Proceedings of the 1983
Winter Simulation Conference
S. Roberts, J. Banks, B. Schmeiser (eds.)

A SIMULATION MODEL FOR MANAGING STATE HIGHWAY MAINTENANCE

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A simulation model is developed in this study for managing state highway maintenance. The purpose of this model is to develop causal links between revenue sources and expense demands of highway maintenance so as to suggest how to formulate cost allocation policies and programming strategies that are fair, economic and sustainable.

1. INTRODUCTION

With the shock of the energy crisis of the mid 1970s came the realization to the transportation community at all levels of government that fiscal and nonrenewable natural resources are declining while the travel demands of the American public are continuing to increase. The response has been a variety of regulations and policies embodying a concept known as transportation system management TSM. We perceive TSM to be a process involving a systematic perspective on the needs and resources of a region--a planning concept that ties together the network of existing facilities and resources into a regional system.

In 1980 the Virginia Department of Highways and Transportation undertook a series comprehensive reviews, analyses, and evaluations of the Commonwealth's transportation system culminating with the JLARC Report by the Joint Legislative Audit and Review Commission. One volume of the JLARC series dealing with highway and transportation issues entitled, "Highway Construction, Maintenance, and Transit Needs in Virginia, "addressed itself in part to maintenance needs for the Commonwealth's highway system. The paper presented here was mandated and motivated to a great deal by JLARC findings and recommendations [1,2,3,].

2. BACKGROUND

The decades of the 1970s saw a dramatic reversal in the fortunes of state highway finances across the U.S. The causes of this plight are well-documented. The energy crisis altered the public's consumption and travel patterns and introduced the more fuel efficient motor vehicles. These events led to a leveling of fuel consumption that directly affected highway tax revenue dollars. The decade also witnessed an increasing share of highway expenditures allocated to non-capital functions, reducing highway investment programs to a fraction of past performance.

Traditionally, motor fuel tax revenue has been the cornerstone of state highway finance. However in the past decade, the fraction of total highway-user revenue collected by the states represented by motor fuel taxes has dropped almost 20 percent. This decline is due to the failure of the states to increase motor fuel tax rates sufficiently to maintain motor fuel taxation's share of the total highway tax burden. Before the energy crisis, increased revenue was achieved through increased motor fuel consumption; however, when consumption dropped the historic pattern of averaging a mere one cent per decade increase in the tax rate could not begin to keep up with inflation. In contrast with motor fuel revenue trends, motor vehicle tax revenues have displayed a steady growth pattern. Still, the need exists to not only increase overall highway user taxes and charges so as to generate more revenues, but to do it equitably.

3. APPROACH

In response to the need for a fair cost responsibility scheme as a basis for future highway taxation policies, Virginia has commissioned several studies which have been reported on recently [4,5,6]. While this paper draws heavily on data and interrelationships developed in these works, it differs significantly in its approach in that use is made of a simulation model to generate and evaluate alternative strategies for matching revenues to expenditures.

The development of this model consists of detailing essential financial management parameters and the causal links between revenue sources and expense demands so as to suggest how to formulate cost allocation policies and programming strategies that are fair, economic and sustainable. The model is applied to a specific application --highway maintenance-- of the inevitable user, supplier, society trade-off that dominates socio-technological systems.

In addition to its role as a forecasting tool, the model serves to aid the users to better understand the response and behavior of the highway maintenance financial system under different conditions. For example, suppose that highway management personnel are considering increasing some fuel tax and want to compare the highway physical condition before and after tax increase. The questions then arise are how much the increase should be (3 cents or 5 cents)? What are their influence on the highway system? How many lane-miles of highway can be improved by a 3-cent increase? How many lane-miles of highway can be improved by a 5-cent increase? In each situation, the decision maker should analyze the system and compare many variables, since his goal is to make a decision with least error.

Pursuant to this objective and consistent with the system dynamics simulation approach that was utilized, the steps in the plan of research consist of:

1. using the causal diagram to convey the assumed links between user revenues and user expenses,

2. developing the mathematical model of DYNAMO equations to establish a "policy laboratory" for highway maintenance management, and

3. illustrating how the "policy laboratory" can be used by highway administrators to evaluate cost allocation policies, maintenance programming alternatives, and the impact of exogenous inputs such as inflation and energy costs.

4. SETTING

The highway system of Virginia is the third largest one in the nation and consists of about 61 thousand miles of roads. The state highway system serves all levels of need for mobility and access, ranging from modern high-speed, controlled-access routes to two-lane country roads. Highways in Virginia are divided into four administrative systems: interstate, primary, secondary, and urban.

The interstate highway system was created by the Federal-Aid Highway Act of 1956. Typically, these are four-lane divided highways with controlled access. In 1980, Virginia had completed 969 miles of interstate highways which corresponded to 4,200 lane-miles.

The primary highway system includes the arterial network which complements the interstate system and connects major cities and towns. In 1980, Virginia had 7,895 miles of primary highways consisting of 20,159 lane-miles.

Primary highways which pass through cities and towns over 3000 in population constitute the urban highways. In 1980, Virginia had 8,166 miles of urban highways which corresponded to 18,001 lane-miles.

All public roads in the counties and all public roads and community roads leading to and from public schools, streets, bridges, and wharves in incorporated towns with 3500 or fewer residents comprise the secondary highway system. In 1980, Virginia had 43,851 miles of secondary highways which were equal to 87,881 lane-miles.

Further, in this study, according to Virginia's highway maintenance program, each highway system is classified into three categories: (1) usable highways which are in good operating conditions, (2) deficient highways or fair condition highways which need immediate ordinary maintenance, and (3) deteriorated highways or poor condition highways which need replacement maintenance in order to become usable highways.

Highway administrators have recognized that adequate maintenance is essential to preserving Virginia's highway system and ensuring the safety of the traveling public. In 1977, the Virginia General Assembly directed that the Highway and Transportation Commission allocate all reasonable and necessary funds for highway maintenance before allocating funds for other programs. The intent of this provision was to ensure that sufficient funds would be available to protect the Commonwealth's investment in its highway system and to provide acceptable levels of safety, comfort, and convenience [3].

The purposes of highway maintenance include: (1) to prolong highway life and postpone renewal; (2) to lower vehicle operating costs; (3) to keep roads open and safe; (4) to promote the safety of the traveling public; and (5) to preserve the existing facilities.

According to the scope and frequency of work performed, the Virginia Department of Highways and Transportation classifies highway maintenance work into two broad categories: ordinary maintenance and maintenance replacement.

Ordinary maintenance refers to the function of preserving each type of roadway, structure, and facilities as near as possible to its condition as constructed. Some activities of typical ordinary maintenance are spot sealing or skin patching of road service; shoulder maintenance; cleaning ditches; filling potholes; removing brush; repair or reset of guard rail; traffic counts; repairing, replacing or resetting signs; surface repair, etc.

Maintenance replacement is the function of restoring each type of roadway, structure, and facilities as near as possible to its condition as constructed. This activity is primarily major rehabilitation works such as pavement resurfacing; replacing guardrails, signs, or drainage structures; major flood damage repairs; and extensive bridge repair. Replacement work is generally more expensive and performed less frequently than ordinary maintenance [7].

In this study, we refer to highways that need ordinary maintenance as "deficient highways" and to highways that need maintenance replacement as "deteriorated highways".

Vehicles using Virginia highways are grouped into four classes which correspond to the way that traffic volume data are maintained. The four classes are:

- Class I, including passenger cars, pickup/panel and two-axle four-tire trucks.
- Class II, including two-axle tractors and two-axle six-tire trucks.
- Class III, including two-axle, six-to-ten-tires trucks.
- Class IV, including three, four, and five-axle combination trucks.

Buses are excluded from the study because of their extremely low volume on these routes.

The state fuel tax is 11 cents per gallon of fuel for Class I and Class II vehicles and 13 cents per gallon of fuel for Class III and Class IV vehicles.

The registration fees paid by different classes of vehicles in this study were computed using the weighted average fees recommended by Virginia law, as shown in Table 1 [4]

5. MODEL DESCRIPTION

According to physical characteristics, for the purposes of Virginia's highway maintenance program, highways in the model are placed into three categories: (1) usable highways which are those in good operating condition, (2) deficient highways or those in fair condition, and (3) deteriorated highways which are those in poor condition. After a period which can be thought of as the "aging time", which is assumed to be 5 years under normal conditions in this study, the usable highway will gradually degrade to "fair" condition. After another period of time, which is assumed to be 20 years under normal conditions in this study, a deficient highway will become deteriorated. The deficient highway can be upgraded to become usable if treated with "ordinary maintenance". The deteriorated highway can be upgraded to be a usable highway through "maintenance replacement". The lane-miles of highways subject to ordinary maintenance per year is the smaller of the following: the amount of the agency's capability and the road-users' demand. The ordinary maintenance capability is defined as the ratio of the highway ordinary maintenance fund to ordinary maintenance unit cost, while the road users' demand is the lane-miles of deficient highways. The lane-miles of highway per year requiring maintenance replacement is calculated in a similar way. Both highway construction and maintenance costs are initial unit costs adjusted for inflation. All aging times, deterioration times and destruction times are influenced by travel and weather factors. Heavier traffic and/or adverse weather conditions would lead to shorter time periods. The amount of highway construction expenditure is the remainder of total revenues from local, federal aid and matching fund sources after highway maintenance, planning and general expense have been paid for. The highway maintenance fund is the sum of the highway maintenance budget and the maintenance residual from the previous year. The highway maintenance residual is the remainder of the available highway fund after the actual maintenance expense has been paid for.

Total revenues from each of the four classes of vehicles are accumulated in the highway fund. A fraction of this fund goes to total highway maintenance which is, in turn, allocated to the four highway types in the order of interstate, primary, urban and secondary. For each highway type, ordinary maintenance and maintenance replacement allocations are made according to physical requirements.

The number of each class of vehicles is influenced by three factors: (1) the initial number of vehicles, (2) the population multiplier, and (3) the income multiplier. It is assumed that if the population or income increases, the number of vehicles will increase. The vehicle miles of travel is obtained in the same way. Fuel tax revenue is calculated by multiplying fuel tax rate by fuel consumption. The amount of fuel consumption is obtained by dividing vehicle miles of travel by average gas mileage. Average gas mileage is adjusted by a TABLE function which assumes fuel efficiency is improving over time. The registration fee revenue collected from each class of vehicles is the product of the appropriate fees per vehicle type and the number of that kind of vehicle.

6. CAUSAL DIAGRAMS

Throughout this study, visual representation or causal diagrams consistent with the system dynamic methodology are used to communicate the underlying structure of the highway maintenance management phenomenon.

The causal diagrams of this model are shown in Figure 1, 2, and 3. Figure 1 shows the causal relationships among the variables in the highway construction and maintenance sector and highway maintenance budget allocation sector, which is represented by interstate highway subsector. Primary, secondary and urban highway subsectors are drawn in the same way -- only change the word "interstate" containing in the variables by "primary", "secondary" and "urban" respectively except the variable Fraction Highway Maintenance Budget to Interstate Factor FHBIF in equation M1-9. In Figure 2, a causal diagram referring to revenues generated from vehicle Class I is shown. The structure for the other vehicle class subsectors is identical. Figure 3 shows the organization of this model. The variables TRC1, TRC2, TRC3 and TRC4 refer to class one, two, three and four vehicle revenue subsectors respectively and the variables ICE, IMB refer to interstate highway construction and maintenance subsector; the variables PCE, PMB refer to primary highway construction and maintenance subsector; the variables SCE, SMB refer to secondary highway construction and maintenance subsector; the variables UCE, UMB refer to urban highway construction and maintenance subsector. For better understanding of these causal diagrams, some illustrations are provided below.

In the causal diagrams, a few of the key parameters are identified and the interactions between the parameters are displayed by arrow and signs. Two types of arrows (solid or dashed) and two types of signs (plus or minus) form four cases of relations between variables. Case 1 is solid arrow with plus sign. Case 2 is solid arrow with minus sign. The parameter at the head of the arrow is a level variable and the parameter at the tail of the arrow is a rate variable. The unit of the rate variable at the tail is that of the level variable at the head divided by years. The sign on the solid arrow tells us if the rate variable adds to, or subtracts from, the level variable. Case 3 is a dashed arrow with a plus sign. Case 4 is a dashed arrow with a minus sign. The parameter at the tail of a dashed arrow may be a variable or a constant. The plus sign on a dash arrow means that an increase (decrease) in the parameter at the tail of the arrow will cause an increase (decrease) in the variable at the head of the arrow. The minus sign is quite the contrary; it means that an increase (decrease) in the parameter at the tail of the arrow will cause a decrease (increase) in the variable at the head of the arrow. A parameter with only arrows emanating from it is a constant.

In summary, the convention of causal diagram can be described as follows: (1) the arrows describe the direction of causality between pairs of variables; (2) the lines (solid or dashed) denote (physical or information) flows; and (3) the signs tells us the nature of the relationship between a dependent-independent variable pair -- (direct or inverse) [8].

7. RESULTS

The results of the simulation runs are divided into: (1) the basic run describing the model's behavior without any new policies, and (2) the scenario runs representing the impacts of some hypothetical scenarios. Through the simulation of the model the behavior of the system is represented in the form of tables and time-series plots. Both show how the selected variables change over time based on the model equations defining all inter-relationships between variables.

The outputs of the basic run are shown in Table 2 which represent the behavior of key variables over a 20-year time period obtained using a computer. Because highway physical condition is a good measure to evaluate the effectiveness of a highway system, the key variables here are the length of usable, deficient, and deteriorated highways in each type of system. Each category of physical condition is also presented by the relative percentage of that type of highway facilities to the total.

8. SCENARIOS

Because the future is uncertain, it is necessary for us to simulate the model under several different scenarios describing the future. Through scenario analysis, we can learn and gain some "experience" from the future in almost the same way as we do from the past. The following scenarios are considered in this study:

1. Higher inflation rate: A greater value of inflation rate is assumed. The base value 5% is replaced by 10%.

2. Breakthrough in fuel-efficiency: A breakthrough in automobile technology is achieved in five years. The table for fuel efficiency multiplier is replaced by "1.0/1.2/1.3/1.4/1.45/1.5".

3. Business prosperity: Assumption is that some attractive conditions appear and many big companies move to this area. The population and average income is increased. The population factor POPF is replaced by 1.025.

4. Lower inflation rate: The oil price is reduced and the Consumer Price Index for All Goods remains at the same level. We replace the parameter inflation rate INRT by 1%.

5. Increasing the road users' charge in the tenth year: The policy time for the current fuel tax rates and registration fees is set for 10 years; from the tenth year, a proposed rate will be used.

In the first scenario, a greater value of inflation rate is assumed. The base value of the inflation rate of 5% is replaced by 10%. For a quick and informative glance of the results, Table 3 summarizes the values of some important indicators and compares them with the base run values at time equal to the 20th year.

In rerun 2, we assume a breakthrough in automobile technology after five years. The table equation for fuel efficiency multiplier FECIMT "1.0/1.06/1.11/1.15/1.18/1.20" is replaced by "1.0/1.2/1.3/1.4/1.45/1.5". A comparison of results from this scenario with the basic run at time equal to the 20th year is shown in Table 4.

In rerun 3, we assume that attractive conditions cause many big companies to move to this area. The population and average income increase. The population factor POPF base value 1.01 is replaced by 1.025. A comparison of results from this scenario with the basic run at time equal to the 20th year is shown in Table 5.

The oil price is reduced a little while the Consumer Price Index for All Goods is kept at the same level. We replace the parameter, inflation rate INRT 5% by 1%. A comparison of results from this scenario with the basic run at time equal to the 20th year is shown in Table 6.

In this last run, the policy time for current fuel tax rates and registration fees is set for 10 years. From the tenth year, a new policy rate will be used. For a quick and informative glance of the results, Table 7 summarizes the values of some important indicators and compares them with the base run values at time equal to the 20th year.

9. CONCLUSIONS

Simulation experiments conducted using this model lead to the following conclusions:

1. The behavior of the model of a complex regional system is determined more by its structure than by the precision of data. The methodology of system dynamics places emphasis on the causal relationship among system's variables. The concept in which after establishing the model structure and then collecting data, not only saves time and money but also is acceptable for dynamic model operation.

2. The model presented here is meant to be illustrative rather than conclusive. Some numerical values are based on reasonable assumptions. Further, some variables such as weather, travel and income multipliers are assumed to be constant in the model while treating them as variables may be more suitable.

3. One of the most important characteristics of a simulation model is to test different scenarios of policies.

4. System dynamics simulation cannot tell you which decision is the best one. It just provides a management laboratory to help the manager understand what kind of decision would lead to what kind of result. This type of understanding will, however, increase the accuracy of decision making, even though it can not achieve optimization.

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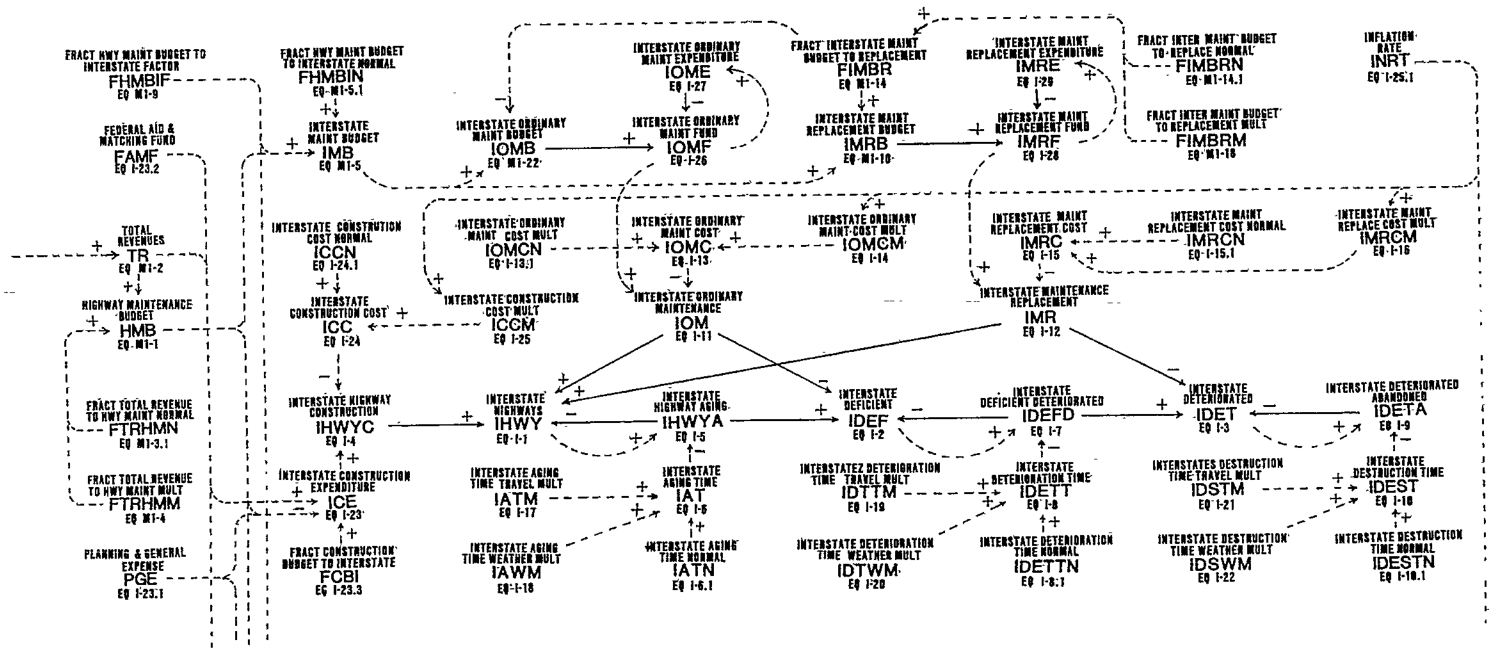
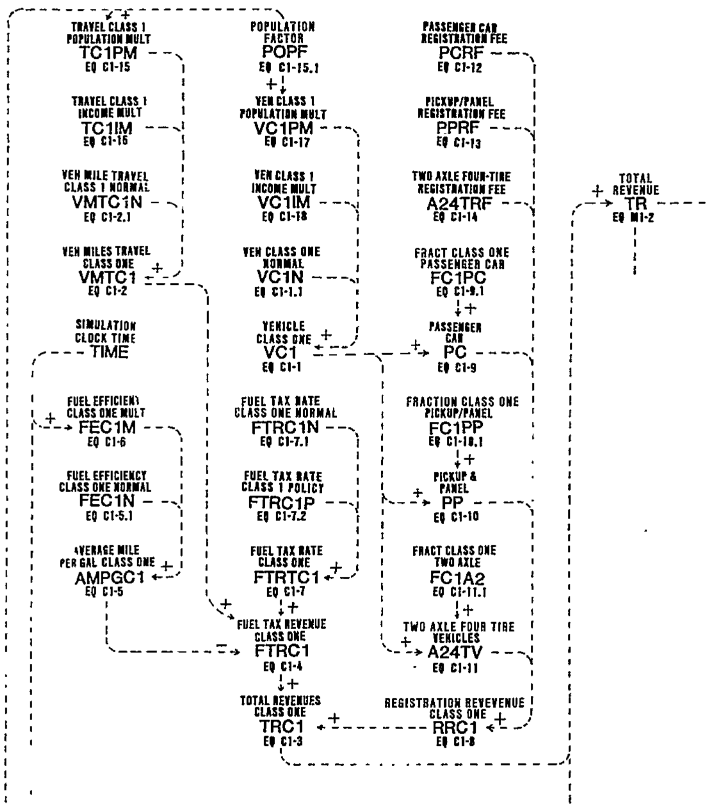


NOTE: PRIMARY, SECONDARY, AND URBAN HIGHWAY SECTORS ARE DRAWN IN THE SAME WAY.

FIGURE 1 – INTERSTATE HIGHWAY CONSTRUCTION AND MAINTENANCE & HIGHWAY MAINTENANCE BUDGET ALLOCATION SECTOR



NOTE: CLASS TWO, THREE, AND FOUR VEHICLE SECTORS ARE DRAWN IN THE SAME WAY.

FIGURE 2 - CLASS ONE VEHICLE REVENUE SECTOR

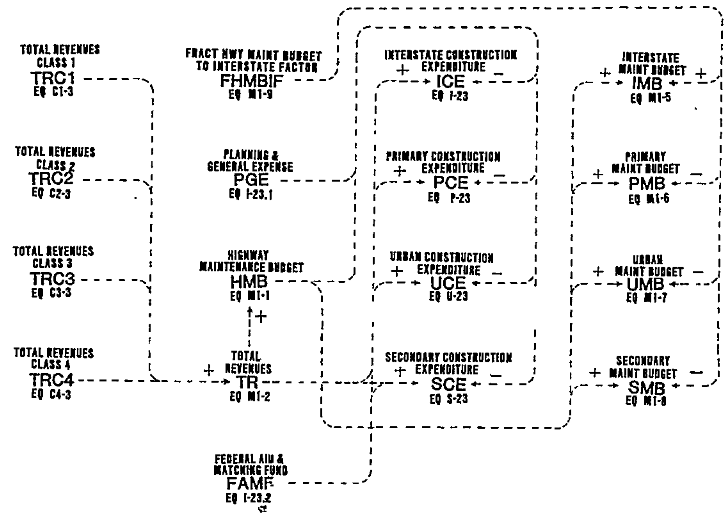


FIGURE 3 - ORGANIZATION OF HIGHWAY MAINTENANCE MANAGEMENT MODEL

TABLE 1

Registration Fees of Vehicles by Type

Class	Type	Fees (dollars per year)
I	Passenger Cars	15.00
	Panel and Pickups	20.00
	2-Axle and 4 Tires	27.00
II	2-Axle-Tractor	30.60
	2-Axle and 6 Tires	81.86
III	3-Axle-Truck	190.00
IV	3- or more Axle-Tractor	559.00

TABLE 3

Effect of Higher Inflation Rate

indicators	Basic Run	This Run	Change
1 Interstate Highways IHWY (Lane-Miles)	2394	1491	-903
2. Interstate Deficient IDEF (Lane-Miles)	2728	2727	-1
3. Interstate Deteriorated IDET (Lane-Miles)	478.3	802.6	+324.3
4. IHWYP (%)	43	30	-13
5. IDEFP (%)	48	54	+6
6. IDETP (%)	9	16	+7
7. Primary Highways PHWY (Lane-Miles)	8790	4310	-4480
8. Primary Deficient PDEF (Lane-Miles)	10480	11670	+1190
9. Primary Deteriorated PDET (Lane-Miles)	1794	3902	+2108
10. PHWYP (%)	42	22	-20
11. PDEFP (%)	49	58	+9
12. PDETP (%)	9	20	+11

TABLE 2 -- BASIC RUN: PHYSICAL CONDITION OF EACH HIGHWAY TYPE IN LANE-MILES

TIME=	.00	IHWY=	3360.	IDEF=	630.	IDET=	210.0	PHWY=	16.13T	PDEF=	3.02T	PDET=	1088.
SHWY=	70.31T	SDEF=	13.18T	SDET=	4.39T	UHWY=	14.40T	UDEF=	2640.	UDET=	880.		
TIME=	2.00	IHWY=	3419.	IDEF=	961.	IDET=	53.8	PHWY=	15.28T	PDEF=	4.80T	PDET=	319.
SHWY=	58.41T	SDEF=	26.28T	SDET=	3.01T	UHWY=	13.34T	UDEF=	4391.	UDET=	268.		
TIME=	4.00	IHWY=	3404.	IDEF=	1193.	IDET=	52.9	PHWY=	14.81T	PDEF=	5.52T	PDET=	257.
SHWY=	50.26T	SDEF=	34.05T	SDET=	3.27T	UHWY=	12.77T	UDEF=	5098.	UDET=	235.		
TIME=	6.00	IHWY=	3392.	IDEF=	1389.	IDET=	61.6	PHWY=	14.62T	PDEF=	5.85T	PDET=	270.
SHWY=	44.37T	SDEF=	38.56T	SDET=	4.44T	UHWY=	12.50T	UDEF=	5438.	UDET=	251.		
TIME=	8.00	IHWY=	3330.	IDEF=	1613.	IDET=	71.7	PHWY=	14.24T	PDEF=	6.36T	PDET=	291.
SHWY=	39.47T	SDEF=	41.65T	SDET=	5.90T	UHWY=	12.09T	UDEF=	5880.	UDET=	301.		
TIME=	10.00	IHWY=	3199.	IDEF=	1843.	IDET=	122.4	PHWY=	13.62T	PDEF=	6.95T	PDET=	433.
SHWY=	35.35T	SDEF=	43.63T	SDET=	7.52T	UHWY=	11.42T	UDEF=	6437.	UDET=	468.		
TIME=	12.00	IHWY=	3013.	IDEF=	2087.	IDET=	191.9	PHWY=	12.74T	PDEF=	7.71T	PDET=	645.
SHWY=	31.88T	SDEF=	44.68T	SDET=	9.23T	UHWY=	10.56T	UDEF=	7145.	UDET=	642.		
TIME=	14.00	IHWY=	2824.	IDEF=	2315.	IDET=	259.1	PHWY=	11.72T	PDEF=	8.55T	PDET=	869.
SHWY=	28.91T	SDEF=	45.05T	SDET=	10.95T	UHWY=	9.66T	UDEF=	7842.	UDET=	848.		
TIME=	16.00	IHWY=	2654.	IDEF=	2502.	IDET=	328.6	PHWY=	10.70T	PDEF=	9.32T	PDET=	1134.
SHWY=	26.31T	SDEF=	44.91T	SDET=	12.62T	UHWY=	8.78T	UDEF=	8454.	UDET=	1094.		
TIME=	18.00	IHWY=	2510.	IDEF=	2640.	IDET=	401.9	PHWY=	9.71T	PDEF=	9.98T	PDET=	1441.
SHWY=	24.00T	SDEF=	44.40T	SDET=	14.21T	UHWY=	7.94T	UDEF=	8946.	UDET=	1382.		
TIME=	20.00	IHWY=	2394.	IDEF=	2728.	IDET=	478.3	PHWY=	8.79T	PDEF=	10.48T	PDET=	1794.
SHWY=	21.91T	SDEF=	43.62T	SDET=	15.68T	UHWY=	7.17T	UDEF=	9283.	UDET=	1713.		

TABLE 4

Effect of Breakthrough in Fuel-Efficiency

indicators	Basic Run	This Run	Change
1. Interstate Highways IHWY (Lane-Miles)	2394	2286	-108
2. Interstate Deficient IDEF (Lane-Miles)	2728	2756	+28
3. Interstate Deteriorated IDET (Lane-Miles)	478.3	529.3	+51
4. IHWYP (%)	43	41	-2
5. IDEFP (%)	48	49	+1
6. IDETP (%)	9	10	+4
7. Primary Highways PHWY (Lane-Miles)	8790	8030	-760
8. Primary Deficient PDEF (Lane-Miles)	10480	10780	+300
9. Primary Deteriorated PDET (Lane-Miles)	1794	2123	+329
10. PHWYP (%)	42	38	-4
11. PDEFP (%)	49	52	+3
12. PDETP (%)	9	10	+1

TABLE 5

Effect of Business Prosperity

indicators	Basic Run	This Run	Change
1. Interstate Highways IHWY (Lane-Miles)	2394	2761	+367
2. Interstate Deficient IDEF (Lane-Miles)	2728	2558	-170
3. Interstate Deteriorated IDET (Lane-Miles)	478.3	341.3	-137
4. IHWYP (%)	43	50	+7
5. IDEFP (%)	48	43	-5
6. IDETP (%)	9	7	-2
7. Primary Highways PHWY (Lane-Miles)	8790	11210	2420
8. Primary Deficient PDEF (Lane-Miles)	10480	9037	-1443
9. Primary Deteriorated PDET (Lane-Miles)	1794	1037	-757
10. PHWYP (%)	42	53	+11
11. PDEFP (%)	49	42	-7
12. PDETP (%)	9	5	-4

TABLE 6

Effect of Lower Inflation Rate

indicators	Basic Run	This Run	Change
1. Interstate Highways IHWY (Lane-Miles)	2394	4140	+1746
2. Interstate Deficient IDEF (Lane-Miles)	2728	2076	-652
3. Interstate Deteriorated IDET (Lane-Miles)	478.3	119.2	-359.1
4. IHWYP (%)	43	66	+23
5. IDEFP (%)	48	32	-16
6. IDETP (%)	9	2	-7
7. Primary Highways PHWY (Lane-Miles)	8790	17180	+8390
8. Primary Deficient PDEF (Lane-Miles)	10480	4664	-5816
9. Primary Deteriorated PDET (Lane-Miles)	1794	221	-1573
10. PHWYP (%)	42	77	+35
11. PDEFP (%)	49	21	-28
12. PDETP (%)	9	2	-7

TABLE 7

Effect of Increasing Road Users' Charges

indicators	Basic Run	This Run	Change
1. Interstate Highways IHWY (Lane-Miles)	2394	2804	+410
2. Interstate Deficient IDEF (Lane-Miles)	2728	2527	-201
3. Interstate Deteriorated IDET (Lane-Miles)	478.3	322.1	-156.2
4. IHWYP (%)	43	50	+7
5. IDEFP (%)	48	45	-3
6. IDETP (%)	9	5	-4
7. Primary Highways PHWY (Lane-Miles)	8790	11370	+2580
8. Primary Deficient PDEF (Lane-Miles)	10480	8893	-1587
9. Primary Deteriorated PDET (Lane-Miles)	1794	984	-810
10. PHWYP (%)	42	53	+11
11. PDEFP (%)	49	42	-7
12. PDETP (%)	9	5	-4