1,000)	9	7
Rank	1 - Mode	1	2
	2 - Program element	4	1
	3 - Rank	6	3
Inflation	1 - Year (2-digit)	1	2
	2 - Mode	4	1
	3 - Differential inflation (capital)	6	5
	4 - Differential inflation (operation and maintenance)	12	5
	5 - Base inflation	18	5
Retired needs	1 - Mode	1	1
	2 - Program element	2	1
	3 - Priority	3	4
	4 - Subprogram element	7	2
	5 - Year, need (2-digit)	9	2
	6 - Funding type	11	3
	7 - 1980 cost	14	9
	8 - Inflated cost	23	9
	9 - Dollars by federal-state-local split	32	135[b]
	10 - Funding source, revenue	167	3
	11 - Year, revenue (2-digit)	170	2
	12 - Deficient need record pointer	172	7
Unmet needs	1 - Mode	2	1
	2 - Program element	4	1
	3 - Priority	6	6
	4 - Subprogram element	13	2
	5 - Year (2-digit)	16	2
	6 - Funding type	19	3
	7 - 1980 cost	23	10
	8 - Deficient need record pointer	35	5
Residual revenue	1 - Funding code	4	2
	2 - Year (2-digit)	11	2
	3 - Program element	14	2
	4 - Appropriation	17	10
	5 - Residual revenue	32	10

[a] 99—indicates any subprogram.
[b] 15 x 9.

Table 2. Subprogram element codes.

No.	Subprogram Element Code	No.	Subprogram Element Code
1	Facility replacement in kind	28	New interchanges
2	Service subsidy[a,b]	29	New rest areas/information
3	Facility acquisition	30	Facility construction
4	Precision instrumentation	31	Equestrian access
5	Roadside amenities	32	New dredging
6	Transportation systems management	33	New port authorities[a]
7	Turnbacks	34	Site access
8	Off-system improvement	35	Federal forest highways
9	Vehicle acquisition	36	Economic growth center highway
10	Rural small bus	37	Rail/land banking
11	Facility maintenance[a]	38	Basic ground aids
12	Maintenance dredging	39	Upgrade to standards
13	Vessel acquisition	40	High hazard locations
14	Port authorities[a]	41	Critical bridges
15	Relocation service subsidy[a,b]	42	Railroad crossings
16	Facility relocation in kind	43	Pedestrian access
17	Freight transfer facility	44	Railroad signalization
18	Facility expansion	45	Security measures
19	Increased service subsidy[a,b]	46	User information/controls
20	Increased facility maintenance[a]	47	Hazard elimination
21	Improvement dredging	48	Minimal track safety
22	Improved port access	49	Carpool lots
23	Increased load capability	50	Ridesharing
24	Increased speed capability	51	Park side lots
25	New airport	52	Vanpool
26	New service subsidy[a,b]	53	Commuter facilities
27	New routes		

[a] Operation and maintenance.
[b] Subsidy.

Unmet Needs

The unmet needs file has a separate record for each need. The data on each record are mode, program element, subprogram element, year in which the deficiency occurs, funding type, and cost in 1980 dollars. There is a separate file for each mode.

Residual Revenue

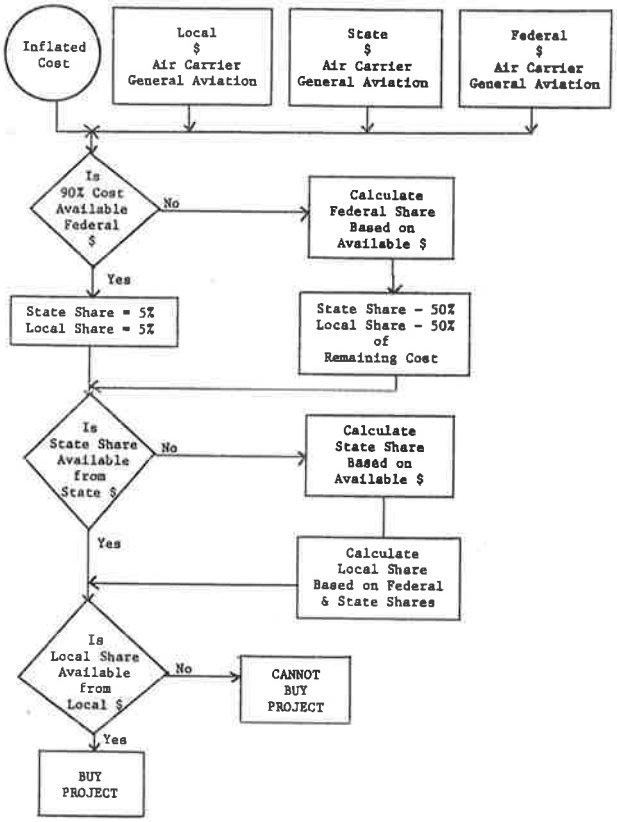
The residual revenue file has a separate record for each funding combination of source, year, and program element. The data on each record are funding source, money year, program element, money appropriated, and residual money. There are records for both state revenue and federal revenue. Each mode has a separate file.

PROGRAM DETAILS

The TRIP program was written in FORTRAN programming language and run on a Burroughs B7700 computer. The details of the computer program decision rules are described by mode.

Within TRIP, each mode has its own set of decision rules that determine whether a need may be re-

Figure 5. Aviation decision rules.



tired based on the available revenue for that mode. At the point where the decision rules begin, the program is attempting to buy the highest available priority need. It has already had its 1980 dollar cost inflated to the year of revenue that is attempting to retire it.

Aviation

Decision rules for the aviation mode are shown in Figure 5. The first check in retiring an aviation need (project) is on available federal revenue. TRIP determines whether 90 percent of the cost of the project is available from the appropriate federal fund. If it is, the state and local shares are each set at 5 percent of the cost. If 90 percent of the cost is not available from the federal fund, a new federal share is calculated by using the federal funds remaining. New state and local shares are then calculated. They are each 50 percent of the cost remaining after the initial cost has been reduced by the federal revenue.

The next check is on state revenue. TRIP determines whether the state share of the cost is available from the appropriate state fund. If it is not available, a new state share is calculated by using the state funds remaining. A new local share is then calculated. It would be the residual left after the cost has been reduced by the federal and state shares.

The final check is on available local revenue. If the local share is available from the appropriate local fund, the project is retired (bought). If the local share is not available, TRIP cannot retire the project with that year's revenue. Aviation decision rules do not allow projects with subprogram elements 2, 15, 19, and 26 (Table 2) to be retired because there is no funding for these types of projects. The revenue input is all assigned to program element 1, service continuation, for the first match of revenue and needs. This reflects the real-life assignment of funds. These revenues are also separated into two groups: the share that funds air carrier needs and the share that goes to general aviation needs.

Highways

Decision rules for the highway mode are shown in Figure 6. Highway mode has the most complex set of decision rules within TRIP. The different funding types within this mode have separate state and federal revenue allotments. The various funding types are linked with their revenue allotment through the funding source code. To simplify the discussion of highway decision rules, they are described here by funding type.

For projects with funding type 1, Interstate, the first check is on program element. When the program element is service continuation, Interstate projects are retired in the same way as funding types 2, 3, 8, and 9. The next check is on federal funds. The federal share is set at 90 percent of the cost. If 90 percent is not available from the appropriate federal fund, the project cannot be retired that year. If the federal share is available, the next check is on the state share. The state share is set at 10 percent. When 10 percent of the cost is not available from state revenue, the project cannot be retired that year. If the state share is available, the project is retired.

For projects with funding type 4, nonfederal aid, there is only one check and that is on state revenue. If 100 percent of the cost is available from the appropriate state fund, the project is retired. When there is not enough state revenue to cover the state share, the project cannot be retired that year.

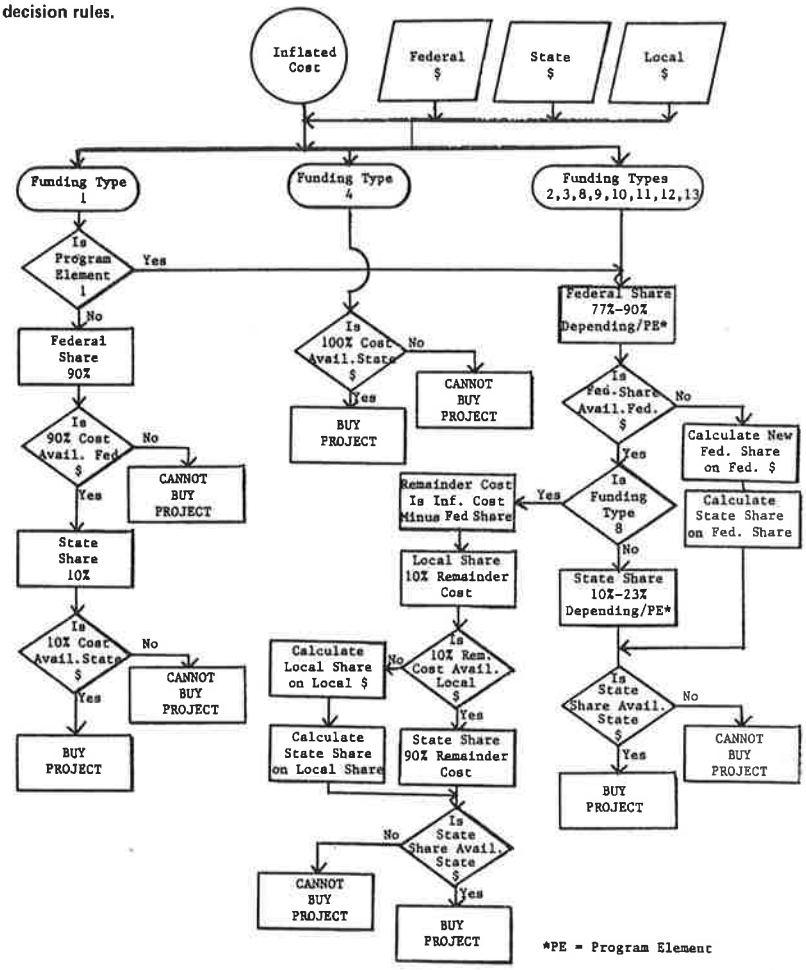
For funding types 2 (federal aid primary), 3 (federal aid secondary), 8 (federal aid urban), 9 (structure replacement), 10 (structure widen), 11 (railroad crossing upgrade to structure), 12 (railroad crossing at grade), and 13 (special projects), the federal share is 77 to 90 percent depending on the program element. If the federal share is available from federal revenue, the next check is for funding type 8, federal aid urban. When the federal share is not available, a new share is calculated based on remaining federal revenue. Then a state share is calculated based on the federal share. When the federal share is available and the funding type is not federal aid urban, the state share is set at 10 to 23 percent depending on the program element. If the state share is not available, the project is not retired that year. When the state revenue is available, the project is retired.

If the funding type is federal aid urban, a remainder cost, which is the inflated cost minus the federal share, is calculated. The local share for funding type 8 is 10 percent of the remainder cost. If the local share is not available from local revenue, a new local share is calculated based on remaining revenue. A state share is then calculated based on the local share. When 10 percent of the cost is available from the local fund, the state share is 90 percent of the remainder cost. If the state share is not available from state revenue, the project cannot be retired that year. If the state share is available, the project is retired.

Intercity Bus

Decision rules for the intercity bus mode are shown in Figure 7. The only check in retiring an inter-

Figure 6. Highway decision rules.



city bus need (project) is on state funds. If the entire cost of the project is available from the state fund, the project is retired. When only part of the cost is available, a partial buy is done by using the remaining state funds for that year. Intercity bus projects cannot be backlogged.

Intercity Rail Passenger

There are two sets of decision rules for the intercity rail passenger mode: one for capital needs (projects) and another for operation and maintenance needs (projects). These two sets of decsion rules are shown in Figures 8 and 9.

Capital Projects

The first check for capital projects is on funding type. If the funding type is 100 through 135 or 220 (Detroit to Chicago and Detroit to Toledo projects), TRIP attempts to buy the project with 100 percent federal funds. When 100 percent of the cost is not available from federal revenue for these types of projects, they are handled in the same way as other capital projects.

When the capital project is not funding type 100 through 135 or 220 or 100 percent of the cost is not available in federal funds, TRIP checks to see whether 50 percent of the cost is available from federal revenue. If 50 percent of the cost is not available, a new federal share is calculated based on the remaining funds. Then a state share is calculated based on the federal share. If the federal share is 50 percent of the cost, the state share is set at 50 percent.

The next check within TRIP, which is on state revenue available, is then performed. If the state share is available from the state fund, the project is retired. When the state does not have enough funds to meet the state share, the remaining state revenue is used to retire as much of the project as possible.

Operation and Maintenance Projects

Funding type is the first check for operation and maintenance projects. When funding type is 1 through 9 (Detroit to Chicago and Detroit to Toledo projects), TRIP attempts to buy the project with 100 percent federal funds. If 100 percent of the cost is not available from federal revenue for these types of projects, they are handled in the same way as other operation and maintenance projects. Other projects have a federal share set at 35 to 50 percent depending on the revenue year and program element. If the federal share is not available from federal funds, a new federal share is calculated based on remaining revenue. A state share is calculated based on the federal share. The next check on available state revenue is then performed. If the state share is available from the state revenue, the project is retired. When the state does not have enough revenue to meet its share, the project is not

retired and no more operation and maintenance projects are retired that year.

Local Transit

There are two sets of decision rules for the local transit mode: one for capital needs (projects) and another for operation and maintenance needs (projects). These two sets of decision rules are shown in Figures 10 and 11.

Operation and Maintenance Projects

The first check for operation and maintenance projects is on federal revenue. If the federal share, 50 percent, is not available from the federal fund, a new share is calculated based on the remaining funds. Then a state share is calculated based on the federal share. If the 50 percent federal share is available from the federal fund, the state share is set at 30 percent of the cost. The local share is set at 20 percent of the cost. The second check is on available state revenue. If the state share is available from the state fund, the project is retired. When the state does not have enough revenue to meet its share of the cost, the remaining state revenue is used to retire as much of that project as possible.

Capital Projects

Funding type is the first check with capital projects. If the funding type is 3 or 4 (county incentive programs) and 100 percent of the cost is not available from state funds, the project cannot be retired. The federal share is set at 80 percent when the funding type is 1 or 2 (urban programs). If the federal share is not available from federal funds, a new share is calculated based on the remaining federal revenue. Then a state share is calculated based on the federal share. If there is enough federal funding to cover 80 percent of the

Figure 7. Intercity bus decision rules.

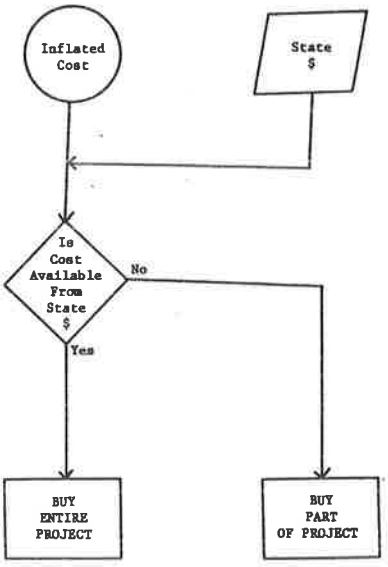


Figure 8. Intercity rail passenger capital decision rules.

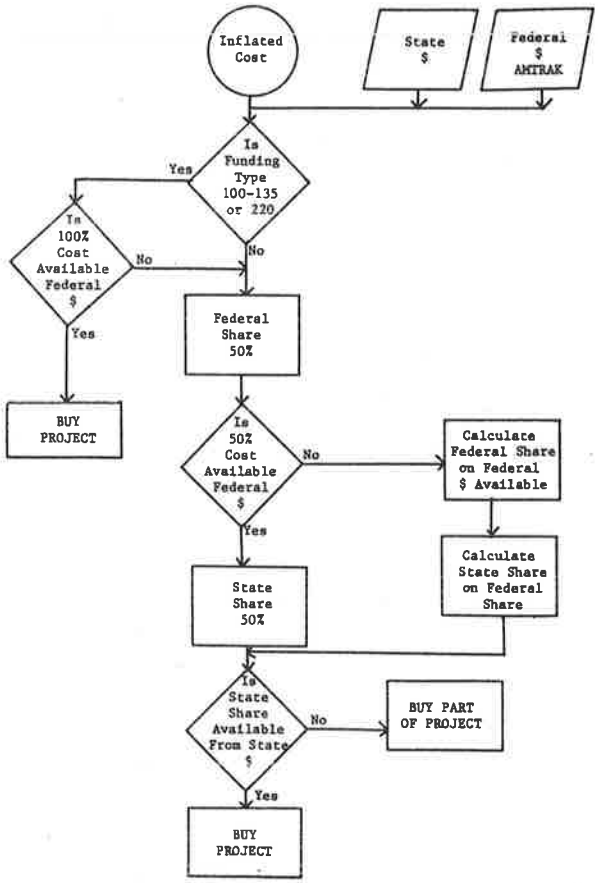


Figure 9. Intercity rail passenger operation and maintenance decision rules.

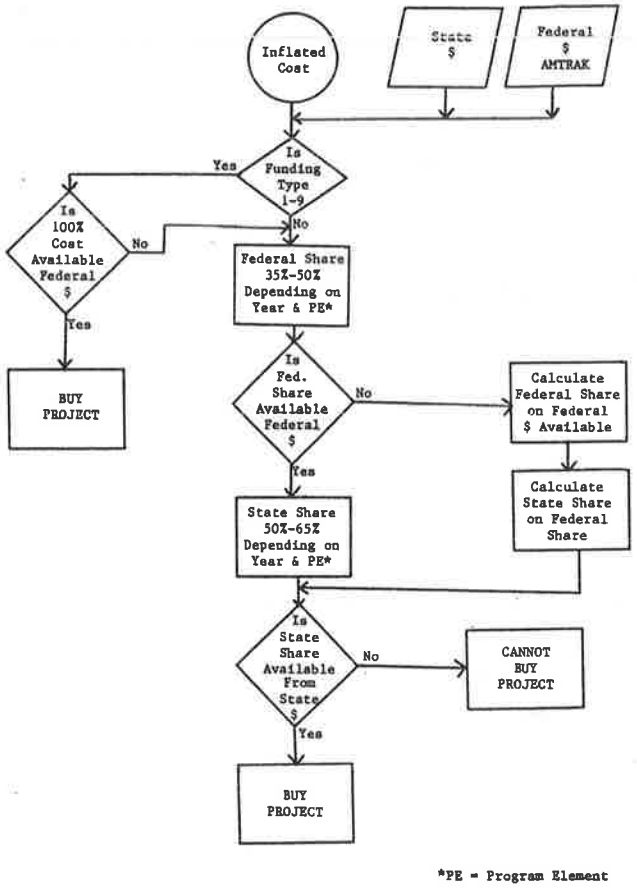


Figure 10. Local transit operation and maintenance projects.

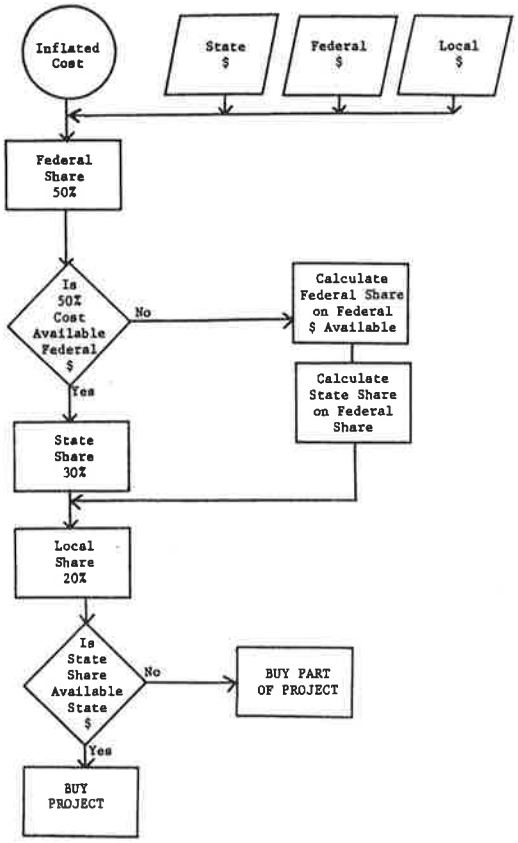
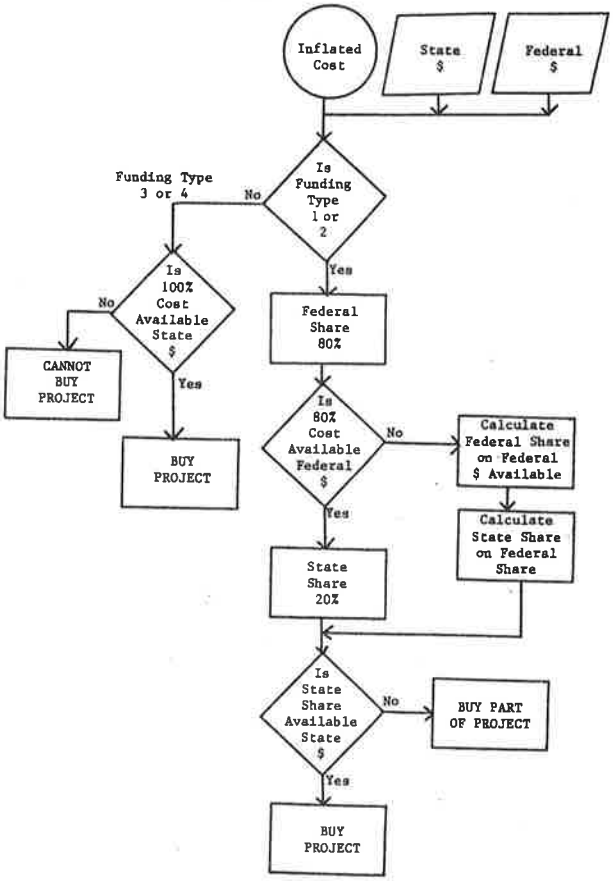


Figure 11. Local transit capital projects.



cost, the state share is set at 20 percent of the cost.

The check on state revenue is then performed. If the state share is available from state revenue, the project is retired. When the state fund cannot cover the state share of the cost, the remaining state revenue is used to buy as much of the project as possible. All local transit projects can be retired only with revenue of the year in which they become deficient.

Marine

Ports have two sets of decision rules: one set is for dredging-type needs (projects) and the other is for all other types of needs (projects). These two sets of decision rules for the marine mode are shown in Figures 12 and 13.

Dredging Projects

The first check in ports is on federal revenue. If 100 percent of the cost is available from federal funds, the project is retired entirely with federal revenue. If 100 percent is not available in federal money, a new federal share is calculated based on the remaining funds. A state share is then computed that picks up the remaining cost of the project. If the state fund does not have enough revenue for the state share, the project is not retired that year.

Other Projects

There is only one check for other projects. If 100 percent of the cost is available from the state fund, the project is retired. If there is not enough revenue, the project is not retired that year.

Nonmotorized

Decision rules for the nonmotorized mode are shown in Figure 14. There is only one check in retiring a nonmotorized need (project). If 100 percent of the

Figure 12. Marine dredging decision rules.

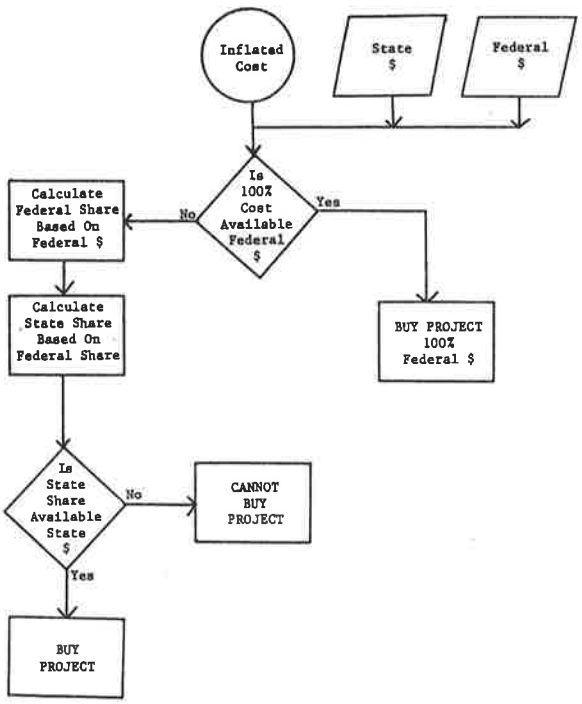


Figure 13. Marine operation and maintenance, terminal construction, and vessel acquisition decision rules.

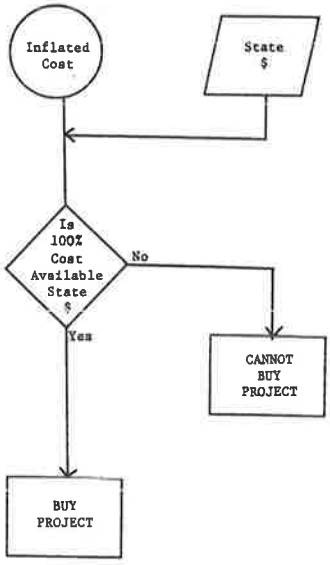
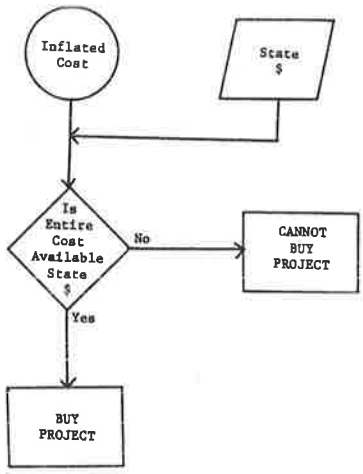


Figure 14. Nonmotorized decision rules.



cost is available from the state fund, the project is retired. If there is not enough revenue, the project is not retired that year.

Rail Freight

The rail freight mode has two sets of decision rules: one for capital needs (projects) and the other for operation and maintenance needs (projects). These two sets of decision rules are shown in Figures 15 and 16.

Capital Projects

The first check for capital projects is on federal revenue. If the federal share, 70 percent, is not available from the federal fund, a new share is calculated based in the remaining funds. Then a state share is calculated based on the federal share. If the 70 percent is available from the federal fund, the state share is set at 30 percent of the cost.

Figure 15. Rail freight capital decision rules.

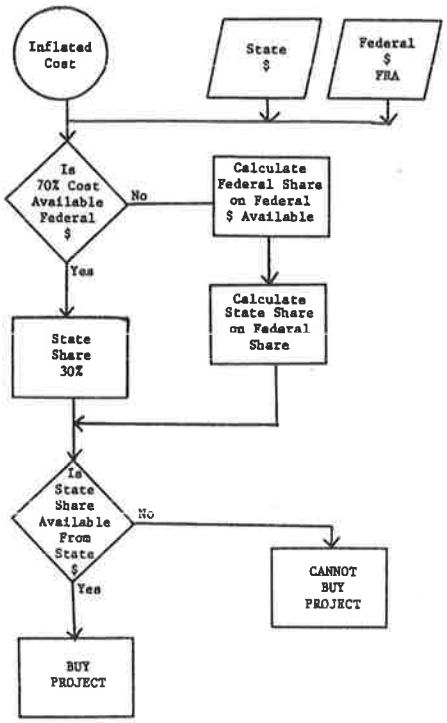
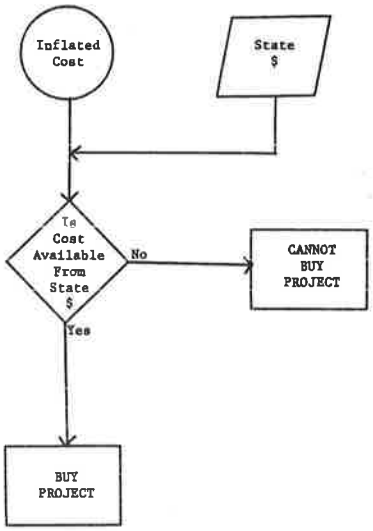


Figure 16. Rail freight operation and maintenance decision rules.



The second check, which is on available state revenue, is then performed. If the state share is available from the state fund, the project is retired. If the state does not have enough revenue in the fund to meet the state share, the project is not retired that year.

Operation and Maintenance Projects

Operation and maintenance projects are retired solely with state funds. If 100 percent of the cost is not available from the state fund, the project

Figure 17. TRIPSUM.

MICHIGAN STATE TRANSPORTATION PLAN

**** SUMMARY ****

for Strategy 1 , REV= 1, OBJ= 1
ADD 3 ZEROES TO 1980 DOLLARS SHOWN

Mode	Program Element								
	CONT.	RELOC.	IMPROV	NEW S.	DISADV	EC DEV	SAFETY	ENERGY	ALL PE
CO	0	0	0	0	0	0	0	0	0
AV	146104	0	0	0	0	0	510	0	146614
HY	104164	6270	179903	20568	0	0	33821	34	344759
IB	7620	0	1695	1814	0	0	0	0	11128
IR	26531	0	44486	44388	0	0	0	0	115405
PT	217427	0	128829	484725	0	0	0	3234	834215
PO	39415	0	10600	5700	0	0	0	0	55715
NM	202	0	201	0	0	0	0	0	403
RF	42312	0	49386	2051	0	0	1623	0	95372
CT	0	0	0	0	0	0	0	0	0
AL	583775	6270	415099	559247	0	0	35953	3268	1603612

Figure 18. Retired city needs: TRIP output for 1982 tax revenue.

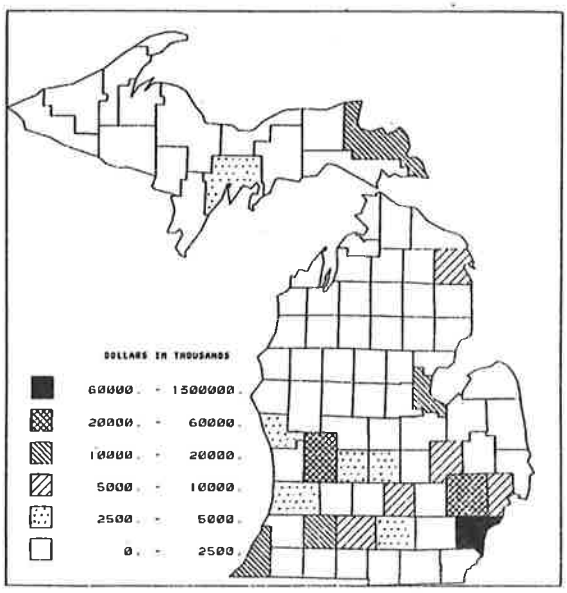
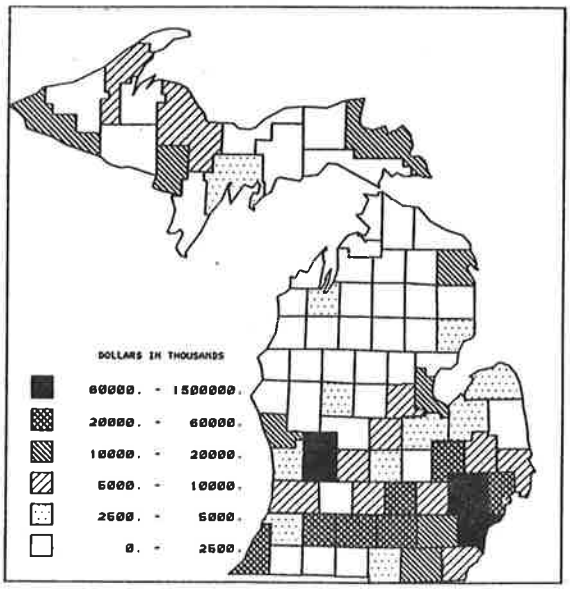


Figure 19. Retired city needs: TRIP output for Brown tax revenue package proposed in 1982.



cannot be retired that year. If the cost is available, the project is retired.

Service continuation projects (program element 1) of either the capital or operation and maintenance type cannot be backlogged.

APPLICATION

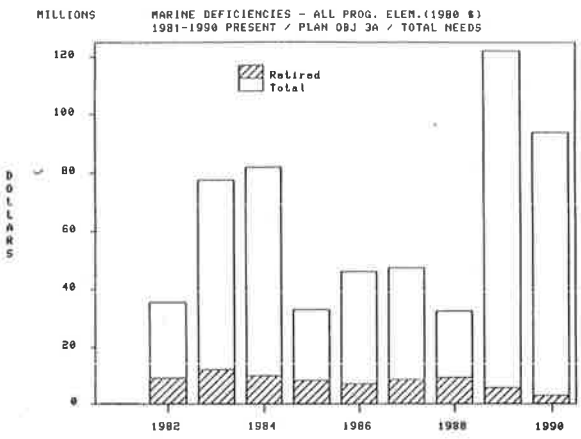
The primary output of TRIP is computer files of needs: one containing retired needs and the other unmet needs. Computer listings of these files can be large and difficult to use. It is not easy to use these files in the daily decision-making process. In order to make more use of TRIP, application reports were developed.

The first application report examined is TRIPSUM. This is a computer program that inputs TRIP output files and produces reports. The report shows dollars of retired deficiencies accumulated by mode and program element (see Figure 17). It also has the ability to report deficiencies by deficiency type and region. It can compare retired needs with total needs and produce results reports. TRIPSUM is a valuable tool in the initial assessment of TRIP output.

To analyze the location and distribution of TRIP

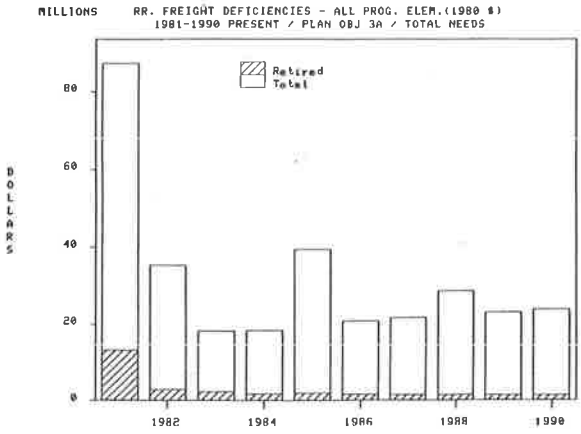
Figure 20. Network plot.

Figure 21. Marine deficiencies: all program elements.



output, CALFORM maps and network plotting are used. By using a code on the need record, the total dollars of retired deficiencies by county can be accumulated. These county totals are then displayed with shading in CALFORM maps (see Figures 18 and 19). The number of projects or selected subsets could also be displayed in a CALFORM map. Network plots are created in a similar manner. By using control section number, highway projects can be associated with their corresponding links in the highway network. Retired projects can be accumulated by number of projects or dollars. The magnitude can be displayed on the links by using bandwidth plotting (see Figure 20). Selected program elements or years can also be displayed. CALFORM maps and network plots visually explain TRIP output easily and quickly.

Figure 22. Railroad freight deficiencies: all program elements.



Another way to look at TRIP output is with bar charts (see Figures 21 and 22). These bar charts show the total (1980) dollars of needs versus the retired needs by year for a given mode. These graphs could be used to look at particular program elements also.

All of the applications shown could easily be run for different revenue package TRIP outputs. The CALFORM maps (Figures 18 and 19) show an example of this. Figure 18 shows TRIP output from the 1982 tax revenue and Figure 19 shows TRIP output for Brown tax revenue, which was a tax revenue package proposed during 1982. The two maps point out quickly the implications in terms of needs retired for two different policy decisions. This is where TRIP can become a valuable tool in daily strategic planning analysis.

CONCLUSIONS

As transportation systems grow older and the number of transportation needs grows larger, deciding where to spend the limited revenue available becomes an ever more difficult question. TRIP helps decision makers to address this question. Various revenue projections and different distributions of revenue among transportation modes can be input into the TRIP planning process. The output can be summarized and graphically displayed to enable analysis to be done quickly and easily. TRIP can assist decision makers in making more knowledgeable and informed choices.

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