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Foreword

The measurement of vehicular benefits and new approaches to benefit cost analysis are subjects of importance to transportation economists, to highway engineers and to highway planners. Two of the papers in this RECORD are directed toward these subjects.

In "The Measurement of Vehicular Benefits," St. Clair, Todd, and Bostick analyze and interpret the vehicular benefits as determined by the differential-benefit study of highway cost allocation which was included in compliance with Section 210 of the Highway Revenue Act of 1956. The authors describe the processes of measuring the four types of benefits (reduction in time, operating costs, accidents, and impedance). The estimated annual benefits on the Interstate System by vehicle type and type of benefits are reported. A rudimentary model is illustrated and explained and suggested approaches for improvement of the technique for measuring costs and benefits are suggested.

Newcomb in "New Approach to Benefit Cost Analysis" suggests that the present method of calculating benefits and costs of highway construction can be challenged. It is his thesis that the solution which requires the least total social (and in some cases social and private) costs for the benefits provided is the solution to such. The implication is that the best solution may require greater transport costs but will decrease other costs more than it increases transport costs.

Highway administrators are constantly aware of the need for additional highway-user revenues and are also aware of the public resistance to increases in tax rates. Cook and Rush in "Consumer Awareness of Motor Fuel Tax Rates and Prices" report the findings of a survey of highway users in rural and urban areas of Virginia. It was their conclusion that the majority of highway users were aware of the division of gas taxes between state and federal governments and that there was no widespread resistance to gasoline taxes as a source of highway funds. Furthermore the need, convenience, regular scheduled stopping times and other factors had a much more important bearing on gasoline purchases than the price per gallon.

In "State Highway Patrols, Their Functions and Financing," Gladstone and Cooper point out that the highway law enforcement agencies vary greatly not only in their organization, activities and functions but also in the methods of financial support. The study was done in cooperation with the International Association of Chiefs of Police. The authors' conclusions are that the complexity of highway police problems is increasing, and that the annual expenditures for this activity could well reach $450 million by 1969. Even with increasing mileage of divided highways, the number of traffic accidents and deaths each year is also increasing. There is no conclusive evidence that merely increasing patrol strength or activities would, in itself, decrease accidents.

Contents

The Measurement of Vehicular Benefits

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•THIS PAPER is a by-product of the differential-benefit study, which was one of the highway cost allocation methods used in the study conducted in compliance with Section 210 of the Highway Revenue Act of 1956 (1). Until its later stages, the differential-benefit work was carried on by Paul J. Claffey, whose effective work in this field is attested to by a number of publications discussing the methods and findings of several sub-projects of the differential-benefit study (2, 3). There remains only a mopping-up operation in which we examine what was produced in the study and what we have learned that may be of value for such work in the future.

SIGNIFICANCE OF VEHICULAR BENEFITS

The differential-benefit study was restricted to the benefits realized directly by motor vehicle users because the purpose of the study was to allocate motor-vehicle-tax responsibility for the Federal-aid program in proportion to the benefits to be derived by vehicles in the various type and weight groups. The study of indirect or nonuser benefits was undertaken as a separate phase of the Highway Cost Allocation Study and reported on separately (4). Even when confined to the so-called vehicular benefits, the problem is one of unusual difficulty. One must first identify those benefits that are of significance and susceptible of measurement. Next, one must find means of measurement that will reflect the magnitudes of benefits produced by various kinds of highway improvements. Third, and perhaps most difficult, one must find a means of estimating with some degree of plausibility the extent of the benefit-producing accomplishments of the projected highway program.

In line with the work of McCullough (5), vehicular benefits were defined in terms of reductions in cost produced by highway improvements. Rather broadly interpreted, these cost-reduction benefits are of four kinds: (a) reductions in operating costs; (b) reductions in time costs; (c) reductions in accident costs; and (d) reductions in the so-called impedance costs, i.e., the strains and discomforts of driving under congested conditions.

There is some disposition to regard the measurement of benefits as nothing more than an exercise or as a tool of propaganda or publicity for the particular type of improvement that is advocated. This is particularly true in the case of time savings and the even more subjective comfort and convenience factor. Seligman (6) ridicules, with much justification, the piling-up of astronomical figures on the costs of various alleged evils to the American economy. He touches a sensitive nerve when he directs his scorn to some statistics on accident costs produced by the National Safety Council, pointing out that an item of $150 million for medical expenses includes earnings received by doctors and that an item of $2,350 million for overhead of insurance includes the salaries of claim adjustors. "So," he concludes, "the figures do not add up to any economic loss to society."

Neither the National Safety Council nor others interested in highway safety would be quite willing to accept Seligman's implied conclusion that motor-vehicle accidents aren't a bad thing after all. If we did accept this notion, we should be abashed that the Inter-

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*Presently with Wilbur Smith and Associates.

state System is disrupting the national economy by depriving repair garages, physicians, and insurance companies of legitimate business, not to mention the undertakers and tombstone manufacturers whose services can only be postponed, not avoided. Still, the books do balance, and one man's poison is another man's meat. So it seems that in a world where the most ghastly accidents are producers of business and employment, we must find a working principle by which to measure, and give a dollar value to, the advantages derived from reducing accident costs and other unwanted elements in motor vehicle travel. In the case of accident costs, we can find the justification in the economic allocation of resources. Nobody, not even the doctors, garage men, and insurance companies, really desires to increase the business of producing highway accidents.

In the case of time savings and reductions in the so-called impedance costs, the justification is not so obvious but it is found by resort to market economics. A product, a notion, a service, is valuable if people are willing to pay for it. The toll-booth cash registers tell us that people are very willing to pay for time savings, whether on business or pleasure. At one time there was a tendency to regard time savings as having a value only when the time saved could be employed in a gainful pursuit. The willingness of American motorists to pay for highway improvements, whether by taxes or by tolls, is ample evidence that time savings is a marketable commodity, whatever the use to which the saved time is put.

It is plain that time savings or time losses must always be valued within this market concept and cannot be handled in exactly the same way as tangible costs or savings, e.g., those of fuel consumption. You cannot save 24 hours a day; you must somehow spend the day. It is also true that measurements of the value of time must always be averages, and generally rather unstable ones at that. Time is of different value to different persons, and to the same person on different occasions.

It is also held, and generally acknowledged, that minute time savings are of less unit value than time savings of considerable amount. For a million persons to save one minute out of an hour's trip does not, so it is said, produce the same dollar savings as 100,000 persons making a 10-minute savings in an hour. While the truth of this proposition seems obvious at the extremes, there is some evidence that many motorists behave as if minute time savings were a major objective. The active and aggressive driver continually tries to pass the cars ahead of him, although the net result may be only a few minutes or a few seconds saved in a trip of considerable length.

The same market considerations apply to impedance costs, the strains and discomforts of congested or nonuniform driving. Many people regard any attempt to give a dollar value to such costs or their reduction as fantastic and unworthy of attention. To this it may be replied that the Pullman Company made a very good thing for many years out of selling comfort and convenience to railway passengers. There would be no reason for people to sit down on railroad trains, let alone sleeping in a berth, if comfort had no value. Automobile and even truck manufacturers know the value of comfort and convenience to their customers and incorporate these qualities in the vehicles they design. To build the same attributes into the highways is simply following good business practice. There is no doubt that much of the popularity of turnpikes and freeways, and the willingness of people to finance them, results from the greater ease and comfort of the ride they provide.

It is hardly necessary to dwell upon the reality of savings in vehicular operating costs produced by improved highways. Very dramatic savings are found in moving from primitive forms of transportation, such as the ox cart, to modern highway or railway transport. Reductions in rise and fall afford great savings in truck transportation, as was shown in the studies made some years ago on the Pennsylvania Turnpike and U.S. Routes 11 and 30 (7). For automobiles such savings in unit operating costs are generally converted to time savings by driving at increased speeds with a probable increase in fuel and tire costs.

In sum, all of the four classes of vehicular benefits are very real and have great significance in determining the kinds of highways we build and the amount of money the American people are willing to invest in this activity. On the other hand, this is not the whole story. In the building of any highway, or of any highway network, there are minuses as well as pluses. Something is sacrificed when any piece of highway work is

done, even if it is only the inconvenience caused to motorists during construction. There are many indirect effects, some of them unfavorable, and enlightened highway policy must take these effects into account. Disclosure of the prospective benefits to users explains why they want the highways and are willing to pay for them. It does not give the final answer as to whether the investment should be made or whether a particular highway should be built in a particular place. Broader social consideration must be brought into play.

THE PROCESS OF MEASUREMENT

It can be stated that, in general, savings in operating costs, time, accident costs, and strain-discomfort costs in driving can be achieved through improvements of highways. The question is—how can these savings be measured? Obviously it is necessary to have average values of each of these four cost elements for each size and weight group of vehicles under a variety of operating conditions that will span the "before and after" states of highway improvement.

The work of investigators for many years has produced valuable information about motor vehicle transportation costs and their reduction through highway improvement. The early studies of Agg, Winfrey, and Moyer at Iowa State College and those of McCullough, Beakey, and their associates in the Oregon State Highway Department stand as landmarks in the field. In recent years greater attention has been paid to accident costs, to the measurement and evaluation of time savings, and to the effect of highway improvements on the quality of motor-vehicle transportation. A list of references emphasizing the more recent work on these subjects is given on pp. 224-5 of the "Final Report of the Highway Cost Allocation Study." A prior list, to be found on p. 128 of the first progress report of that study, gives some of the earlier references (1).

Special Research for Differential-Benefit Study

Although the body of literature reporting previous research in the field was of immense value in the differential-benefit study, it was found necessary to conduct or arrange for a number of substudies in order to fill gaps in the data or to bring up to date the factors of unit cost and cost reduction. Among these the four principal ones were the following: first, a study by Claffey to determine travel-time and fuel-consumption characteristics of automobiles and single-unit trucks (2); second, a series of studies, conducted by university groups, of the travel-time and fuel-consumption characteristics of selected trucks and combinations in rural and urban line-haul service and in city delivery service (8); third, a comparative study of motorists' use of toll roads and alternative free roads, designed to provide means of estimating the average unit value of time and of the so-called impedance or comfort-and-convenience factor (3); and, fourth, a study by Green (9) to evaluate estimates of the average unit value of time savings to commercial vehicles of different types and sizes.

The first of these studies supplemented the earlier work of Saal (10) and others in observing and measuring the operating characteristics of passenger cars and single-unit trucks. Three test vehicles were used in the study: a passenger car, operated with driver and observer; a pickup truck operated both empty and fully loaded; and a dump truck operated both empty and half loaded. Both travel time and fuel consumption were measured under the following variations in driving conditions: (a) operating speeds of 15 to 55 mph; (b) gravel and concrete surfaces; (c) stop-and-go operation; and (d) temporary speed reductions. This work, combined with earlier and contemporary findings, resulted in the evaluation of unit-cost factors applicable to numerous road-improvement elements, such as reduction in length, surface improvement, reduction in curvature, and elimination of intersections-at-grade.

The second series of studies performed the same service for combination rigs in rural and urban line-haul service and for both light and heavy trucks and combinations in city pickup and delivery service. Studies were conducted at Ohio State University and the Universities of Michigan and Washington and by a transportation consultant from the University of Maryland. Two major reports (8) resulted from these researches. Here again the results of earlier studies, notably Saal's work on the Pennsylvania

Turnpike and the alternative route (7), as well as those of contemporary work, were drawn upon in evaluating unit cost factors applicable to the operating and time savings of these classes of vehicles.

The third of the cited studies (3), Claffey's experiment to determine average estimates of the unit value of time and of the "impedance" factor, was based on 38 successful runs on 14 toll roads and the alternative free roads, all in situations where the motorist is confronted with a definite choice of routes between two terminal points. Data pertinent to the determination of these unit values included the amount of the toll and, on both roads, the amount of fuel consumption, time of trip between terminals, the summation of impedance units accumulated during the trip, and the proportions of motorists using the two alternative routes.

An impedance unit is defined as a speed change of one mile per hour, plus or minus, for all speed changes in excess of three miles per hour. The reasons for using speed change as an indicator of strain and discomfort were expressed as follows in an earlier paper (11):

> Nearly all the factors that contribute to annoyance, discomfort and nervous tension on a trip have their most direct and immediate effects in causing changes in speed (including reductions to zero speed). Sharp curves, steep grades, narrow roads, poor conditions of repair, left turns, right turns, stop signs and signals, passing maneuvers and many other items cause the motorist repeatedly to check his speed, to accelerate, to stop, to start, or in other words, to depart from the condition of uniform speed which is characteristic of a pleasant trip. The necessity to change speed requires certain physical movements on the part of the driver and an increase of the attention he must pay to driving. On all occupants of the car acceleration or deceleration exerts forces that are proportional to the magnitudes of the speed changes.

In addition to providing the information leading to a statistical solution for the required unit values, this study supplied data on motor-vehicle operating characteristics under both freeway and ordinary driving conditions.

Accident-Cost Research

In the field of accident costs the differential benefit study profited from the fact that Public Roads-state cooperative studies of the costs of motor-vehicle accidents were completed or in progress in four states, Illinois, Massachusetts, New Mexico, and Utah (12); data from all of them became available during the study. From an analysis of these studies the average costs per accident were obtained for three classes of vehicle—automobiles, single-unit trucks, and combinations—and for six classes of roads—Interstate and other federal-aid primary highways, federal-aid secondary highways, and non-federal-aid systems, both rural and urban.

Data From States

Representative states in each census division (31 states in all) were asked to provide specific data on the amount of benefit-producing improvements to be realized by the program. These data were prepared separately for each of the federal-aid systems, rural and urban. The following were among the specific data requested:

1. Miles of resurfacing that involve upgrading from unsurfaced or low type to intermediate or high type; and
2. Miles of reconstruction and construction on existing and new locations that result in (a) reductions in rise and fall, (b) elimination of intersections at grade, (c) elimination of access points, (d) elimination of sharp curves, (e) increase in the number of lanes, and (f) reduction in travel distance.

The benefits resulting from highway improvements make driving easier, quicker, and safer and at the same time reduce operating costs. Each of the kinds of improvement cited above produces, in varying degree, one or more of the four basic vehicular

Figure 1. A road improvement in mountainous country eliminates a sharp curve, reduces length, and cuts down rise and fall.

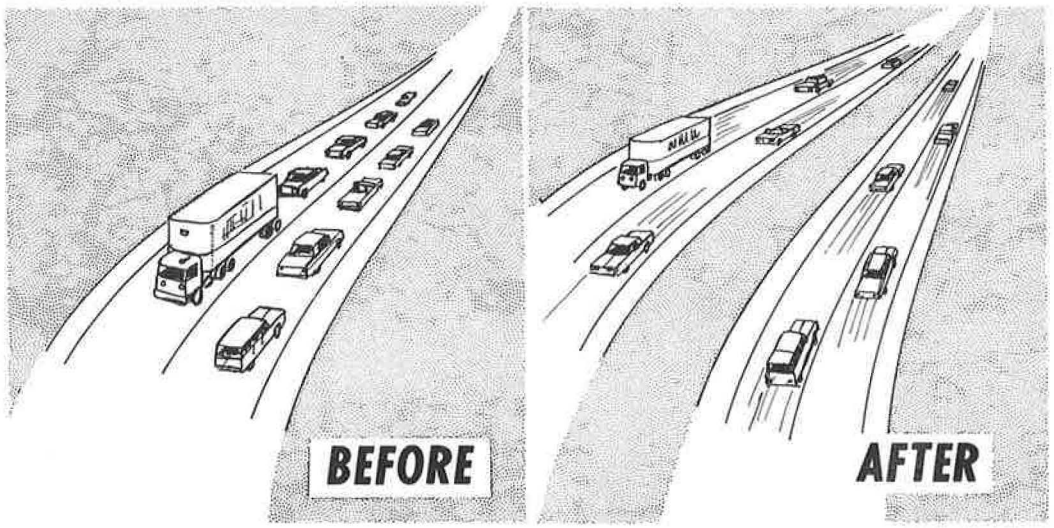

Figure 2. Upgrading a 2-lane road to a 4-lane divided highway to increase capacity, relieve congestion, and reduce accidents.

benefits. An upgrading of the road surface brings them all in: decrease in fuel and other operating costs, accident reduction, time savings, and increased riding comfort. A reduction in rise and fall, as was demonstrated (7), primarily brings about reductions in travel time and in fuel consumption and other operating costs. The effects of eliminating intersections-at-grade are well illustrated by the case of traffic signals, which cause the driver to brake, to come to a stop, to wait, and to accelerate to normal driving speed. These actions produce time delays, increased tire wear and fuel use, driving strain, and some accident hazard; elimination of the signal produces the corresponding benefits.

Figures 1 and 2 illustrate some of the kinds of highway improvement that result in savings to highway users. Figure 1 shows the elimination of a sharp curve by the realignment of a route through a mountainous area. This realignment also results in a reduction in length and in rise and fall. Unfortunately, the artist left us with a raw cut which we can hope will be transformed by a beautification project.

Figure 2 illustrates the up-grading of a 2-lane road to a 4-lane divided highway, thus increasing capacity and relieving congestion by separating the opposing traffic streams. The savings involved include accident costs as well as time savings and the reduction of strain and discomfort. Not shown in the sketch are the further benefits derived by the elimination of intersections-at-grade and private access points.

From the data on benefit-producing accomplishments received from the states, census division estimates were calculated by applying average factors obtained from the data of the responding states to the mileage of different classes of construction work in different kinds of terrain within the entire division.

The data collected were for the 16-year period (1957-72) of the expanded federal-aid highway program. Estimates were made for each federal-aid system as to the portion of the program that would be completed by the midpoint (1964) of the program. The purpose of these estimates was to place the benefit calculations in the setting of the midpoint of the program, 1964. The data supplied by the states, however, covered the entire program and were thus susceptible of evaluation to yield estimates of the vehicular benefits to be derived in 1973, the year following completion of the program.

Other Data Supplied by States.—In addition to the estimates of miles of highways to be completed by 1964 and 1972, it was necessary, as a basic part of the highway cost allocation study, to estimate vehicle-miles of travel by visual type of vehicle, by registered gross weight, by fuel type, and by class of operation. Loadometer studies were conducted at numerous weighing stations throughout the country on the several systems to measure operating weights and to record corresponding registered weights of representative vehicles. Both types of weight were required, as operating cost savings vary according to operating weight, yet must be linked in terms of registered weight for tax allocation purposes.

From the 1964 projections, vehicle-miles of travel were determined for each operating weight group. Average benefit values per vehicle-mile as determined by other studies were multiplied by the total travel in each operating weight group to measure the dollar benefits of that group. A further breakdown by fuel type and class of use was also used throughout the benefit calculations.

Application of Data in Evaluation of Benefits

To produce a valid, or at least plausible, estimate of the benefits to be derived by each type and weight group of vehicles, the several classes of data described were consolidated in a series of multiplications and summations performed on the computer. The structure of the evaluation was cellular, the basic cells for vehicles and highways being as follows:

1. For vehicles: The number of vehicles of a given visual type, registered gross weight, use class (publicly owned, private, and for hire) and fuel type (gasoline or diesel) registered in the states of a given census division in a given year (1964, 1973, or other).
2. For highways: The number of miles of highway of a given type (low, intermediate, high-type 2-land, high-type 4-land, and 6-lane or more), on a given system (Interstate, other FAP, FAS state, and FAS local, each divided into rural and urban portions) in the states of a given census division in a given year.

For travel, by a combination of the two structures, the basic cell was determined as the number of miles traveled by the vehicles of a given cell group on the roads of a given cell group in a given year. Because of travel between census divisions this concept was modified by withholding the identification between the numbers of vehicles of a given class and the corresponding vehicle-miles until the assembly of nationwide totals. Values were calculated to yield the estimated benefits of the completed program, but were modified for 1964, or for any year prior to 1973, by factors representing the status of program completion in that year.

An illustration of the calculations involved in the evaluation and summation of vehicular benefits is given in Appendix D of the Supplementary Report of the Highway Cost

TABLE 1

CALCULATION OF DOLLAR VALUE TIME SAVINGS TO AUTOMOBILE USERS RESULTING FROM ELIMINATION OF 17 SIGNALIZED INTERSECTIONS-AT-GRADE IN 66 MILES OF 4-LANE DIVIDED HIGHWAY[a]

Item	Class Interval of Hourly Traffic Volume				
	0 to 400	400 to 800	800 to 3,000	Over 3,000	Total or Average
Percentage distribution	2.6	15.0	81.9	0.5	100.0
Nominal speed, mph	57	55	42	37	—
Average stopped delay time at rural intersections, min[b]	0.210	0.210	0.210	0.210	0.210
Excess time consumed in stopping and resuming speed, min[c]	0.251	0.251	0.201	0.170	—
Total time per vehicle stopped, min	0.461	0.461	0.411	0.380	—
Saving per vehicle stop eliminated, at 2.37 cents per min, cents	1.093	1.093	0.974	0.901	—
Average per passage (30 percent of vehicles stopped), cents:					
Unweighted	0.328	0.328	0.292	0.270	—
Weighted by hourly volume	0.009	0.049	0.239	0.001	0.298
Value for 17 intersections eliminated in 66 miles, cents	—	—	—	—	5.066
Average benefit per vehicle-mile, cents	—	—	—	—	0.07676
Vehicle-miles of travel in year, millions	—	—	—	—	345
Dollar value of annual time benefits	—	—	—	—	$264,822

[a](1, Supplementary Report of the Highway Cost Allocation Study, Appendix D, pp. 359-365). [b](3, p. 11). [c](2, p. 19).

Allocation Study (1, pp. 359-365). For simplicity the highway element or cell is taken as 66 miles of 4 lane divided high-type road on the Interstate rural system. The demonstration problem is to estimate the benefits derived by two vehicle groups, (a) automobiles and (b) 2-axle, 6-tire trucks of 26,000 to 32,000 lb gross weight, from the improvement of this road by the elimination of 9 sharp curves and 17 signalized intersections-at-grade.

Table 1 illustrates one small part of that demonstration, the evaluation of the automobile time savings produced by the elimination of the 17 signalized intersections in a year in which the automobile travel on the 66 miles of road was 345 million vehicle-miles. Since the time lost in stopping and regaining speed varies with the speed of the car, the travel on this highway is divided into four class intervals of hourly volume. It will be observed on the first two lines of Table 1 that 81.9 percent of the automobile travel occurs at hourly volumes of 800 to 3,000, and that the nominal speed of traffic in this range of hourly volume is 42 miles per hour. Claffey defines nominal speed as the modal operating speed of all vehicles of a given class while moving on sections of a highway where they are not stopped by highway impedances such as traffic signs and signals, sharp curves, etc. (2, p. 16).

Claffey found (3) the average stopped time delay at a traffic light to be 0.21 min, or about 13 sec, at rural intersections. Average time delay caused by coming to a stop and regaining speed varies from 0.17 min at 37 mph to 0.25 min at 57 mph. At 2.37 cents per min the value of time savings per vehicle stopped ranges from 0.90 to 1.09 cents. Further steps in the calculation allow for the fact that, on the average, only 30 percent of the vehicles are stopped, and obtain a weighted average value of 5.07 cents saved for each vehicle passage over the 66-mile stretch of road. The annual savings comes to $264,822, for the annual vehicle-miles of 345 million.

Benefit Estimates

In the Highway Cost Allocation Study the benefits to be derived by vehicles of different type, weight, and class groups were evaluated primarily for the purpose of making allocations of cost responsibility in proportion to benefits. We are concerned here

more with the benefits themselves as evaluated through the measuring process described in the preceding paragraphs.

Table 2 gives the estimated benefits accruing to users of the Interstate System in 1973. Total benefits are expected to reach $11.4 billion. Of this total, $8.4 billion will be realized by automobiles and $3.0 billion by buses and trucks.

Estimated benefits from savings in operating costs of $3.5 billion account for 30.4 percent of the 1973 total, with time benefits ($2.9 billion) and accident benefits ($2.6

TABLE 2

ESTIMATED ANNUAL BENEFITS ON INTERSTATE SYSTEM BY TYPE OF VEHICLE AND TYPE OF BENEFIT, 1973[a]

Type of Vehicle	Type of Benefit				
	Time	Operating Costs	Accident	Impedance[b]	Total
Automobiles	1,673,967	1,912,701	2,470,046	2,371,917	8,428,631
Buses					
Transit	10,127	8,538	6,614		25,279
Intercity	22,177	18,922	11,043		52,142
School and miscellaneous	4,449	3,765	2,648		10,862
Total	36,753	31,225	20,305	—	88,283
Trucks and combinations					
Single-unit trucks:					
2-axle, 4-tire	309,041	281,083	54,042		644,166
2-axle, 6-tire	205,855	197,540	36,647		440,042
3-axle	27,379	35,978	4,970		68,327
Total	542,275	514,601	95,659	—	1,152,535
Combinations:					
With semitrailers:					
3-axle (2-S1)	125,066	185,668	19,570		330,304
4-axle (2-S2, 3-S1)	399,902	648,025	42,371		1,090,298
5-axle or more (3-S2, etc.)	92,764	148,012	7,858		248,634
Total	617,732	981,705	69,799	—	1,669,236
With full trailers:					
3-axle (2-1)	851	836	104		1,791
4-axle (2-S2, 3-S1)	4,497	4,984	512		9,993
5-axle (2-3, 3-2)	8,297	8,034	879		17,210
6-axle or more (3-3, etc.)	461	439	40		940
Total	14,106	14,293	1,535	—	29,934
With semitrailers and full trailers	13,476	14,026	1,579	—	29,081
All combinations	645,314	1,010,024	72,913	—	1,728,251
All trucks and combinations	1,187,589	1,524,625	168,572	—	2,880,785
All vehicles	2,898,309	3,468,551	2,658,923	2,371,917	11,397,700
Percent	25.43	30.43	23.33	20.81	100.00

[a]Amounts in thousands of dollars. [b]Impedance benefits assigned to automobiles only.

TABLE 3

ESTIMATED BENEFITS TO BE DERIVED BY A SELECTED GROUP OF MOTOR VEHICLES PER YEAR, PER MILE OF TOTAL TRAVEL AND PER MILE OF INTERSTATE SYSTEM TRAVEL, 1973

Item	Class of Vehicle							
	Automobile	Trucks and Combinations						
		2-Axle 4-Tire	2-Axle 6-Tire	2-Axle 6-Tire	3-Axle (2-S1)	4-Axle (2-S2)	4-Axle (2-S2)	5-Axle (3-S2)
Registered gross weight or equivalent (pounds)	4,413	6,000	14,000	18,000	45,000	55,000	55,000	66,000
Type of fuel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Diesel	Diesel
Average annual travel:								
On all roads and streets	9,747	8,756	8,389	9,990	32,133	43,380	64,805	57,920
On Interstate System	1,597	1,098	1,393	1,758	10,496	13,835	22,452	24,874
Estimated benefits in 1973 (cents):								
Per mile of total travel	1,500	1,243	1,545	1,744	3,832	4,489	4,873	5,221
Per mile of Interstate System travel	4,540	4,193	4,189	4,579	7,529	8,689	8,885	6,501
Interstate benefits in 1973, per vehicle	$ 73	$ 40	$ 58	$ 80	$ 790	$1,202	$1,995	$1,617

billion) accounting for 25.4 and 23.3 percent, respectively. Impedance benefits, assigned to automobiles only, will total $2.4 billion or 20.8 percent of the total.

For automobiles the largest portion of the total benefits will be realized from reductions in accidents, with impedance benefits next in magnitude. For buses and single-unit trucks the benefits realized from time savings are the largest. For combinations with semitrailers and full trailers, savings in operating costs will be most important.

Table 3 gives the estimated 1973 benefits that will be realized from the highway improvement program by eight typical vehicles of specified gross weight, fuel type and annual travel. The annual mileages are those given by the study for vehicles in the given gross weight group. It will be noted that the benefits per mile of travel on the Interstate System are substantially in excess of the benefits per mile of total travel on all roads and streets. This is due chiefly to the fact that the Interstate System is to be completed to high standards by 1973 while the needs of other systems may be only partially met at considerably lower standards. Therefore, the benefits occasioned by the completion of the Interstate System may be fully realized while only varying degrees of full realization of benefits can be anticipated on other road systems.

The 1973 Interstate benefits per vehicle vary from $46 for a 2-axle, 4-tire truck to $1,995 for a 2-S2 diesel combination. The average benefits predicted for the automobile in 1973 are $73.

CRITIQUE AND PROGNOSIS

The foregoing has dealt with vehicular benefits as they were measured in the Highway Cost Allocation Study, with a cursory look at benefit measurements by others. When a job is done and its product neatly wrapped up in a report, a concern for future work in the same field is more appropriate than either complacency or remorse for what is now a part of the past. With respect to benefit measurements, we should now ask ourselves not "What did we do wrong?" but "What can we do better in the future?" There is some tendency, particularly in a report produced by a government agency, to claim perfection for it, lest by the admission of imperfections those dissatisfied with its findings may be enabled to destroy it. No honestly fabricated piece of research is either that good or that vulnerable to criticism. It is in this spirit that these exploits in the measurement of vehicular benefits are opened to clinical examination.

A Rudimentary Model

Although explicit instructions were developed for the computer program in the differential-benefit study, it must be acknowledged that no models supportable in logical or mathematical terms were ever formally developed. What is shown in the next three figures can hardly be dignified by the term, but they do show the fundamental reasoning and give some support to the procedures followed. In Figure 3 unit vehicular cost is plotted as a function of quantity of travel without specific definition of these variables. Quantities of travel perhaps would be thought of as vehicles per hour on a given road and unit vehicular cost as the average cost per mile or average cost of trip. The unit cost could apply to any or all of the four categories of cost whose reductions are defined as vehicular benefits. The two curves represent conditions on two roads, R_b representing the original road, R_a the one that replaces it. The lower limiting conditions, properly representing the cost of free movement of one vehicle per hour (or other time unit) on each of the two roads, are shown as C_O and C'_O. The beginning assumption is that the old road disappears in the construction of the new road either by a reconstruction or by abandonment. If we assume that the new road (perhaps a 4-lane road replacing a 2-lane road) accommodates the same traffic as the old road, then the unit vehicular cost on the old road is represented by the ordinate OC_1, and the unit vehicular cost on the new road is represented by OC'_1. The total cost for the quantity of travel Q_1 is represented for the old road by the rectangle $OC_1B_1Q_1$, and the total cost for the new road is given by the rectangle $OC'_1A_1Q_1$. The difference or total cost reduction (vehicular benefit) is given by the shaded rectangle.

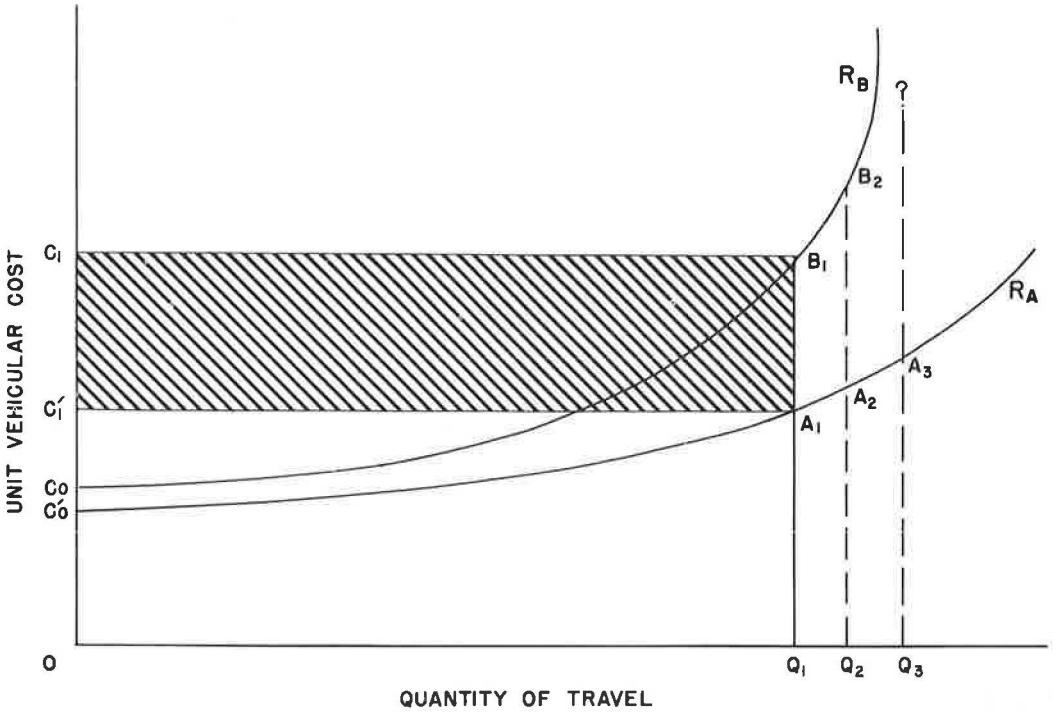

Figure 3. Interpretation of vehicular benefits: first step.

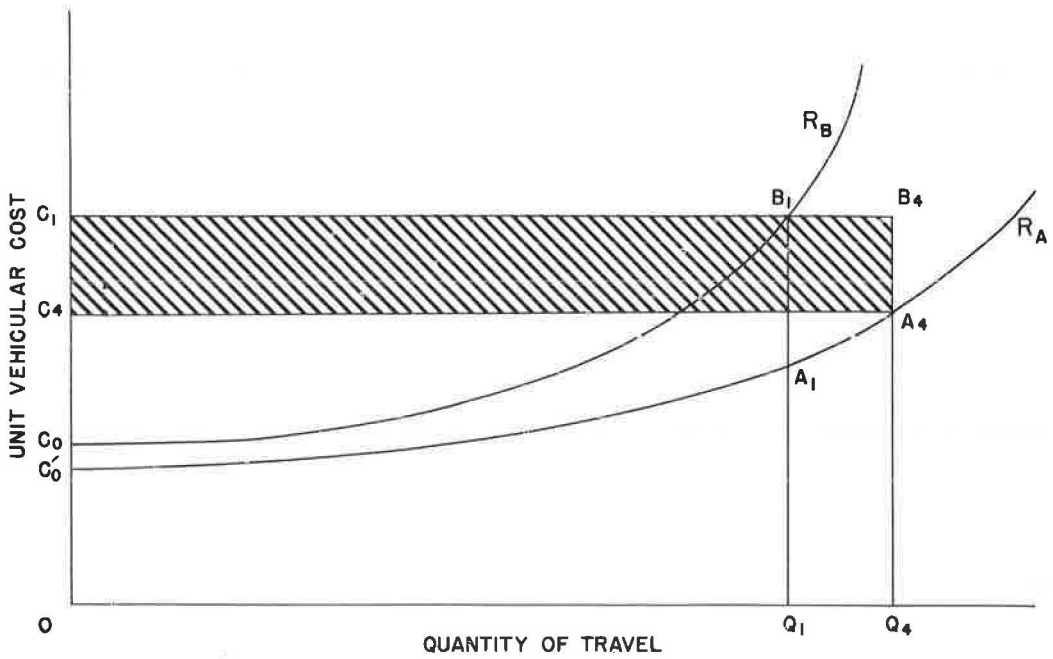

Figure 4. Interpretation of vehicular benefits: second step.

Now we know that, in the ordinary course of events, the new road will attract an increased volume of traffic which we may designate as OQ_2. The temptation is to represent the difference in unit cost by the line A_2B_2, since this is the difference in unit cost on the two roads at the new traffic volume. But this unit cost was never experienced on the old road, or at least not under the average or governing conditions with which we are dealing. We would therefore be overclaiming the benefit if we used A_2B_2 as a measure of the unit value of savings.

The point is made clearer yet if we indicate the new quantity of travel as represented by the line OQ_3, which is a magnitude beyond the capacity of the old road. Here there is no upper limit to the cost ordinate and no way of measuring the unit cost reduction.

How may we extend or elaborate the concept to take care of this complication? It is recognized that the increased traffic on improved roads is composed of that diverted from other roads and that induced either by a general growth of traffic or specifically by the improvement itself. Since the new road will accommodate a greater traffic than roads of the older type, we may visualize, in the first instance, the traffic on roads of type R_b as being accommodated on a smaller number of roads of type R_a. Thus ten roads of type R_b might be replaced by six roads of type R_a, causing the traffic volume on the new roads to be higher than on the old roads. This condition is represented in Figure 4, where the average traffic on roads R_a is represented by the line OQ_4. The unit cost for this higher average traffic volume is represented by OC_4 and the reduction in unit cost by C_1C_4. The total cost reduction is represented by the shaded rectangle. Comparison of Figures 3 and 4 reveals clearly that we have eliminated the overclaiming of benefit shown in Figure 3.

It is customary, in discussing diagrams of this sort, to hold that the net benefit consists of the reduction in unit cost multiplied by the pre-existing travel volume OQ_1 plus one-half the increase Q_1Q_4. This would be represented by the trapezoidal figure $C_1B_1A_4C_4$. The basis for this view is that the build-up of road improvement and traffic volume is incremental and the final increment of traffic benefits only from the final increment of road improvement. If this were true a period of stability (no additional road improvement and no increase in traffic) would be one in which no benefits were enjoyed from the road improvement R_a. But the comparison is with the old condition, R_b, and all users, at a given time, share alike in the reduction of unit costs over those prevailing earlier. To use a homespun example, if a pair of shoes cost three days' work in 1900 and one-half day's work in 1940, and again one-half day's work in 1960, the improved condition of the 1960 workman was equal to that of his 1940 counterpart, even though there was no further improvement in the interim. Furthermore, equal felicity in buying shoes was enjoyed in either year by those old enough to have bought shoes in 1900 and those who in that year were not yet born.

Not all possibilities or variable circumstances are provided for by Figure 4. In particular, the assumption that roads of type R_b are entirely replaced by roads of type R_a is not tenable. Although many roads are reconstructed and some are abandoned, the more common practice is for the old road to remain in existence but to retrograde in importance when a modern road is built in the same corridor. Thus an Interstate route may replace a federal-aid primary highway with the latter remaining as a route of secondary importance serving shorter trips and also serving as an alternative or auxiliary to the Interstate route. A primary state highway may be relinquished to the county and become a county primary when a new state highway is built in the same corridor.

When this type of substitution occurs, the simplest condition we can assume is that the traffic OQ_1 is distributed, without increase, between the two highways. Since this condition is quite unlikely to occur, it is not shown. In Figure 5 is shown the condition where traffic volume OQ_1 on the old road (or an assemblage of roads of the old type) is replaced by an increased average traffic volume OQ_4 on the new roads R_a, plus a diminished traffic volume OQ_5 on roads of the old type R_b. Unit costs under the old condition are represented by the ordinate OC_1, unit costs on the new roads R_a by OC_4, and unit costs of the diminshed traffic on the old roads R_b by OC_5. It is clear that under these conditions the cost reductions are represented by the sum of the two shaped rectangles, $C_4A_4B_4C_1$ and $C_5A_5B_5C_1$.

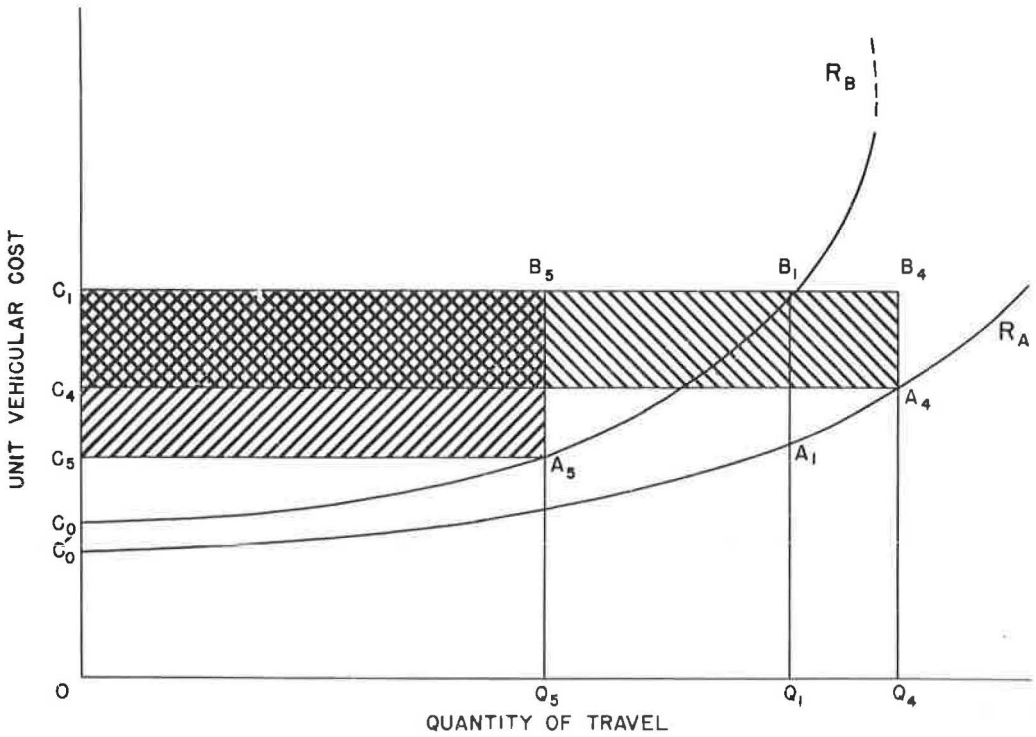

Figure 5. Interpretation of vehicular benefits: third step.

The savings in vehicular costs resulting from reduction in traffic on an old road when a new one is built actually do occur, but generally only for a short period. The general increase of traffic to be served and the resurfacing, widening, and other reconditioning of old roads generally results in their performing increased service even though retrograded in stature by the building of a new road. The normal condition is that roads are being improved at all levels and Figure 4 may be regarded as typical of the cost reductions provided, whether the old roads are replaced or are themselves included in the improvement program. For these reasons the increment of benefit caused by reduced traffic on old or retrograded roads was not taken into account in the differential-benefit study.

It may be that the approach to benefit measurement illustrated in these three diagrams is rather elementary, perhaps even naive. It is quite true that a more sophisticated analysis, based on the network concept, is called for. Students of the subject are beginning to concentrate on this type of solution, but that is another story.

Improving the Measurement of Costs and Benefits

Those who were engaged in the differential-benefit study were not entirely happy with the means available for measuring vehicular costs and the benefits resulting from reduction of costs. The experiments conducted by Dr. Claffey and by several universities (2, 3, 8) produced new data on the subject. Those which measured operating or running cost were more successful than the effort to find unit values for time cost and the impedance cost of congested driving, in which the relative numbers using toll routes and alternative free routes were used as the basis of a statistical solution.

Running Cost.—Work has been going on and progress has been made in the years since the experimental work of the differential-benefit study was performed. In the field of running costs the work of Winfrey (13) at the Bureau of Public Roads and

Claffey (14) for the National Cooperative Highway Research Program can be cited. Certainly it is important to update continually measurements of motor-vehicle performance and corresponding costs under varying conditions. One of the difficulties in this field is that experimental work in vehicle operating costs, however accurately done, can only be performed with a small number of vehicles. Efforts to attack the problem from the standpoint of records or questionnaires, of which the work of Stevens (15) and Lieder (16) are examples, encounter the opposite difficulty that pinpoint accuracy is impossible no matter how carefully selected the sample. A judicious combination of experimentation and sampling seems to be the only valid approach to the problem of measuring operating costs.

Another difficulty is the wide extent of variation in performance characteristics among the different types of commercial vehicles. It may be fairly reasonable to try to find a representative automobile, although a minimum of three varieties seems preferable. To find a representative truck is an impossibility. To run the gamut of performance and operating cost characteristics it would be necessary to obtain both experimental and statistical data for each of the major visual types of trucks and combinations, not to mention buses.

Measuring the Value of Time.—By the time the differential-benefit study was completed, two major gains had been recorded in the hazardous exploit of trying to measure the value of time: (a) recognition of the demand or market value of motorists' travel time, regardless of purpose of trip; and (b) recognition that in any measurement of the mean value of time the standard deviation of such mean value will be large and generally of the same order as the mean value itself (11, 17).

Rather curiously, there are at least four ways of measuring the value of automobile travel time, all of them fraught with uncertainties. Perhaps the first to be used was the so-called trade-off method by which, for example, the value of time to a person wishing to travel at 65 rather than 60 miles per hour is computed by measuring the increase in fuel, tire, and other costs resulting from such an increase in speed.[1]

A second method is that used in the differential-benefit and some earlier studies, in which the mean value of time is measured statistically by comparing the preferences of motorists for traveling on toll roads and alternative free roads. A third method is that of making the assumption that the motorist, under the postulated condition, values time at the rate of his salary or wage. The fourth method is that of determining the value of motorists' travel time by the highway costs that are incurred to provide time savings of given magnitude. This method was proposed by Vaswani in 1958 (18). More recently this approach has been followed in work at the Stanford Research Institute by Haney (19) and Curry (20). Stated in familiar terms, the idea is that if a certain cost is incurred to replace a 2-lane road by a 4-lane road, for example, in order to save a certain quantity of motorists' travel time on that route, the the total time saved may be divided into the total cost to obtain a unit value of cost of time. This is, of course, an oversimplification, but it illustrates the concept.

Further work in the cost or value of time should explore all of these concepts to determine how they may lead to a unifying method. There should also be an evaluation of the philosophy involved and a rather salty appraisal of the extent to which this particular tool needs to be used in the measurement of benefits and other aspects of economic analysis.

Measurement of Impedance.—The term impedance, by an interesting analogy to electrical phenomena, was applied by Cherniack (21) to those events or obstacles that im-

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[1]Mathematically it is a question of minimizing costs: If C = cost per mile, S = speed in miles per hour, v = value of time in dollars per hour, and other costs are represented by a function of speed, f(S), then

$$C = v/S + f(S)$$

Differentiating and equating to zero,

$$dC/dS = -v/S^2 + f'(S) = 0;$$

$$v = S^2 f'(S).$$

pede the free flow of traffic. The obstacles themselves are poor road conditions, intersections, vehicles on the left or right or approaching from the roadside, vehicles to be passed or met, etc. The driving maneuvers that result are stops, start, braking, accelerating, right turns, left turns, passing and being passed, etc. All of these actions require both muscular and mental effort on the part of the driver and increase the strain of the driving operation. The optimum driving condition would not be one making no demands on the attention of the driver, for this is likely to lead to drowsiness. The ideal freeway condition is not that of a level tangent, but one of gently rolling curvature, with pleasing variations in the environment.

That motorists demand such conditions and are willing to pay for them can hardly be questioned. To find a way of evaluating the intensity of the demand in dollar terms is, however, a difficult problem. In the differential benefit study we followed the lead of Greenshields (22) and others in using the summation of speed changes as a measure of impedance, on the ground that all of the driver actions caused by nonuniform driving are characterized by change of speed. Greenshields, in more positive terms, uses speed changes as an inverse measure of the "quality" of a ride, but the principle is the same.

There have been objections that speed changes are a crude measure of the comfort and convenience (or perhaps discomfort and inconvenience) factor. The results of the experiment made with toll roads and their alternative free roads were not such as to give unquestioned support to the speed-change unit. The work of Michaels (23) and others in using the Galvanic Skin Reflex (GSR) for measuring driver tension responses to traffic events offers a promising substitute for the measurement of speed changes, and one that is much more directly related to the subjective responses of the driver to events causing strain or tension.

This line of inquiry is not confined to the use of the GSR device. More recently, through the development of attitude scaling techniques, the effort has been made to gage the attitudes of motorists toward freeways and their alternative non-freeway routes, and thus to probe the motivations leading to choices between them. In the most recent report on the subject, Michaels (23) supports this approach with the remark, "No economic determination seems feasible unless the scale of values drivers use and its relation, if any, to dollars is known."

One might be tempted to reply to this statement by pointing out that economic evaluations are often (indeed most often) made without inquiring into motivations or scales of values. Thus one can analyze the relative demand for oranges and persimmons by studying the production, distribution, and marketing characteristics of the two products and arrive at useful conclusions. Nonetheless, the study of the motivations of consumers has long since proved its value in marketing research, and a more sophisticated approach to the study of the relative demand for different forms of highway service is indeed welcome. One of the subjects worth probing is the extent to which noneconomic measures can be substituted for dollars in evaluating the effects of time savings and reductions of impedance on the demand for freeways and other types of highway improvement.

Research in Highway Safety and Accident Costs.—In the differential-benefit study the data on accident costs were derived from the state studies of the subject made in cooperation with the Bureau of Public Roads (12). There is great promise that research in the next few years will refine the data on costs of motor-vehicle accidents. Project 2-3 of the National Cooperative Highway Research Program, "Analysis of Motor-Vehicle Accident Data as Related to Highway Classes and Design Elements," is being conducted by Cornell Aeronautical Laboratory, Inc., and an interim report was produced in August 1964 (25). The recent impetus given to research in highway safety and the orientation of the Public Roads research program in that direction give promise of further fruitful development.

The Integrated Approach to Measurement of Benefits

As in all branches of research, it is to be expected that the application of sophisticated modern methods to the measurement of vehicular costs, and vehicular benefits in reductions of costs, will produce systematic procedures readily adaptable to com-

puter handling. Work has been going on for some years at Massachusetts Institute of Technology through which the elements of highway and vehicular cost as functions of topography, road characteristics, and traffic can be programmed for the solution of problems in alternative location and design.

The techniques developed at MIT and examples of their use have been set forth in numerous reports and papers (26). Among them the 1962 paper, "An Evaluation of Techniques for Highway User Cost Computations," by Lang, Roberts, and Robbins, compares the EA-1 (computer simulation) and the AASHO methods for computing vehicle operating costs on alternative route locations and interchange designs. The 1963 paper, "Link Analysis for Route Location," by Roberts and Suhrbier, deals with the problem of alternative location decisions with respect to links in a highway network. A conspicuous aid to this work is the Digital Terrain Model developed at MIT. Although these researchers claim only modest accomplishments to date, the possibilities in the substitution of automated for conventional methods of economic analysis are vast.

Kuhn (27) outlined the essentials of an approach to highway planning that would systematize it in terms of economic theory. Adoption of Kuhn's principles, and techniques based on them, would tend to insure that internal and immediate decisions in highway planning would be governed by broader considerations of economic policy in the metropolitan area, the state, and the nation. A hint of his underlying objective and viewpoint is given in the following quotation:

> Throughout, it was pointed out that many market and non-market cost and gain effects will be caused by highway actions. These different value species pose treacherous problems of identification, quantification and aggregation. Although they may have to be presented separately, in dollars, in words, in physical or other terms, it is not permissible to ignore any effects for which evidence exists and which are relevant to the problem at hand. Some cost and gain effects will appear to be internal, others external, to the analyst's area of responsibility. It was argued that any public agency, by virtue of its legislative mandate, must adopt the broadest possible viewpoint—that of the national, state, regional, or metropolitan economy. This means that any project effects occurring within this broadest of horizons—repercussions inflicted upon other projects, technologies, transportation or the economy as a whole—are internal to the decision-making viewpoint, and therefore of analytical interest and concern.

There is no question that there are immense possibilities in an integrated approach to highway planning, of which the measurement of costs and benefits would be an incidental product. A word of warning, however, is perhaps not amiss. There is a temptation in such research to think in terms of a highly articulated system that would solve all problems. The resources of operations research and automatic data processing are so great and so rapidly increasing that the analyst may dream of a system that would automate all decision-making in highway location, design, administration, and financing. The tremendous potentials of modern analytical methods must be realized and used to the extent of their applicability. No single system, however, can solve all major problems, let alone the minor ones.

There are two dangers in a system of analysis that would provide for the unified processing of all highway data for the varied uses to which such data have to be put. One danger is that the fully integrated system would fall of its own weight and, in spite of computer speed, be found unable to produce the needed analysis in time for the decision-making. The other danger lies in the fact that no model or system of models is perfect. No model can take account of all the variations or predict all the contigencies; each one is an abstraction from reality which inevitably simplifies the complex. Finally, any system of analysis will be found to produce its best results in the sphere in which its creator is most expert. Thus a model created by an expert in economic analysis might appear to be applicable to highway taxation problems because its mathematics apparently

embraced all the major variations, but might be found on further scrutiny to neglect considerations that are essential in that field.

Factors Tending To Reduce Benefits

The estimates of future benefits of the Interstate System were given in the differential-benefit study and quoted here for the year 1973. This is the first year after the scheduled completion of the Interstate improvement program. It is possible to extend the benefit estimates further—e.g., to the year 1990—by applying the estimated vehicle-miles of subsequent years to the benefit factors developed in the study. The question arises as to whether there is a basic inaccuracy or tendency toward overestimate in applying this process. A broader question is whether in these or any other benefit calculations there is a tendency to "accentuate the positive" and fail to take account of factors that would tend to reduce the benefits actually realized below their calculated values.

One adverse factor that the touring motorist will at once recognize is the effect of construction work going on. In spite of the best efforts of highway departments and contractors' organizations, the motorist or commercial vehicle forced to travel through or around a construction project is subjected to increases in running costs, time delays, discomforts, and hazards quite as real as the reductions in corresponding costs that he will realize from the completed project. During a period of accelerated construction activity, such as the present, these adverse effects are of considerable magnitude, and some motorists may get the impression that they are suffering more than they are benefiting from the construction program.

More serious, and of more long-range effect, is the failure, in computing future benefits, to take account of their trend toward reduction as time goes on and conditions change on a particular road or network. The benefit calculations in the differential-benefit study were conservative in that they were restricted to those situations or time periods (such as the hours of peak traffic) when the benefits of a new road over an old road (4-lane divided over 2-lane, for example) are demonstrable and capable of positive evaluation. It is true, however, that as a new road, such as a freeway, becomes older, the traffic tends to increase and the percentage which its peak-hour traffic bears to its practical capacity becomes higher. A calculation based on time savings at certain comparable conditions on the old road and the new tends gradually to become invalid as peak-hour traffic approaches capacity. This gradual diminution of the benefit-producing potential of a road applies to all the four categories of vehicular benefit and probably to most of the benefit-producing features of highway improvements.

Since we are verging on a revolution in the art of calculating benefits, based on the potentials of systems analysis and computer technology, there seems to be no reason why the factors tending to reduce benefits both during the construction period and as time goes on after the completion of the improvement should not be taken into account in the procedures that are developed. This poses a challenge to the model-makers; no doubt they will be equal to the task.

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New Approach to Benefit Cost Analysis

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This paper is not a detailed economic or statistical analysis of present methods of calculating benefits and costs of highway construction. It is a short challenge to the basic premise frequently used that if each of two proposed roads will provide the same capacity, but one will yield greater cost reductions than the other, the road which will yield the greater savings in transport cost should be selected. It is the thesis of this brief paper that this conclusion may be false. The solution which requires the least total social (and in some cases social and private) costs for the benefits provided, is the solution to seek. If this solution does require a greater transport investment than some other solutions, but will decrease other costs more than it increases transport costs, it will benefit the community more than a solution with lower transport but higher other costs.

•THE CONVENTIONAL approach to assessment of benefits expected to result from highway construction in the United States uses a comparison of the costs of transportation as currently handled with the expected costs should the proposed construction be completed. The difference between the two calculations is roughly the estimated benefit. Included in the calculations are data on capital costs, operating and maintenance costs, accidents, time savings, and, increasingly, allowances for comfort and convenience. Refinements in the technique are of course legion—for instance, the use of marginal rather than average costs for parts of the calculations. But in essence the difference between the before and after unit costs times the volume of traffic which would move without the new construction plus one-half the additional volume projected as moving because of the lowering of costs and/or increases in capacity indicates the expected benefits, as generally calculated.

Studies of the effects of new transport capacities and of lower transport costs provided in developing countries are helping to create a new dimension to the concept of benefits created by new transport capacities. If a worker could climb palm trees and press palm oil all day long, but has no road, rail, water or air connection to markets, he produces only enough palm wine and palm oil for his needs and those of his wives, children, and any extended family members. He does not produce for sale or for transport to other areas. But once a road is built to his village and traders appear who will buy his palm nuts, palm oil, and palm wine, the subsistence economy begins to wane. Transistor radios, bicycles, clothes, trucks, schools, doctors, agricultural extension workers, even bankers, begin to appear. "Civilization" makes its appearance. Its effects cannot, however, be calculated by the technique which depended basically on multiplying previous traffic potentials by cost savings. No matter how many refinements are made to the marginal vs average cost concepts, how many adjustments are made to the proportion of generated traffic which should be multiplied by the cost savings, or what allowances are given to the comfort and convenience of chilled beer instead of warm palm wine, cost savings formulas do not work. The road has brought a breakthrough to the economy whose measurement requires entirely different techniques.

Those familiar with the economics of developing countries have recognized the existence of breakthroughs resulting from new transport, and other investments, and have learned to use an entirely different technique for measuring the effects of invest-

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ment. In essence, they are using an overall with and without approach: what was the economy like before the investment, what would it become without the investment and what would it become with the investment? With refinements, to be discussed later, the difference between the economy with and without the new investment represents the effects of the investment (benefits). The cost of the new capacities (with adjustments discussed later) can then be compared with the benefits anticipated. Benefit cost ratios, rates of return, and payoff periods can then be calculated, as desired.

A very obvious illustration of the use of this overall net benefit approach occurs in the U.S. today when a firm studies the wisdom of building an access road into a virgin forest. It calculates the gross revenue it expects to receive from the operation, and sets against this the costs it must incur, including the cost of building and maintaining the road. If the difference between the gross income and the gross costs, reduced to a comparable base, represents a high enough return on the investment, and the funds are available, the investment, including the construction of the road, is undertaken. The cost of the road is not examined as a separate item. The least expensive investment for meeting transport needs satisfactorily is decided upon, of course, but transport is only a part of the overall operation. Total revenues and total costs are considered. This is in essence also the approach that must be used in calculating the economic benefits and costs of putting a road into an underdeveloped area of a new developing nation.

The lessons being learned in the use of such an overall approach for the transport investment decisions of large companies, and of developing countries, may be applicable in considerable measure to benefit/cost transport studies for the highways of the United States.

The use of this approach already used in developing countries may become more difficult as the economic effects become increasingly diverse and hard to measure, and as the investments that accompany or follow the new transport capacity become more diverse and harder to measure—or even to foresee. Nevertheless it is a feasible method, and often the best method theoretically and pragmatically.

It is suggested, therefore, that the general rule should be that the total cost of the new investment required for the growing economy of the area must be matched against the value of the increase in the volume of production and services—the value of the growth in the area—as a first step. If, and only if, the value of the expected growth in the economy is greater than the cost of the total investment, is the proposed highway investment worth examination. If it is worth examination, the second step requires a judgment as to the difference between the value of the potential growth in the economy with and without the proposed road. If the development as a whole is warranted, and if the cost of the road is less than the value of the increase in the economy that will occur only if the road is built, the road is worth building. Whether another investment would be still better is another matter, and needs a separate analysis.

It may be that if transport capacity is provided in one area, a $7 million investment in roads and a $68 million investment in other fields would bring a benefit of $150 million; while in another area a $5 million investment in roads would require a $95 million investment in other utilities to bring a benefit of $150 million. A total new investment of $75 million including a $7 million road outlay would yield a B/C ratio of 2/1; an investment of $100 million including a $5 million outlay for roads would yield a B/C ratio of 1.5/1—though the road cost in the second case is only 5/7 as great as it is in the first case. If the transport analyst is asked to report on one of these alternatives, using this technique, he would report a 1.5/1 B/C ratio for the $5 million road cost and $100 million total investment cost, and a 2/1 B/C ratio for the $7 million road cost and $75 million total investment opportunity. He would report that while the second road cost more, ancillary costs would be less, and the total investment required would be less per unit of return in the second than in the first case.

This may be the opposite of a report based on savings in transport cost. In the second instance we could be dealing with a generally unbuilt area. It will require additional utilities, schools, housing, etc.; but that would be ignored if the analysis is based on transport savings alone. The analyst working on the first case would find that, in view of the fact that transport over the available poor road was, and would continue

to be, expensive, the new road would cut present costs appreciably. As traffic increased, without a new road congestion would increase and costs would rise. So the new road would cut future costs even more. And, as the capacity of the existing road is limited, the increased volume of traffic on the new road would be very appreciable. An allowance for half the new traffic times the difference between the present costs (to say nothing of future costs on the existing road) and costs on the new road would increase projected benefits even more. The end result might be a return on the investment of 20 percent or more.

If this conventional analysis is applied to the first instance the analyst would find himself dealing with a neighborhood which has most of the needed facilities—factories, stores, houses, etc.—together with supporting facilities such as hospitals, schools, churches, etc. But he could find the area stifled by a bottleneck in transportation—the lack of a bridge, or a poor connection between roads. If the bottleneck is broken, the economy of the area will expand quickly. Breaking the bottleneck will cost $7 million. Traffic will increase about as much as in the first instance, but savings per unit of travel will be less, because, except at the bottleneck, the existing roads are good, and vehicle per mile costs are low. Savings per mile traveled, and for total traffic, are less than in the first case, and the construction cost is greater, so the return on the investment as calculated by the cost savings approach, is less. The return on the investment may be reported as under 10 percent. The difference between the two results is due of course to the fact that the transport saving approach does not take into consideration costs for things other than transport which are necessary to the local economy.

At first glance it may seem that the use of the total economy approach is too complicated, requires data that are not available, and while acceptable on theoretical grounds, is not a feasible method in the real world.

This need not be so.[1] In order to develop traffic forecasts for B/C analyses even as currently made, it is necessary to have forecasts of economic activity. This requires judgment on the production, distribution and consumption of goods in the area served by a proposed road. A given volume of production will require a given production capacity. If that capacity does not exist, it will have to be built. There are many sources of data on the relationships between investment and production, and investment and value added, in various industries.

The story is similar for distribution. A given figure for traffic involves purchases and sales. There are usable sources of information on sales per square foot, for various types of merchandise. Usable judgments as to the amount of additional retail and wholesale space that will be needed for the projected traffic can be developed from the premises that yield the traffic figures that would be used in a conventional highway feasibility study.

A given volume of traffic under specific conditions promises a given number of home-to-work, home-to-shop, social, and other trips, and therefore, the population and number of households involved and their income. From this can be developed judgments on the prospects for residential and other types of construction, and/or the trend and order of magnitude of the total area income. Expenditures per square foot for retail and wholesale trade, and per unit of production and value added, may be relatively constant within a region for each type of business and may not be difficult to compute.

Outlays for sewer, water, schools, for utilities and services in general, can vary widely per unit of services to be performed. A development in one part of the area may be able to take advantage of existing efficient sewer and water capacities. Elsewhere connections to existing capacities may be expensive, or even not feasible. Schools, churches, libraries, parks, etc., may be available to one part of the area but not available in another. If development proceeds where those services are not available, they will have to be supplied at a high cost.

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[1]For an illustration of how to study the impact of a location decision on a local economy see "An Analytical Technique for the Selection of Federal Employment Center Locations in the National Capital Regions," by Lestor Tepper and Frank Piovia, published by CEIR, Inc.

Alternative road proposals therefore may imply alternative utility and related costs which can be measured at least roughly. Even if the private investment figures for the area are inadequate, the utility and related cost figures should be usable.

If a judgment can be reached without the inclusion of information on private investment, should the analyst go to the time and trouble of trying to develop such information? The answer would appear to be no, except in two types of situations: (a) if it is clear that there will be a sizable difference in the private investment required for possible alternative solutions, and (b) if the case is a close one without the inclusion of data on the relative private investment requirements of alternative solutions.

The first exception could occur if one proposed route would lead through an area already relatively well developed and having unused efficient industrial, commercial, and other capacities, while the alternative route would go through undeveloped land and would handle little traffic until new factories, stores, housing developments, etc., were built. In such a case, the first road would appear to require much less in the way of private investment than the second.

A question may arise, however, about the quality of the existing private capacities—are they really efficient? It may be that existing capacities should be moved to reduce production and distribution costs, or that extensive remodeling of both the private facilities and the transport and other services will be required. This could be quite expensive—possibly more expensive than building a new complex from scratch. The choice between relocation and rehabilitation therefore may not be obvious. Should another 123 be built, or should the downtown be remodeled? The remodeling solution may be cheaper but not simpler. If it is the cheaper solution, it still may not be an acceptable solution because of legal, political, or institutional difficulties. If this is the case, however, it would seem that those making the decision should know how much more the 123 solution would cost than would the rehabilitation solution. But the decision may not require this knowledge.

The second situation in which an estimate of the private investment requirements of alternative solutions is desirable is that in which there is little to choose between the costs and benefits, or the return on the investment, of the public expenditures required under various alternatives. If it appears that the private investment required may differ appreciably, so that the totals will differ markedly between the alternatives, then at least the differences between the private investment requirements should be put into the equations.

The general conclusion, therefore, is (a) decisions should not depend on the differences between the B/C ratios or yields on the transport investment alone; and (b) while for a perfect analysis total investment requirements should be matched against total benefits, as a matter of practice the matching of total government outlays (not just highway outlays) against total benefits may yield enough data for the cases in which it is known that the differences in private investment requirements will not affect the decision.

This conclusion may seem to run counter to the concept that the beneficiary should pay for his benefit. If spending $2 million more on roads saves $4 million on water and sewer costs, this analysis suggests that we should spend the extra $2 million on roads. The highway user should, the logic implies, subsidize the users of the sewer and water systems.

This is a nice problem in external economics. It suggests one further reservation. If beneficiaries are clearly distinct, the costs and benefits should be linked; in this illustration a sewer and water tax, a special benefit assessment, should be levied to meet the additional $2 million road cost. However, if in general the beneficiaries of the sewer and water systems are the same as the beneficiaries of the transport system, it may not be worth the extra cost of setting up the special benefit assessment in order to achieve theoretically perfect equity.

This discussion is intended to be provocative and illustrative, not detailed and conclusive. I hope it will stimulate serious and meticulous discussion of the points it adumbrates.

Consumer Awareness of Motor Fuel Tax Rates and Prices

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•THE VIRGINIA Highway Department has recently conducted several long-term highway needs studies to assess the state's road system in the light of increasing highway use. These studies have included both analysis of past expenditures and projections of future highway revenue needs based on the existing tax system. However, previous highway needs studies have not investigated specific revenue sources for financing Virginia highways.

The present report attempts to analyze motor fuel taxes as a source of state highway funds. About 80 percent of all Virginia highway dollars currently come from motor fuel taxes, and this study examines effects of the tax on the consumption of gasoline, along with evaluating it as a continuing source of revenue. The study investigates the extent to which Virginia and out-of-state motorists were aware of gasoline taxes and prices, and evaluates driver and vehicle characteristics possibly influencing buying patterns for gasoline.

METHODOLOGY

A point-of-purchase questionnaire was developed for interviewing at service stations throughout the state, and it was decided to interview motorists stopped at sample service stations who were actually in the process of buying gasoline at the time the questions were asked. The questionnaire was pretested before beginning the study, and certain unsatisfactory procedures, such as the inclusion of "opinion" questions, were discarded.

The survey had two separate phases: a 7-day, 24-hour study conducted at one station in Charlottesville, and a statewide study in which motorists were interviewed at more than 400 service stations located in over 100 cities, towns, and rural areas throughout Virginia. All told, more than 2,600 questionnaires were completed.

The Charlottesville study was conducted to provide one sampling location where a week-long, around-the-clock study was feasible. The sampling time period for the statewide phase of the study was from 7:30 A.M. until 7:30 P.M., all 7 days of the week. Time periods for different days of the week received equal sampling coverage.

The Survey Technique Questionnaire

The motorist questionnaire was designed to compile a variety of information: personal data concerning drivers, their price consciousness concerning gasoline, method of making purchases, vehicle information, time of interview, and data concerning the interview stations' facilities and locations. Questionnaire information was obtained either visually by interviewer (such as make and model of car), or through questions addressed to the drivers.

All data were designed for electronic data processing, and in addition to the driver questionnaire, an information sheet was prepared for each of the more than 400 service stations which served as interview sites during the survey. These forms obtained such information as brand name and location, quality of physical facilities, and prices of various grades of gasoline.

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Interviewers were given a manual of instructions defining each of the questions and terms used in the survey. The questionnaire avoided leading questions, and interviewers were instructed not to prompt respondents.

The interviews took approximately 5 minutes, about the time necessary for a routine purchase of gas, and therefore in most cases did not delay motorists or interfere with service station operators. Interviewers asked drivers the form questions, and then marked other information (such as state of registration) by observation.

Cooperation by service station operators and motorists was excellent with less than one percent of each group refusing to permit interviews.

Design of Sample

Since many characteristics of the gasoline-buying population are not known, and since there is no complete listing of Virginia service stations in operation, a random or stratified sampling technique was not practical. Therefore, the survey procedure attempted to obtain a representative sample based on known Virginia population characteristics.

Numerous factors were considered in determining survey locations. Among these were: geographic areas of the state, the urban-rural composition of these areas, population size of cities, observable service station characteristics, and their locations by primary or secondary routes. Virginia is divided into eight administrative highway department districts, based on geographical location, and these districts were used as surveying areas.

The number of sampling sites within these districts was determined by population counts from the 1960 federal census of population. For example, a district with a population of 500,000 was sampled only half as much as one with a population of 1,000,000.

Regardless of population, at least 2 rural samples and 2 urban samples were taken in all districts. Likewise, all time periods of the sampling day were sampled in all districts. No more than 4 consecutive days were spent in any one sampling district, and distant geographic regions were sampled in succeeding weeks so that any possible variations caused by week or month could be compensated for as much as possible.

Individual surveying sites were picked in different geographic regions of a district in order to cover all areas. For cities and urban areas each location was divided into quadrants for sampling purposes, and one station was selected for interviewing in each quadrant. In the case of larger cities, such as Richmond and Norfolk, these areas were sampled on more than one occasion, with only one or two of the quadrants surveyed the first time around.

Of all the more than 2,600 interviews taken, approximately one-half were in towns or rural areas with populations of less than 2,500. About 40 percent of the samples were taken in towns and cities of between 2,500 and 50,000; and approximately 10 percent were taken in cities having populations of 50,000 or more. Each city and town in the sample was coded on the survey form according to its size so this factor could be considered in evaluating price and tax awareness in areas of varying population density.

Four-City Survey of Gasoline Stations

To estimate the probable composition of service stations within given areas, a preliminary survey of 4 central Virginia cities and towns, Charlottesville, Orange, Waynesboro, and Culpeper, was made before beginning the consumer awareness study. This phase enumerated all service stations in business in the 4 towns, noting whether the stations were on primary or secondary routes, whether they were located at intersections, near other stations, near the center or edge of town, whether they were major or independent brand stations, and whether they advertised gasoline prices.

Sampling Times

During the Charlottesville study, conducted at one service station on an around-the-clock basis, interviewers attempted to query every passenger car stopping at the station during the week. Cars stopping for reasons other than the purchase of gasoline were excluded from the survey.

During the 11-week statewide study 2 interviewers and a supervisor conducted the survey at the more than 400 stations throughout Virginia. In order to sample equally all days of the week, the work schedule was divided into 6 days of interviewing, followed by 3 days off. Over a 3-week period a normal 40-hour week was worked, giving equal sampling time to all days of the week.

Preliminary analysis of the Charlottesville responses, gathered on a 24-hour-a-day basis, indicated that on the tax and price awareness questions responses taken between 7:30 P.M. and 7:30 A.M. were not substantially different from those taken during the day. Consequently, for the statewide survey the sampling time period was established between 7:30 A.M. and 7:30 P.M. with this 12-hour period divided into 3-hour sampling blocks. The actual interviewing time each day amounted to 6 hours with the remaining 2 hours reserved for traveling and locating interview stations.

During the 3-hour sampling time blocks, either two 90-minute or six 30-minute samples were taken. In the 100 cities and towns that were sampled at least one 90-minute sample was taken in each quadrant of these areas. In rural areas and other sites, 30-minute samples were taken.

Over 400 different samples were taken with the total almost equally divided between the 90-minute and 30-minute time periods.

The 90-minute samples were based upon a predetermined pattern for the state which was made on the basis of geographic areas and population centers. The 30-minute samples were taken en route between the 90-minute sites.

Sample times were balanced according to survey districts, time of day, and day of the week. Thus, insofar as possible, all times of the day, as well as all days of the week, were sampled in each survey district by the end of the study. Besides balancing the sample by interview time of day and day of week, a number of samples taken within the districts were based upon total population of these areas.

ANALYSIS OF DATA

Every question on the driver interview form was included to either determine some factor by itself or establish a comparison with other variables, such as type of automobile to grade of gasoline purchased. Before the study began a general outline of questions was prepared and tabulated in outline form.

During analysis of the data all variables were first tabulated by themselves. Then a 2-variable matrix containing some 2,000 comparisons was prepared. The significance of these possible combinations (for example, age of car to speedometer mileage) was evaluated and around 200 were selected for study.

Questionnaires were sorted into different comparison groups for analysis, and interviews with out-of-state motorists were separated from those with Virginia drivers. Also the 24-hour-a-day Charlottesville study was analyzed apart from the statewide study, and comparisons were organized by these categories: (a) Charlottesville study, Virginia drivers; (b) Charlottesville study, out-of-state drivers; (c) statewide study, Virginia drivers; and (d) statewide study, out-of-state drivers.

Information from each of the 200 analyses was then grouped under these topic headings: (a) general tax awareness of respondents; (b) general price awareness of respondents; (c) overall gasoline buying patterns; and (d) factors possibly affecting buying habits.

SURVEY FINDINGS

Low General Awareness of Taxes and Prices

Of all drivers surveyed, only about 35 percent, or approximately one-third of the entire group, knew the total tax rate of 11 cents. Answers coming within one cent of the 11-cent total were counted as correct. Only 15 percent of the entire interview group knew the correct total of the 4-cent federal tax per gallon on gasoline. And of the one-third of all drivers knowing the 11-cent total of the state-federal gasoline tax, only half knew the correct distribution of these rates between the 2 levels of government.

When considering tax rate increases for gasoline, state legislatures estimate effects of a proposed increase in areas along state borders. In Virginia it has been suggested that an increase in the state tax resulting in a price higher than those of adjoining states will induce border area residents to cross state lines to buy gasoline where the tax rate, and presumably the price, is lowest.

To investigate this assertion in Virginia border areas, drivers were asked, "Are gasoline prices in Virginia higher or lower than those in the adjoining state?"—which was specified, depending upon the interview location.

Thirty percent of all drivers answering this question made some positive statement as to whether prices were higher or lower in the adjoining state. Seventy percent of this particular response group said they did not know whether there were any price differences.

Awareness of State License Plate Costs

Although only 35 percent of the Virginia drivers knew the total state-federal tax per gallon for gasoline, when they were asked, "How much did you pay for your state automobile license plates?", 67 percent of all Virginia drivers knew the correct amount.

However, in comparing out-of-state driver awareness of license plate costs there was little percentage difference between those aware of state-federal gas taxes (36 percent) and those knowing how much they had paid for their state license plates (37 percent). The fact that the state of Virginia had just increased license plate fees before the interview summer (1964) possibly resulted in a higher level of awareness for Virginia drivers than might normally have been expected.

Price Awareness and Tax Consciousness

Overall analysis of general awareness of gasoline taxes indicates there is a group of drivers that tends to be conscious of all types of highway taxes and another group that is not as conscious. In evaluating gasoline taxes as a continuing source of revenue, and in contemplating any tax rate change, one factor to be considered is the effect of potential changes in demand for gasoline brought about by changing prices for the product.

The question can be stated, "Will a rise in the price of gasoline, occasioned by tax increase, cause a reduction in the rate of consumption or absolute amount of gasoline consumed?"

It has been argued that if gasoline prices are increased because of higher tax rates a decrease in the demand for gasoline could result. Such propositions are usually founded upon at least two assumptions: first, that the driving public is conscious of the price structure of retail gasoline, and second, drivers can and will react to increased prices by reducing their consumption of gasoline.

In order to appraise this first assumption, motorists who were buying gasoline were asked, "How much per gallon are you paying for gasoline?" Even at the moment of purchase, only about 50 percent of both Virginia drivers and out-of-state drivers knew how much they were paying per gallon for gasoline.

In comparing price consciousness to tax consciousness it was found that those drivers who, as a group, were aware of gas prices also usually knew the tax rate on gasoline. This situation held true for both Virginia and out-of-state drivers.

When gas price awareness was compared to license plate cost awareness the same tax awareness pattern recurred; those motorists who were aware of gasoline prices were also fairly well informed on license plate costs. Conversely, those motorists unaware of gasoline prices tended to be less familiar with license plate costs.

About half the drivers of automobiles buying gasoline were not aware within one cent of the price they were paying for gasoline. Only about one-third of the buyers knew within one cent the total amount of the state and federal taxes per gallon. And those drivers who were aware of prices and state-federal taxes were also more aware of pricing differences between grades of gas, license tax costs, and the apportionment of gasoline taxes between the state and federal governments.

Concerning tax and price awareness, there appeared to be no substantial differences between Virginia drivers and out-of-state drivers buying gas in Virginia. However,

twice as many Virginia drivers were found to be aware of the cost of their state license plates. As noted, this situation may have been due to the recent fee increase for Virginia automobile registrations.

Service Station Characteristics

In analyzing motorist awareness of gasoline prices and tax rates, an attempt was made to evaluate certain factors possibly influencing the motoring public's familiarity with gas taxes and prices. Service station characteristics were among these factors taken into consideration. Surveys at service stations on primary highway routes were compared with those taken on secondary roads. The location of a given station on either a primary or secondary route apparently did not affect driver tax awareness. However, most service stations with any sizeable volume of business were located on or adjacent to primary traffic arteries. Those stations not on primary routes generally were multipurpose operations, such as groceries and service stations combined.

Thirty-five percent of all buyers at stations located on primary routes were aware of gasoline tax rates, compared to 38 percent on secondary routes. Likewise, when comparing responses from motorists at different classes of service stations, there were no conspicuous differences in awareness within these groups. (Service stations were rated and assigned to one of 3 categories according to overall appearance, facilities such as number of pumps, paved driveway, lighted signing, number of pump islands, and other criteria: Class I, modern; Class II, not modern; and Class III, multipurpose, i.e., grocery-service station.)

Levels of tax and gas price awareness were compared for major and independent brand stations. Gas buyers at independent stations showed greater price awareness than buyers at major brand stations. Sixty-six percent of the motorists buying gas at independent stations were aware of the price per gallon, compared to 51 percent at the major brand stations. This finding held for both Virginia drivers and out-of-state drivers interviewed in Virginia. Motorists at independent stations also showed a slightly higher awareness of license plate costs (72 percent), compared to buyers at major brand service stations (66 percent).

However, on awareness of the total state and federal gas tax, motorists at independent stations showed slightly less awareness (33 percent) than those at major brand stations (36 percent). Therefore, while there was some increased awareness of price at independent stations, there was not a substantially higher degree of tax awareness.

Urban and Rural Characteristics

Data were evaluated according to size of the drivers' cities of residence to determine whether urban buyers were more or less aware of gas taxes than those from smaller towns and rural areas. About one hundred incorporated and unincorporated towns and cities were sampled. About half of these locations had populations of less than 2,500, approximately one-third of the survey sites were in towns of between 2,500 and 25,000, and the rest of the locations were in cities of over 25,000 population.

In comparing tax awareness to city size, the group of those drivers aware of the total state and federal tax equaled 25 to 40 percent of all responses; however, there was no consistent pattern, and there did not appear to be any meaningful relationship between city size and tax awareness.

Locations of the drivers' places of residence were compared for gas tax awareness variations. Thirty-five percent of all drivers living in cities or towns were aware of the total gas tax, compared with 33 percent of those living in rural areas. In the urban-rural comparison for license plate tax awareness there was no pronounced difference between city and county drivers.

Price Awareness by Sex of Driver

Sex of driver was also compared for tax awareness variations. In the entire survey males comprised three-fourths of the responses. As a group, men were more than twice as aware of state and federal taxes. Forty percent of all men interviewed knew

state and federal tax rates, compared to 18 percent of the women. This same relationship was also found to exist in the level of federal gas tax awareness. Eighteen percent of the men, compared to 6 percent of the women, knew the correct total of 4 cents. Regarding costs of state license plates, 71 percent of the men knew what they had paid, compared to 52 percent of the women. Although exact percentages varied slightly, the same relationship between male and female tax consciousness existed for out-of-state drivers buying gas in Virginia.

Awareness by Age Group of Driver

Age group and length of time motorists had been licensed drivers were also compared to tax awareness. Statewide, about 20 percent of all Virginia drivers were in the 15-25 age group, 60 percent were 26 to 50, and 20 percent were over 50 years old. In all 3 age groups there was no appreciable difference in gasoline tax awareness. Likewise, there was no apparent relationship between the length of time motorists had been licensed drivers and their gasoline tax awareness. As driver ages increased there was an upturn in awareness of license plate costs. Perhaps this was partially due to the general information level of the respective groups, with older drivers tending to be better informed.

Driver Awareness by Type of Vehicle

Vehicle ownership by types of cars was sorted and compared with tax awareness questions to determine what relationships, if any, there were between the vehicles driven by respondents and their gasoline price and tax awareness answers. The same procedure was followed for questions concerning vehicle use in terms of miles driven per year.

For purposes of this study vehicles were assigned the following classifications: (a) American standard-size cars; (b) American compacts; (c) foreign cars; and (d) noncommercial panel and pickup trucks. Distinguishing between standard size and compact cars is difficult on the basis of horsepower, weight, length, and wheelbase, since the "compacts" have grown substantially since their introduction around 1960. In this study compacts were defined as those vehicles which were originally introduced as compact cars, i.e., Pontiac Tempest, regardless of how much size and horsepower they had acquired by the survey year, 1964.

Type of vehicle operated had no distinct relationship to tax awareness for either Virginia drivers or out-of-state motorists who bought gasoline in Virginia. For all types of vehicles, two-thirds of the drivers did not know and one-third did. Foreign car owners, however, did slightly better on awareness of license tag costs than did drivers of other type vehicles.

Analysis also indicated that the number of vehicles owned by the respondents had little if any effect upon their tax and price awareness. In the statewide survey 34 percent of the Virginia one-car families were aware of the total state and federal gas tax, compared with 38 percent of all the Virginia two-car families.

Number of miles per year the interview car is driven was then compared to total state and federal tax awareness on the part of all drivers. There seemed to be a slight correlation between mileage driven per year and gasoline tax/price awareness. Twenty-eight percent of all drivers in vehicles driven less than 6,000 miles per year were aware of the state and federal gas tax. The rate of tax awareness increased with mileage driven to the point where 48 percent of the group driving between 15 and 22,000 miles per year were aware of the amount of state and federal gasoline tax.

Those drivers traveling more than 22,000 miles a year indicated a slightly lower degree of awareness with only 41 percent knowing the total amount of the state and federal gas tax. One possible explanation for the decrease at this higher annual mileage level may be that these drivers were using company or leased cars, and not paying attention to price or tax. However, this analysis has not been made and it is merely conjecture on the part of the researchers.

Whether the respondents' cars were purchased new or used was compared to gasoline and license tax awareness; however, little difference was observed in gas and license tax awareness.

Tax awareness was also related to ownership and use of gasoline credit cards. The number of credit cards owned by the respondents did not show a positive relationship to gas tax awareness. However, credit card owners did show a greater awareness of state and federal taxes (about 40 percent) than did all sampled drivers as a group.

Grade of gas purchased and number of cylinders in the interview car were matched to awareness of state and federal gasoline taxes. Once again, no difference was noted in tax awareness, either by grade of gas purchased or number of engine cylinders.

SUMMARY

Gasoline Tax Awareness

Only 35 percent of all drivers buying gasoline at service stations throughout Virginia knew the total amount of the state and federal taxes on gasoline to the nearest cent. Only 15 percent of the gas-buying public was aware of the federal tax rate on a gallon of gasoline. By comparison, 67 percent of the Virginia drivers knew what their state license plates had cost.

For those drivers aware of gasoline tax rates there was a noticeably greater tendency to also know the federal tax per gallon, license taxes, gasoline prices, and border area price differentials.

Thus, at the time of survey, only about one-third of all Virginia motorists buying gasoline were aware of gas taxes, compared to the two-thirds who knew their license plate taxes.

About half (53 percent) of all motorists buying gas at more than 400 Virginia service stations knew within one cent how much they were paying per gallon at the time of purchase. Those motorists who were price-conscious also tended to be tax-conscious. Forty-six percent of those knowing the price of gasoline also knew the total state and federal tax per gallon; the comparable figure for the group not knowing gas prices was 24 percent. The same relationship also held for federal gasoline tax awareness, and those motorists who were price conscious for gasoline were also more aware of license plate costs.

The location, class of station, and brand of gasoline had no apparent effect on the gasoline tax consciousness of motorists buying gasoline. Responses sorted by city size showed no consistent relationship to gasoline or license tax awareness, nor did the location of responding drivers' residences in either urban or rural areas.

Sex of driver appeared to be related to tax awareness. Of the entire sample, three-fourths of all respondents were males, and 40 percent of all the men were aware of the total state and federal tax per gallon of gasoline, compared to 18 percent of all women.

Driver age group showed no appreciable effect on gas tax awareness, nor did the length of time the motorists had a driver's license. However, driver age group did tend to affect license plate costs awareness, with the degree of awareness increasing with age.

The type of vehicle driven and number of vehicles owned had no apparent influence on gasoline tax awareness of the respondents.

Gasoline Price Awareness

Regardless of sex, approximately half the Virginia and out-of-state drivers buying gasoline in Virginia were aware within one cent of the price they were paying at the time of purchase. When motorists were asked the price difference between regular and premium gasoline at the stations where they were being interviewed, 43 percent of the Virginia drivers knew, compared to about 50 percent of the out-of-state drivers.

Those drivers, both Virginia and out-of-state, who knew how much they were paying for gasoline also tended to be aware of the price differential between regular and premium grades of fuel. Of those motorists knowing how much they were paying for gas at the time of purchase, 73 percent of the Virginia drivers and 78 percent of the out-of-state drivers were also aware of the price difference between regular and premium gas at the stations where they were interviewed.

In border area cities and towns motorists buying gasoline were asked, "Are gasoline prices in Virginia higher or lower than those in the adjoining state?" Thirty percent of

Virginia drivers indicated they knew, or thought they knew, whether prices were the same or different in the adjoining state.

When gas price awareness in general was compared to border area price awareness, there was a tendency for those drivers aware of the price per gallon also to be aware of border area price differences. Because of price differences between regular and preminum gas—usually about 4 to 6 cents per gallon—border area price awareness was compared to grade of gasoline purchased to see if drivers buying regular gas tended to be more aware of interstate price differences than those drivers buying premium gas. Analysis indicated that the grade of gas purchased had no relationship to awareness of price differences in border areas. Motorists buying economy or regular grades of gas were no more price conscious than those purchasing premium gas.

Sex of driver was compared to price consciousness for gasoline. As with tax consciousness, men were almost twice as aware of the price they were paying for gasoline as were women. When driver age group was compared with price awareness for gasoline, 52 percent of Virginia drivers under 25 years old, 57 percent of those from 26 to 50, and 43 percent of those over 50 years old knew how much they were paying for gasoline at the time of purchase.

No consistent response pattern was observed when interview city size was compared to gas price awareness. But when location of driver residence was compared to price awareness drivers from cities and towns showed a greater degree of awareness than those from rural areas. The relative price awareness of those buying gasoline was 55 percent for drivers living in cities and towns, compared to 51 percent for the suburbs and 45 percent for the rural areas. The same relationship held when location of residence was compared to awareness of difference between the prices of regular and premium gasoline. In contrast, few if any urban-rural differences were observed on tax awareness.

Both Virginia and out-of-state drivers buying gas at independent brand service stations tended to be more price conscious than those purchasing fuel at major brand stations.

Stations advertising gas prices were analyzed for the extent of price awareness exhibited by customers. Where prices were advertised, 58 percent of all motorists buying gas knew within one cent how much they were paying per gallon, compared to 46 percent at stations where prices were not advertised.

Also, price advertising at service stations seemed to result in greater awareness of price differences per gallon between regular and premium grades. Where prices were advertised, 47 percent of the Virginia drivers knew the price difference between regular and premium, compared to 38 percent of the same group where prices were not advertised. For out-of-state drivers price advertising appeared to make little if any difference concerning price awareness. Motorists at stations advertising price were slightly more aware of border area price differences than those drivers at stations not advertising price.

Awareness of Price Per Gallon

Various characteristics were compared with motorist awareness of the price of gasoline per gallon. These variables included: whether the interview vehicle was purchased new or used, type of vehicle, number of vehicles owned, number of miles driven per year, use of gas credit card, reasons given for buying usual grade, and method of purchasing gasoline.

Although several factors indicated some relationship to gasoline price awareness, no consistent or meaningful correlation could be established. However, motorists who gave "cost" as the reason for buying their usual grade of gas were more aware of price (63 percent) than those giving other reasons, such as "manufacturer's recommendations," "engine requirements," "better gas mileage," and "habit."

For all Virginia drivers knowing what they paid for gas at the time of purchase, responses for each reason for buying their usual grades of gasoline were as follows: 51 percent said manufacturer's recommendations or engine requirements; 26 percent said less expensive; 11 percent said habit; 8 percent said better mileage; and 4 percent said they liked to use the best grade.

For all Virginia drivers not knowing what they paid for gas at the time of purchase, percentage responses for the same reasons ran accordingly: 51 percent, manufacturer's recommendations or engine requirements; 19 percent, less expensive; 14 percent, habit; 9 percent, better mileage; and 7 percent, liked to use the best grade.

Responses by out-of-state motorists followed the same pattern. Manufacturer's recommendations or engine requirements accounted for over half of all answers given.

Gasoline Buying Patterns

The study indicated that approximately 50 percent of the motorists interviewed bought regular gasoline, 40 percent bought premium, and the remaining 10 percent bought economy or intermediate grades. On the average, Virginia drivers purchased 8.6 gallons of gasoline and spent $2.80. Out-of-state drivers bought more gas per stop with an average amount of 10.5 gallons at a cost of $3.50.

Virginia drivers tended to fill the tank less frequently than out-of-state drivers buying gas in Virginia. Some 43 percent of the Virginia drivers compared to 77 percent of the out-of-state drivers filled the tank; 30 percent of the out-of-state drivers compared to only 17 percent of the Virginia drivers used gasoline credit cards in making their purchases. Drivers of company or leased cars used credit cards to a much greater extent than drivers of family cars.

Less than 10 percent of all cars stopping to buy gasoline also purchased motor oil at the same time.

Purchases by Hour and Day of Week

In comparing gasoline sales by day of the week, it was found that more drivers bought gas on Sunday than any other day of the week. Wednesday was the slowest sales day; the 3 busiest days were Sunday, Friday, and Saturday, in that order.

The most popular hours for buying gasoline, regardless of day of the week, were 4 to 6 P.M., followed by 8 to 10 A.M., and 12 noon. Virginia and out-of-state drivers both followed this general pattern.

Reasons for Buying Usual Grade

In response to the question, "Why do you buy your usual grade of gasoline?", 23 percent of all Virginia drivers indicated they did so because it was less expensive, and 50 percent of all Virginia drivers said because of "manufacturer's recommendations or engine requirements." The remaining 27 percent gave such reasons as "better gas mileage," "habit," or "want to use best grade." Of all the out-of-state drivers in Virginia, 15 percent gave the reason "less expensive," compared to 59 percent saying "manufacturer's recommendation or engine requirements." Neither age group nor sex of driver appeared to have any significant influence on the reasons motorists gave for buying their usual grades of gasoline.

When reasons given for buying usual grades of gasoline were compared with the grade actually purchased, 83 percent of those saying "less expensive" bought regular gas, and 58 percent of those giving "manufacturer's recommendations or engine requirements" bought either intermediate or premium grade gasoline. Drivers mentioning "habit" as their reason for buying a given grade were fairly evenly divided between regular and intermediate or premium fuels.

When type of vehicle was compared with the reasons given for buying usual grades of gas, about 20 percent of the Virginia motorists, regardless of type of car driven, said they bought their usual grade of gas because it was less expensive. Forty percent of the motorists driving American standard-size cars, compared to 58 percent of those driving American compacts, and 66 percent of those driving foreign cars, said they purchased their usual grade of gas because of "engine requirements or manufacturer's recommendations."

When a comparison was made of grades of gasoline purchased and model year of cars no consistent pattern or relationship was found. However, cars more than 10 years old most frequently used regular gas. Cars less than 10 years old showed variations by model year, but tended to be evenly split between regular and premium gaso-

lines. When grade of gasoline purchased was compared to whether the car was purchased new or used, new vehicles consumed premium fuels to a slightly greater extent than those which had been bought used.

When number of cylinders was compared with grade of gasoline purchased, 6-cylinder car drivers bought a substantially greater amount of regular gas than 8-cylinder car drivers. Seventy percent of all 6-cylinder cars used regular gasoline compared to 41 percent of all the 8-cylinder cars, while 18 percent of the 6-cylinder cars used premium gasoline compared to 47 percent of the 8-cylinder cars.

CONCLUSIONS

The existing varied price structure of gasoline within given areas, the general lack of tax and price consciousness of the gas-buying public, and the overall gasoline buying habits observed indicate that at present there is no widespread resistance to gasoline taxes as a source of highway funds.

Only a small minority of all the motorists interviewed knew the division of gas taxes between state and federal governments, and there was confusion in most motorists' minds as to which levied the larger amount. Virginia motorists were almost twice as aware of license plate taxes as they were of gasoline tax rates. By comparison, the out-of-state drivers purchasing gas in Virginia were about equally aware of these two highway user taxes.

No evidence was found that a Virginia gasoline tax rate higher than those of neighboring states would cause in-state motorists to cross boundaries to buy gasoline. Most Virginia drivers questioned in border areas of the state were quite vague as to gasoline prices in adjoining states.

The current lack of tax and price awareness, varied pricing structures within given cities and locations, the relative inflexibility of demand for a given grade of gasoline, and observed buying patterns indicate Virginia motorists buy gasoline primarily because of need, convenience, regular scheduled stopping times, and other factors apart from the price per gallon.

Compact and foreign car owners followed the overall buying patterns for gasoline, and they exhibited about the same degree of price and tax awareness as drivers of American standard-size cars. Perhaps other economy factors, such as lower initial purchase cost and potentially better gas mileage per gallon, are more important than gas prices in influencing decisions to buy compact cars.

The data indicated that out-of-state drivers also bought gas in Virginia as the need occurred, at what might be considered normal stopping times, and that they exhibited a general lack of concern for gasoline prices and the state-federal tax rates on motor fuel.

State Highway Patrols—Their Functions and Financing

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•CONCERN FOR the safety of the motoring public, and the importance of the state police organizations in enforcing traffic and safety laws, was voiced by the governors of most of the 47 states in which the legislatures met in regular session in 1965. In state after state the governor's message emphasized highway safety and pointed to the need for additional highway patrol troops to curb highway accidents and fatalities.

In at least 30 states requests were made for an increase in patrol strength, either by the governor, by legislative committees, or by safety agencies. Collectively, specific requests were made in 21 states for nearly 3,800 troopers to be added to the patrol strength within the next one to four years. A summary of the requests (as of mid-1965) is given in Table 1. If approved, these requests would increase patrol strength by an average of 23 percent.

TABLE 1

REQUESTS FOR ADDITIONAL PATROL TROOPERS, SUBMITTED TO 1965 STATE LEGISLATURES BY GOVERNORS, LEGISLATIVE COMMITTEES, OR OTHERS

State	Number (where stated)	State	Number (where stated)
Arkansas	-	New York	112
California	195	North Carolina	200 (4 years)
Florida	212	Ohio	400 (2 years)
Georgia	80 (2 years)	Oklahoma	100 (2 years)
Illinois	800 (4 years)	Pennsylvania	300
Indiana	150	South Carolina	-
Iowa	100 (2 years)	South Dakota	-
Kansas	50	Tennessee	100
Maryland	40	Texas	-
Michigan	200	Utah	20
Minnesota	368 (by 1973)	Vermont	42 (2 years)
Missouri	250	Washington	-
Nebraska	50	West Virginia	-
Nevada	-	Wisconsin	-
New Mexico	10	Wyoming	-

Source: Daily legislative bulletins published by the National Highway Users Conference, Washington, D.C.

Paper sponsored by Committee on Highway Taxation and Finance and presented at the 45th Annual Meeting.

Although these requests probably will not meet with full legislative approval in many states, this is an impressive indication of the extent to which the states are giving attention to the need for adequate law enforcement to combat the tragic toll of lives and accidents. Gov. Romney of Michigan pointed to some significant statistics in his special message on traffic safety presented to the 1965 legislature. Labeling them the "Michigan Massacre," he pointed to 2,125 traffic deaths in 1964, 145,000 traffic injuries, and 285,000 reported accidents, all adding to an estimated economic cost of at least $380 million to Michigan and its citizens, or over $1 million a day!

Of further concern was the fact that the rate of increase of traffic mishaps between 1962 and 1964 in Michigan was considerably greater than the increase in vehicles or travel, as shown by the following statistics adapted from the Governor's report:

Category	Increase 1964 over 1962 (percent)
Traffic deaths	35
Traffic injuries	34
Property damage accidents	22
Economic loses	33
Vehicle registrations	10
Licensed drivers	5
Vehicle-miles of travel	13

Gov. Romney's Special Commission on Traffic Safety had concluded that responsible officials lacked much-needed legislation, manpower, financial and public support to keep pace with the ever-mounting problem. Areas needing strengthening were in traffic law enforcement (including 200 additional troopers), traffic accident records, driver licensing and improvement, driver education, and vehicle inspection, to name a few (1).

Michigan thus typifies the concern of state governments in the mid-1960's with the problem of highway safety and the necessity for adequate law enforcement practices and policies as a means of reducing accidents.

ORIGINS AND DEVELOPMENT OF STATE LAW ENFORCEMENT AGENCIES

The law enforcement arm of the states has had an interesting history that began nearly 150 years ago, with creation of the first border patrols. At the present time these agencies are known variously as the "highway patrol," "state police," "state patrol," or "highway police," among others.

The responsibility for law enforcement, in our general structure of self-government, has traditionally been concentrated at the local level. With few exceptions this practice, which dates back to early British institutions, shaped our law enforcement procedures until the 20th century. When the nation was comprised of widely separated municipal places, local enforcement of state laws proved acceptable. However, as society became more mobile and more populous, crime began to outstrip and overpower existing enforcement facilities, rendering them ineffectual.

Other factors also made it apparent that some sort of centralized mechanism was necessary if law and order were to prevail. Some of the major problems that arose from time to time in some areas were: (a) inability of sheriffs and constables to cope with crime and reluctance to enforce unpopular state laws; (b) waste, mismanagement, and political influence helping to cripple the municipal police function; (c) dissimilarities in the methods of enforcement by the numerous agencies and the grave need of uniformity within a state; and (d) the lack of coordination of all activities in an era of mobile crime.

The gravity of the situation was expressed by Gov. Arthur M. Hyde in his message to the 52nd Missouri General Assembly in 1923:

> Nowhere is there any effective agency for enforcement of law and maintenance of order except the National Guard. The state owes an inescapable duty to the public to preserve peace and order . . . No law can be enforced without the cooperation of three officials—sheriff, prosecuting attorney and court. When one or all of these three fails, anarchy results.
>
> . . . No power exists whereby the state can send any of its officials into the county to assist in preserving peace and order. Unless the emergency is grave enough to warrant sending the National Guard, the state and the people are helpless.
>
> . . . The best machinery for law enforcement by state authority yet devised is a state police force. A state constabulary is the remedy, so far as remedy exists in the powers of government against lawlessness.

The first state law enforcement agency was the Texas Rangers, formed in 1835 principally to patrol the Mexican border. Arizona and New Mexico also formed state border patrols in the early 1900's which existed for only a few years and were then abolished because of political involvement. The first state police force or constabulary, as it was initially called, was formed in Massachusetts in 1865. This agency was created primarily to suppress commercialized vice, but was granted general police powers to be exercised throughout the state. In 1879, this agency was absorbed into the Massachusetts District Police, a state detective unit. Its duties included investigating fires, enforcing fish laws, inspecting boilers and buildings along with the other duties assigned to the original agency. This agency was absorbed into the Department of Public Safety in 1920.

The next state to create a state police force was Connecticut in 1903. This agency was patterned after the Massachusetts District Police and was chiefly responsible for the enforcement of liquor and gambling laws. In 1905, the Pennsylvania "State Constabulary," as it came to be known, was organized. Its establishment marked the beginning of a new era in rural police administration, and it became the model for most of the police forces created thereafter. From the beginning, it operated as a mounted and uniformed body which used a widely distributed system of troop headquarters and substations as a base of operations. This provided a continuous patrol throughout the rural areas. The other basic characteristic consisted of the broad administrative powers granted to the superintendent of state police, who was made responsible to the governor alone.

Twelve years passed before the next state police force was organized in New York in 1917. By 1929, 20 states had created such agencies, and in the following decade, 26 more had done so. Thus state enforcement agencies are essentially products of the twenty-year period 1919-1939. Paralleling this phenomenon is the growth in the number and use of automobiles. The automobile created not only its own problems, which in turn were responsible for creating motor vehicle and traffic law enforcement agencies, but added to the woes of the local enforcement agencies responsible for law enforcement.

On the surface, it would appear that the function of criminal law and motor-vehicle law enforcement would be combined under one state agency. But this was not to be accomplished in many states without much controversy.

Local governments were, and still are for the most part, reluctant to relinquish general police powers to a central agency. Needless to say, lawmakers were very careful in the wording of the legislation that created these agencies. It might be added here that labor unions were vehemently opposed to a strong central police force because of the alleged strike-breaking activities of the Keystone Police in Pennsylvania. These pressures and pitfalls notwithstanding, legislation was enacted and statewide criminal law and traffic law enforcement agencies came into being.

Although organization or structures may differ, two types of police departments evolved—those with broad police powers and those limited to highway law enforcement. The distinction is well expressed in the following statement (2):

> . . . Generally speaking, the state police exercise broad police powers, whereas most of the state highway patrols are clothed with limited powers. Enforcement activities of the former, for the most part, are far more extensive than those of the patrols. The state police enforce all laws, including traffic laws and regulations, and their enforcement arms reach into every corner of the state. . . The duties of most state highway patrols, important though they are, are restricted almost entirely to enforcement of traffic laws and regulations and to carrying out highway accident-prevention programs. . .

In those states where local officials were more influential, the fledgling agencies were limited to highway and motor vehicle law enforcement. The argument for a general police force is that a control agency should be designed for combating crime in general—thus given all powers and authority conferred upon peace officers in the performance of this task—and that highway patrolling plays a major role in the apprehension of criminals. In two of the states, Texas and Pennsylvania, parallel agencies were created—to enforce criminal laws and motor vehicle laws. Subsequently, however, the two agencies were consolidated in each state. In many states, particularly those having a highway patrol, general police powers are still vested in local governments.

In some instances, the initial legislation that authorized the enforcement of traffic laws did not create a police organization, but merely authorized the commissioner of highways, secretary of state or other officials of similar authority to appoint individuals to patrol the highways. Their duties were, for the most part, confined to enforcing traffic laws, i.e., driving violations, and motor-vehicle laws including those governing vehicle sizes and weights; but in some instances, their powers included the enforcement of all state laws. All of these early patrols in the 1920's and 1930's were either dissolved or absorbed into the formal agency that was later created.

As time passed, the state legislatures began to show a growing interest in "all-purpose" state policing and a large number of traffic patrol agencies were reorganized as state police. By 1941, 35 state police agencies possessed broad powers to enforce state laws and 13 organizations had limited powers. It should be noted here that, even in the states where broad police powers had been granted, there were limitations to these broad grants in many states that placed restrictions on the agency's activities. Reorganizations of many patrols also changed their positions in the state government. By 1941, 25 police departments or 52 percent had become independent organizations. The other 23 state agencies were subsidiary units of different departments, such as public safety, highway, motor vehicles, law enforcement, public works and revenue.

The means by which lawmakers restrict the duties of law enforcement agencies are few but effective. The most effective tool at their disposal is the wording of the enabling legislation. In many cases the lawmakers spell out the duties and, more specifically, the areas where highway patrolmen have no jurisdiction—namely, criminal investigations. There are additional methods of keeping patrolmen on the highways. One method is to deny the highway patrol the authority to search and seize. Obviously patrolmen may take dangerous weapons from arrested persons but all confiscated evidence must be turned over to the duly authorized peace officers in the given area. A second method involves the fundamental weapon held by any legislature, i.e., the appropriation of funds. Law enforcement agencies are supported by either general fund appropriations, highway-user revenues, or a combination of both. Where supported entirely by general fund appropriations, the activities of the police agency can be tightly controlled by the legislature. A number of state constitutions restrict or earmark highway funds for highway purposes, including enforcement of traffic laws, so in those instances where the patrol is supported entirely by highway funds, the activity of the patrol is limited.

A case in point is Missouri. The highway patrol when created had only highway and motor vehicle law enforcement powers. Later broad police powers were granted, and the agency actively exercised them. The constitutionality of these rights was questioned by the State's Attorney. It was clearly stated in the Missouri constitution that highway monies shall be used for highway purposes only and inasmuch as the entire support of the highway patrol came from these monies, the general police powers granted the patrol were held to be unconstitutional. The fact that a subsequent legislature author-

ized 10 percent of the highway patrol budget to be paid from the state general fund only emphasizes the contention that lawmakers can expand or limit the activities of public agencies by the appropriation of revenues. In this case, the general policing activities of the Missouri Highway Patrol cannot exceed 10 percent of the sum of its activities.

A final method of restricting law enforcement agencies to the highways is self-serving. Traffic enforcement agencies generally have little need for detective or central investigation divisions. These are clearly criminal law enforcement and apprehension tools.

There are occasions when the highway patrol officer is requested or expected to perform duties not of a highway nature. Generally speaking, these duties will consist of the following: (a) investigate crimes originating on the highways; (b) arrest criminals who commit crimes in the presence of the patrolmen; (c) apprehend criminals who use the highways as means of escape after offenses perpetrated elsewhere; and (d) render aid to local peace officers or the governor on request. In each instance, these activities are generally confined to rural areas of the state.

Periodically, and justifiably, lawmakers reexamine existing statutes in the light of changing times and pressing needs. Some legislatures have felt called upon to broaden state police powers when the need seemed pressing and others have restricted the same when abuses were in evidence. Such has been the case with highway police agencies. The trend, however, has been toward expansion of general police powers and, in all probability, the trend will continue. Some agencies that originally had only traffic law enforcement functions have expanded numerically to keep up with increased traffic volume and regulation, but also have assumed broadened regulatory functions under a general public safety department. Such a department handles all general police activities such as criminal identification, communication, training, and miscellaneous related activities. Thus, the old highway patrol may be only a division now, concentrating on traffic supervision, safety education, and in some cases size and weight enforcement, driver examinations, motor vehicle inspections, and assisting in criminal investigations only when asked.

THE HIGHWAY POLICE ORGANIZATION TODAY

The highway police organization of today in most instances has come a long way in form, organization, and purpose from the one that was originally established, and the trend toward the granting of broad police powers continues. Presently, 43 of the 49 states covered by this study have granted broad police powers to the state police agency, while only 6 are still limited to highway-related activities. On the other hand, the trend toward the creation of autonomous agencies has reversed itself with only 19 police agencies presently having this status. This number includes New York and Rhode Island, where the state police are divisions of the executive departments but have independent status, and West Virginia, where the Department of Public Safety and the state police are the same organization. In the other 30 states, the police agency is a subdivision of one of the following departments: Department of Public Safety; Highway Department; Motor Vehicle Department; Highway Safety Department; Department of Law Enforcement; Department of Safety; Department of Law and Public Safety; or Highway Transportation Agency.

Table 2 shows for each state the agency which is, or which contains, the law enforcement function, according to the organization structure in effect at the beginning of 1965.

A further examination of the present status of police agencies compared to their status in 1941 shows that a number of changes of organization have occurred. Although the number of subordinate organizations has only increased by 5, there were 12 subordinate agencies and 8 independent agencies that have been reorganized since 1941. Nine of the subordinate units were placed under a different department, and 3 became independent agencies. Of the 8 independent agencies, 6 became subordinate units of a Department of Public Safety; one became a unit within the Highway Department, and the other, a unit within the Department of Motor Vehicles. These changes are shown in Table 3.

It should be pointed out that although a number of organizations that provide the police function occupy comparable positions within the state government, this similarity

TABLE 2

ORGANIZATION OF STATE LAW ENFORCEMENT AGENCIES AS OF JANUARY 1, 1965

STATE	Primary Agency 1/ Secondary Division Subordinate Units
Alabama	Department of Public Safety Highway Patrol Division Service and Safety Education Division Driver License Division Investigation and Identification Division Training Division Administration Division
Alaska	Department of Public Safety Division of Fire Prevention Alaska Disaster Office Division of State Police Enforcement Section Service Section Records and Identification Section Driver License and Safety Responsibility Section Training and Personnel Section
Arizona	State Highway Department Highway Patrol Division
Arkansas	Department of Arkansas State Police Highway Patrol Division Criminal Investigation and Laboratory Division Safety Education Division Identification and Records Division Communications Division Administration Division
California	Highway Transportation Agency Department of California Highway Patrol Operational Planning and Analysis Division Training Division Safety Service Division Administrative Service Division Zone Commands Area Commands
Colorado	State Patrol Supply and Maintenance Division Communications Division Auto Theft and Central Records Division Personnel and Training Division Troop Divisions
Connecticut	State Police Department Traffic Division Detective Division Administration Division Special Service Division Bureau of Identification Public Safety Division Academy
Delaware	State Highway Department State Police Division Traffic Bureau Bureau of Criminal Identification Bureau of Identification Finance Division Training Division Firearms Division Public Information, Safety Education, and Youth Division Communications Division
Florida	Department of Public Safety Highway Patrol Drivers License Division Administration Division Communications Training Division Quartermaster Division Chief Examiner Field Operations (Patrol)
Georgia	Department of Public Safety Uniform Division - State Patrol Drivers License Division Bureau of Investigation Communication Division Treasurer's Division Motor Vehicle Inspection Division Personnel Division Firearms Registration Division Safety Responsibility Division Safety Education Division Training and Indoctrinating Division Crime Laboratory Accident Records Division Police Academy
Idaho	Department of Law Enforcement Motor Vehicle Bureau Safety Responsibility Division Idaho State Police Traffic Safety and Driver Improvement Division Motor Carrier Division Others (not pertinent)
Illinois	Department of Public Safety General Office Division State Highway Police Personnel Division Field Operations Division Services Division Traffic Safety Division Penal Institutions and others
Indiana	Indiana State Police Business Administration Division Investigation Division Motor Carrier Inspection Division Operations Center Public Relations Division Records and Communications Division Traffic Division (Patrol) Training and Personnel Division
Iowa	Department of Public Safety Division of Administration Division of Criminal Investigation Division of Highway Patrol Division of Motor Vehicle Financial and Safety Responsibility Division of Motor Vehicle Registration Division of Operators and Chauffeurs License Division of Radio Communications Division of Safety Education Division of Fire Marshall
Kansas	Kansas Highway Patrol Communications Division Safety Division Motor Carriers Division Drivers License Division Traffic Law Enforcement Division (Patrol)
Kentucky	Department of Public Safety Division of State Police Division of Accident Control Division of Administrative Services Division of Boating Division of Driver Licensing Division of Fire Prevention
Louisiana	Department of Public Safety Division of Financial Responsibility Division of Drivers License Division of Driver Training

TABLE 2 (Continued)

STATE	Primary Agency 1/ Secondary Division Subordinate Units
Louisiana (Cont.)	Division of State Police Bureau of Criminal Investigation Accident Records Communications Training Auto Theft Crime Lab Troops
Maine	Maine State Police Inspection Division Radio Maintenance Division Safety Division Identification Bureau Criminal Bureau Communications Division Motor Maintenance and Property Division Troop Patrols
Maryland	Department of Maryland State Police Training - Personnel Division Communications Division Investigation Division Intelligence Unit Quartermaster Division Central Accident Records Division Finance Division Medical Division Operations Division (Troops)
Massachusetts	Department of Public Safety Division of State Police Uniformed Branch (Patrol) Detective Branch Traffic Bureau Bureau of Communications Bureau of Criminal Identification Bureau of Criminal Investigation State Police Academy Other Divisions (not pertinent)
Michigan	Michigan State Police Uniform Division Safety and Traffic Bureau Operations and Communications Bureau Bureau of Investigative Services Intelligence and Security Division Civil Defense Division Records and Statistics Division Personnel and Training Division Business Administration Division Fire Marshal Division Executive Division
Minnesota	Minnesota Highway Department Safety Division Drivers License Section Safety Promotion Section Highway Patrol
Mississippi	Department of Public Safety Traffic Enforcement (Patrol) Division Criminal Investigation Division Communications Division Drivers License Division Safety Responsibility Division Motor Vehicle Inspection Division Patrol Records Division Public Relations Division
Missouri	State Highway Patrol Division of Safety and Administration Service Division Radio Division Division of Commercial Vehicle Enforcement Finance and Equipment Division Motor Equipment Division Patrol Troops
Montana	Montana Highway Patrol Enforcement Division (Patrol) Safety Responsibility Division Personnel and Training Division Driver Examination Section
Nebraska	Department of Roads Law Enforcement and Safety Patrol Safety Education and Training Equipment and Supply Criminal Investigation and Identification Communications Operation and Engineering Patrol Troops
Nevada	Motor Vehicle Department Highway Patrol Division Drivers License Division Motor Carrier Division Fiscal, Accounting and Auditing Division Automation Division Vehicle Registration Division
New Hampshire	Department of Safety New Hampshire State Police Training Division Uniform Division Bureau of Criminal Investigation Equipment Supervision
New Jersey	Department of Law and Public Safety Division of Motor Vehicles Division of Weights and Measures Others (not pertinent) Division of State Police Troop Police Commands Administration Operations and Communications Investigation
New Mexico	State Police Department Administration Division Special Investigation - Intelligence Division Communications Systems Division Finance and Budget Division Field Division
New York	Executive Department New York State Police Field Command Uniformed Force Bureau of Criminal Investigation Administration Business Administration Personnel Training Communications Public Relations Science Lab Records Inspection Staff
North Carolina	Department of Motor Vehicles State Highway Patrol Enforcement Division Command and Transportation Division Highway Safety Division
North Dakota	North Dakota Highway Patrol Public Safety Division Patrol Troops
Ohio	Department of Highway Safety Bureau of Motor Vehicles Division of Highway Patrol Enforcement Section (Patrol) Aviation Section Personnel Section Training Section

TABLE 2 (Continued)

STATE	Primary Agency 1/ Secondary Division Subordinate Units
Ohio (Cont.)	Special Services Section Procurement Section Driver License Communications and Record Section
Oklahoma	Department of Public Safety Highway Patrol Division Accident Records Division Safety Responsibility Division Driver License Division Plans and Training Division Special Projects and Analysis Division
Oregon	Department of State Police Traffic Division (Patrol) Fish and Game Division Criminal Division Crime Detection Laboratory Identification and Investigation Bureau Arson Division Training Division Communication Division Fiscal and Property Division District Troop Patrols
Pennsylvania	Pennsylvania State Police Bureau of Detectives Bureau of Technical Services Bureau of Traffic Bureau of Staff Services Bureau of Staff Inspection Bureau of Training
Rhode Island	Executive Department Rhode Island State Police Detective Division Traffic and Supply Bureau Training Bureau Teletype Bureau Radio Bureau Fire Marshal Bureau Bureau of Criminal Identification and Special Services Uniformed Division (Patrol) Reports, Records and Personnel
South Carolina	State Highway Department Law Enforcement Division (State Highway Patrol) Truck Weighing Administration Communications Driver License Supply
South Dakota	Department of Highways Motor Patrol Administrative Office Patrol Section Safety Division Ports of Entry Scale Sites
Tennessee	Department of Safety Division of Administration Division of Drivers License Division of Highway Patrol Division of Financial Responsibility Bureau of Criminal Identification Safety Education Division
Texas	Department of Public Safety Driver and Vehicle Records Division Personnel and Staff Services Division Identification and Criminal Records Division Inspection and Planning Division Regional Commands (Highway Patrol) Intelligence Section Narcotics Section Motor Carrier Lease Section Public Information Section Legal Section Accounting and Budget Section Communication Section
Utah	Department of Public Safety Drivers License Division Financial Responsibility Division Safety Education and Promotion Criminal Identification Highway Patrol Division
Vermont	Department of Public Safety Bureau of Criminal Investigation Marine Division Uniformed State Police Division Civil Defense Division Fire Prevention Division Special Services Division Identification and Records Division Safety Education Division Communications Division
Virginia	Department of State Police Investigations and Records Division Communications Division Safety Division Patrol Troops Personnel and Training Division Property and Finance Division
Washington	Washington State Patrol Communications Division Technical Services Division Accident Records Division Personnel Division Field Operations (Patrol) Training Division Field Services Division Fleet and Supply Division Weight Control Division Driver License Division Internal Communication Division Safety Education Division Safety Council Staff Services
West Virginia	Department of Public Safety (West Virginia State Police) Criminal Identification Bureau Motor Vehicle Inspection Bureau Communications Division Accident Prevention Bureau Supply and Accounting Division Turnpike Division Patrol Companies
Wisconsin	Motor Vehicle Department Registration and License Division Driver Control Division Enforcement Division Planning and Records Section Training and Technical Services Section Communications Patrol Districts Inspection Services Sections Automotive Services Section Highway Safety and Promotion Division
Wyoming	Wyoming Highway Department Highway Patrol Safety Division Uniformed Troops

1/ Where the primary agency is the State Highway Department, only the secondary unit relating to patrol is given. For all other primary agencies, all secondary units are listed where at all relevant.

TABLE 3

COMPARISON OF THE POLICE ORGANIZATION'S POSITION IN THE STATE GOVERNMENT FOR THE YEARS 1941 AND 1965

State	1965						1941					
	Subordinate Agencies				Independent Agencies		Subordinate Agencies				Independent Agencies	
	Department of Public Safety 1/	Highway Department	Motor Vehicle Department	Other 2/	State Police 3/	Highway Patrol	Department of Public Safety	Highway Department	Motor Vehicle Department	Other 4/	State Police	Highway Patrol
Alabama	X						X					
Alaska	X											X (5/)
Arizona		X							X			
Arkansas					X						X	
California				X					X			
Colorado						X						X
Connecticut					X						X	
Delaware		X						X				
Florida	X											X
Georgia	X						X					
Hawaii 6/												
Idaho				X						X		
Illinois	X									X		
Indiana					X		X					
Iowa	X						X					
Kansas						X						X
Kentucky	X							X				
Louisiana	X										X	
Maine					X						X	
Maryland					X						X	
Massachusetts	X										X	
Michigan					X						X	
Minnesota		X						X				
Mississippi	X											X
Missouri						X					X	
Montana						X						X
Nebraska		X						X				
Nevada			X									X
New Hampshire	X										X	
New Jersey	X										X	
New Mexico					X						X	
New York					X						X	
North Carolina			X							X		
North Dakota						X		X				
Ohio	X							X				
Oklahoma	X						X					
Oregon					X						X	
Pennsylvania					X						X	
Rhode Island					X						X	
South Carolina		X						X				
South Dakota		X										X
Tennessee	X						X					
Texas	X						X					
Utah	X											X
Vermont	X								X			
Virginia					X				X			
Washington						X						X
West Virginia					X						X	
Wisconsin			X						X			
Wyoming		X						X				
Total	18	7	3	2	13	6	7	8	5	3	16	10

1/ In New Jersey, the official title is the Department of Law and Public Safety; Ohio, Department of Highway Safety; New Hampshire and Tennessee, Department of Safety.
2/ California Highway Transportation Agency; Idaho, Department of Law Enforcement.
3/ New York and Rhode Island, State Police is a division within Executive Department; West Virginia, State Police and Department of Public Safety are the same organization.
4/ Idaho, Department of Law Enforcement; Illinois, Department of Public Works; North Carolina, Department of Revenue.
5/ Alaska had a Territorial Highway Patrol at this time.
6/ Hawaii has no State Police organization; each island has its own police department.

ceases to exist when the internal structure of each agency is examined. There are as many different organizational structures as there are states. They vary from simple to complex, and no two are alike. In most instances, however, the differences between agencies occupying comparable positions within the state government are attributable to the functions they are required to perform. The agencies described here illustrate some of the more frequent ways that police agencies are organized. The agencies in Pennsylvania and Maryland illustrate state police organizations; those in New Jersey

and Texas, departments of public safety; and those in Missouri and Washington, highway patrols.

The Pennsylvania State Police

In Pennsylvania, the organization consists of six bureaus and a field division of troops. Two bureaus, Technical Services and Staff Services, are under the chief of staff and perform the administrative services of the organization. The Bureaus of Training and Staff Inspection report to the commissioner, and the Bureaus of Detectives and Traffic report to the deputy commissioner and form a line operation with the field division troops. The field division consists of 15 substations with each station containing units for crime, staff, and traffic.

The present internal structure is a recent change in the organizational set-up of the State Police and is significant in that the primary functions of the police have been set apart from the supporting services to insure the most efficient operation.

Maryland State Police

In Maryland, the police organization is divided into a headquarters office, which consists of the superintendent and executive officer and an adjutant, eight divisions, and an intelligence unit. The eight divisions, established as line divisions and reporting direct to the headquarters office are: Training-Personnel; Investigation; Quartermaster; Communications; Accident Records; Medical; Finance; and Operations. The Operations Division includes a communications center, an Aviation Section and the troops. The organization also includes an intelligence unit that reports direct to the headquarters office.

New Jersey State Police

In New Jersey, the State Police is one of seven divisions of the Department of Law and Public Safety. The police organization is divided into three major categories of responsibility, administration, operation, and investigations, plus the five police commands that form the field operations. The Deputy Superintendent supervises the administrative activities which include personnel, fiscal and procurement, inspection, service, planning, and public information and education. The operations activities are directed by the Executive Officer. These include traffic, communications, academy, records, capital police, civil defense, regulation of liquified petroleum gas, and tenement house and hotel fire safety. The Investigative Officer directs the activities of the Criminal Investigation Section and the Bureau of Identification. The five troops that make up the police commands report to the Superintendent.

The Texas Department of Public Safety

In Texas, the headquarters unit is composed of four major divisions, each headed by a chief, seven special service sections, and the Rangers. The significance here is that the six regional commands are organized as replicas of the headquarters structure, including communications, crime laboratory, office services, safety education, driver license, motor-vehicle inspections, license and weight, and highway patrol. Each regional commander reports to the director.

So far, we have examined those agencies that are responsible for the enforcement of criminal law and traffic law and are organized accordingly. The following agencies are highway patrols whose activities are primarily concerned with traffic.

Missouri State Highway Patrol

In Missouri, the highway patrol is divided into six divisions that comprise the headquarters unit and nine patrol troops that make up the field operations unit. The six divisions within the headquarters unit that report to the assistant superintendent are Radio, Finance and Equipment, Service, Safety and Administration, Motor Equipment, and Commercial Motor-Vehicle Enforcement. The nine troops are under the direction of field supervisors.

Washington State Patrol

In Washington, the patrol is divided into a very large number of divisions. Under the direction of the chief are listed the Investigative Division and Finance and Budget Division. The assistant chief supervises the operations of six divisions as follows: Training, Field Services, Communications, Fleet and Supply, Weight Control, and Drivers License. The administrative divisions, under an administrative officer, are: Accident Records, Personnel, Technical Service, Internal Communications, Staff Services, Safety Education, and Safety Council. The field forces, consisting of seven districts, are under the supervision of a staff inspector, along with a Program and Planning Division and General Maintenance Division.

THE POLICE FUNCTION

The tendency appears to be universal to organize the police into functional units, i.e., into separate bureaus or divisions for criminal law enforcement, traffic law enforcement, training, communications, etc. In the same manner, related functions within the organization such as administrative services, technical services, etc., have been grouped together.

As we have seen, the two major objectives of state police agencies are traffic supervision and crime repression. Traffic supervision is carried out in every state police agency and criminal law enforcement in most state police agencies. There are, in addition to the two items mentioned, many other activities for which the police agencies are responsible. Many of these functions are organized as separate divisions within the agency while others merely become an additional duty for the trooper to perform. In order to better understand the role of the police agency, these functions must be more closely examined.

All agencies employ both uniformed and civilian personnel. The uniformed, or sworn, personnel are those designated as peace officers, troopers, patrolmen, etc., who have the power to apprehend and arrest. The civilian personnel perform the clerical tasks of the agency primarily, with the possible exception of handling the communications network in many states.

As will be seen later, police traffic supervision occupies the majority of each state patrolman's time, and therefore becomes the primary function each agency performs. The basic police traffic functions are generally considered to include the following: (a) enforce traffic laws; (b) supervise and direct traffic; and (c) investigate accidents.

Within the framework of enforcing traffic laws, the patrolman's duties are: (a) patrol public ways to observe all vehicle use and users, roadway and vehicle conditions and deter would-be violators of traffic laws; (b) detect pertinent defects in individual behavior or condition, vehicle equipment or condition, or highway condition; (c) initiate appropriate action to prevent such defects from causing accidents or delays, remedy the defects, or discourage repetition of dangerous or prohibited acts; (d) investigate complaints of traffic law violations; (e) record and report all activity; and (f) assist the courts during their adjudication of traffic violations.

In the area of supervising and directing traffic, the patrolman: (a) provides information to aid people in reaching destinations and in complying with traffic laws and regulations; (b) indicates to drivers what is desired and expected of them, especially when and how to move in congested areas; (c) takes emergency action to direct flow of traffic when usual regulations, traffic signals or regular controls prove inadequate; and (d) provides "assistance escort" as authorized.

When investigating accidents, the patrolman is expected to: (a) take action to prevent aggravation of the damage and injury by protecting the scene and other traffic, protecting property of persons involved and providing first aid to the injured; (b) obtain information on how the accident happened, such as circumstances, conditions and actions involved, specific violations of law involved and record and report contributed and acquired information.

In addition to the basic traffic functions, there are several essential supporting functions which implement the basic ones and are usually performed at a technical or supervisory level. They are as follows: (a) maintain records on accidents and enforcement

problems, program and personnel activity; (b) compile summaries of data gathered to reveal corrective action needed; (c) prepare special studies or reports for police administration, program coordination or public information; (d) coordinate plans and activities with other official agencies and support groups; and (e) provide laboratory and technical aids for investigation such as chemical tests for alcohol, microscopy, chemistry, refraction, photography, and fingerprint identification.

There are also incidental service functions allied to traffic functions such as providing "motorist aids" which include mechanical aid, tire changes, calling service trucks and other assistance to distressed persons.

The functions previously described are ones that are performed by every state agency responsible for traffic law enforcement. There are other functions which may be performed by the police in conjunction with some other agency or agencies that can be considered as cooperative functions. It should be pointed out that many of these are not fully accepted as police responsibilities and may or may not be assigned to the police agency.

One of these functions found in many police agencies is safety education. The activities include: (a) aiding in the establishment of driver education programs for school and nonschool groups; (b) conducting driver retraining programs for violators; (c) directing community traffic safety programs; (d) developing traffic safety promotional material; and (e) participating in traffic safety group activity.

Other cooperative functions include driver examination and improvement, which includes examining applicants for operators, chauffeurs and commercial licenses; maintaining driver record files; vehicle inspection of buses and other motor vehicles; vehicle weighing; equipment regulations; bicycle inspection and regulation; and suspension and revocation notices.

One other activity that should be considered along with the traffic-related functions is automobile theft investigation and recovery. Many states have this function located within the activities of the police agency, and in most instances, it is assigned as a part of the criminal investigation function rather than the traffic one.

The other functions assigned to police agencies are those assigned to agencies with broad police powers, i.e., the enforcement of criminal laws. These generally are activities assigned to a detective bureau, identification bureau and a crime laboratory.

There are other miscellaneous functions that are assigned to police agencies that appear in only a few agencies and have little or no connection to those previously mentioned. They cover such activities as fire prevention and investigation; firearms regulation; livestock inspection; theft investigation and patrol; boat registration; liquor control; fish and game law enforcement; building and boiler inspection; underwater recovery; inspecting migrant workers' homes, boarding homes and nursing homes; and last but not least, civil defense. There are also numerous supporting activities that are essential to the efficient operation of the organization. These cover such areas as personnel, finance, quartermaster, planning, maintenance, special services, internal inspection, training, and communications.

The amount of time devoted to traffic- and nontraffic-related activities varies substantially among the agencies. A composite distribution has been made, however, based on precentages supplied by a questionnaire sent to each state police agency. The results are summarized in Table 4.

Of primary interest was the amount of time each agency spends on basic traffic functions. The results of the questionnaire showed that, on the average, personnel (both uniformed and civilian) of police agencies that are subordinate units of a department of public safety spend 47 percent of their total activity on traffic supervision compared to the 64 percent spent by police agencies that are subordinate units of highway and motor vehicle departments. Independent state police agencies devote 47 percent of their time to traffic supervision while independent highway patrols spend 51 percent of their time on the same activity.

When the activity of each agency was confined to the sworn uniformed personnel, higher percentages emerged. Within the department of public safety agencies, 68 percent of the total activity was spent on traffic supervision compared to 75 percent for other subordinate police agencies. Traffic supervision in the independent agencies

TABLE 4

PERCENTAGE DISTRIBUTION OF ORGANIZATION ACTIVITY

	Traffic Functions	Other Traffic Related Activities	Other Activities	Total
TOTAL PERSONNEL				
Subordinate Agencies				
Department of Public Safety	46.8	42.4	10.8	100.0
Highway, Motor Vehicle and Other Departments	64.0	30.2	5.8	100.0
Independent Agencies				
State Police	47.4	26.7	25.9	100.0
Highway Patrol	51.0	46.2	2.8	100.0
SWORN UNIFORMED PERSONNEL				
Subordinate Agencies				
Department of Public Safety	68.0	22.0	10.0	100.0
Highway, Motor Vehicle and Other Departments	75.0	20.7	4.3	100.0
Independent Agencies				
State Police	58.5	20.3	21.2	100.0
Highway Patrol	72.1	24.8	3.1	100.0

takes up 59 percent of the state police agencies' time and 72 percent of the highway patrols' time.

Additional information from questionnaire replies showed that the average work-week for uniformed personnel is 48 hours and 40 hours for civilians. The data were also compiled and analyzed to determine the amount of time the average patrolman spends on the various activities assigned to the agency. In this analysis, the activities have been confined to those performed by a highway patrolman and eliminates from consideration criminal investigation and its supporting functions.

In an average 48 hour work-week, the patrolman spends 40 hours in the performance of basic traffic functions, including traffic surveillance, accident investigation, auto theft and recovery, and court appearances. One hour is spent in compiling records and statistics, and in police laboratory work, which are essential supporting functions.

Driver licensing, truck weighing, motor vehicle and school bus inspection, and safety education account for four hours of the work-week, with three hours spent on communications, personnel, training, and other special services required within the internal structure of the organization.

Another part of the questionnaire concerned the manpower of the police agencies. Each state agency was asked to report its personnel strength for three different periods of time, separated between civilian personnel and sworn uniformed personnel. As of July 1, 1959, there were 22,864 sworn uniformed personnel and 7,981 civilians, a total force of 30,845 persons, engaged in state police activities. By July 1, 1964, the number had increased to 26,784 sworn uniformed personnel and 9,968 civilians, a total force of 36,752. The sworn uniformed personnel increased 3,920 or 17 percent while the civilian strength went up 1,987 or approximately 25 percent. The total strength of the police agencies increased 5,907 or 19 percent.

Each agency was also asked to estimate its manpower requirements as of July 1, 1969. The estimates show that a total of 57,444 persons consisting of 44,210 sworn uniformed personnel and 13,234 civilians will be needed to provide adequate traffic supervision and perform the other assigned functions of the agencies. This is an increase of 17,417 troopers or 65 percent, 3,582 civilians or 33 percent, and a total increase of 20,699, or 56 percent.

Table 5 shows the growth of police agencies over the last 25 years from 1964. It is interesting to note that in terms of actual numbers, the strength of police agencies increased 25,582 during the 25-year period from 1940 to 1964 as compared to an expected increase of 20,699 during the next 5-year period, 1964-1969.

TABLE 5

COMPARISON OF SWORN UNIFORMED AND CIVILIAN PERSONNEL FOR THE YEARS 1940 AND 1964 1/

State	Sworn Uniformed Personnel		Civilian Personnel		Total	
	1940	1964	1940	1964	1940	1964
Alabama	134	561	27	204	161	765
Alaska	-	101	-	46	-	147
Arizona	41	319	10	66	51	385
Arkansas	61	218	7	60	68	278
California	719	2,795	197	907	916	3,702
Colorado	116	332	16	141	132	473
Connecticut	225	502	85	201	310	703
Delaware	92	221	15	53	107	274
Florida	60	614	4	596	64	1,210
Georgia	168	420	12	326	180	746
Hawaii 2/						
Idaho	40	140	46	27	86	167
Illinois	350	1,145	127	525	477	1,670
Indiana	221	651	85	232	306	883
Iowa	128	285	-	82	128	367
Kansas	67	223	5	80	72	303
Kentucky	113	457	10	198	123	655
Louisiana	439	554	26	491	465	1,045
Maine	109	244	11	47	120	291
Maryland	104	733	34	249	138	982
Massachusetts	323	614	105	164	428	778
Michigan	443	1,170	131	305	574	1,475
Minnesota	125	377	13	86	138	463
Mississippi	85	378	18	118	103	496
Missouri	175	505	48	440	223	945
Montana	71	143	9	66	80	209
Nebraska	67	225	3	45	70	270
Nevada	11	50	3	16	14	66
New Hampshire	52	126	12	17	64	143
New Jersey	319	996	70	242	389	1,238
New Mexico	42	204	4	66	46	270
New York	895	2,464	34	282	929	2,746
North Carolina	188	648	41	185	229	833
North Dakota	13	80	5	6	18	86
Ohio	200	855	60	409	260	1,264
Oklahoma	125	348	18	253	143	601
Oregon	168	535	17	91	185	626
Pennsylvania	1,516	2,015	141	312	1,657	2,327
Rhode Island	71	119	10	21	81	140
South Carolina	154	460	25	2	179	462
South Dakota	17	88	-	36	17	124
Tennessee	100	518	32	200	132	718
Texas	340	1,398	98	1,014	438	2,412
Utah	50	152	6	41	56	193
Vermont	37	111	26	53	63	164
Virginia	178	745	42	304	220	1,049
Washington	167	369	50	380	217	749
West Virginia	218	279	32	85	250	364
Wisconsin	45	222	2	187	47	409
Wyoming	15	75	1	11	16	86
Total	9,397	26,784	1,773	9,968	11,170	36,752

1/ Source of the 1940 data--"State and Provincial Police" by David Geeting Monroe, page 9.
2/ Hawaii has no State Police organization; each island has its own police department.

The response concerning the patrolling of state highways within incorporated municipalities showed that 29 state agencies have this responsibility. Of those states, five indicate they patrol these highways upon request of the local governments; five confine their urban patrol activities to the Interstate System; four patrol small cities and towns; four patrol where the local government has no police force; and the remaining states gave no explanation for patrolling these highways. The percentage of patrol activity applicable to municipalities was less than five percent in most instances with six states devoting five to ten percent of their patrol activity in incorporated areas.

In regard to county roads, 41 states indicated the state agency patrols these roads. In addition, county (or township) patrols operate in 39 states, to a greater or lesser extent. Table 6 compares the number of county governments to the number of counties that maintain a road patrol. There are 10 states where there are no local county road patrols and 8 states in which each county has a road patrol. Overall, 25 percent of the counties maintain a separate road patrol.

In the area of separate patrols for patrolling the free sections of the Interstate System, only five states indicated that such patrols existed. However, as more of this mileage is opened to traffic and the demands of the motorist increase, it is expected that the need for these patrols should increase also.

TABLE 6

NUMBER OF COUNTY GOVERNMENTS AS RELATED TO NUMBER OF COUNTY ROAD PATROLS

State	Total Number of Counties	Number of Counties Operating Road Patrols
Alabama	67	1
Alaska	-	-
Arizona	14	1
Arkansas	75	1
California	58	0
Colorado	63	0
Connecticut	-	1/ 81
Delaware	3	1
Florida	67	67
Georgia	159	25
Hawaii	4	4
Idaho	44	44
Illinois	102	102
Indiana	92	92
Iowa	99	0
Kansas	105	5
Kentucky	120	4
Louisiana	64	3
Maine	16	1/ 2
Maryland	23	5
Massachusetts	14	1/ 206
Michigan	83	83
Minnesota	87	20
Mississippi	82	2
Missouri	114	Unknown
Montana	56	56
Nebraska	93	2
Nevada	17	Unknown
New Hampshire	10	0
New Jersey	21	2
New Mexico	32	0
New York	62	2
North Carolina	100	1
North Dakota	53	0
Ohio	88	25
Oklahoma	77	0
Oregon	36	Unknown
Pennsylvania	67	1
Rhode Island	-	1/ 31
South Carolina	46	0
South Dakota	64	0
Tennessee	95	85
Texas	254	6
Utah	29	Unknown
Vermont	14	0
Virginia	96	6
Washington	39	2
West Virginia	55	55
Wisconsin	72	68
Wyoming	23	2
Total	3,054	773

1/ These are township road patrols and are not included in the total.

STATUTORY AUTHORITY OF LAW ENFORCEMENT AGENCIES

Table 7 lists the law enforcement agencies, cites the law creating and financing them, and the source of funds. The laws cited in the second column are those that created the enforcement agency or which transferred the patrol or police along with its duties, functions, and, in some cases, appropriations to the department.

Good Roads Amendments

Presently there are 29 states that have "good roads" amendments in their constitutions that dedicate or earmark highway-user taxes for highway purposes. A model for such amendments has been proposed as follows (3):

TABLE 7

STATUTORY PROVISIONS GOVERNING THE CREATION AND FINANCIAL SUPPORT OF LAW ENFORCEMENT AGENCIES

STATE	PRIMARY AGENCY	CITATION CREATING THESE AGENCIES	SOURCE OF FUNDS FOR LAW ENFORCEMENT AGENCIES	CITATION APPORTIONING OR APPROPRIATING OPERATING FUNDS
Alabama	Department of Public Safety	Title 36, Section 58(54)	Motor-vehicle fees	Title 36, Section 58(61), 53
Alaska	Department of Public Safety	Section 44.41.010 (AS)	General fund	Chapter 167, Laws of 1961
Arizona 1/	Highway Patrol Division	Section 28.231-A (ARS)	Highway-user revenues	Section 28-231D
Arkansas	Department of State Police	Section 42-402 (1947 Stat.)	Driver license fees and general funds	Title 76-309.3(c)(a)
California 1/	Department of Highway Patrol	Section 13975, Gov. (WCAC)	Motor-vehicle fees	Chapter 3, Section 42.271(b)
Colorado	State Highway Patrol	Section 120-10-1 (CRS, 1953)	Highway-user revenues	Section 120-10-23
Connecticut	State Police Department	Title 29, Chapter 529, Section 29-4 (GSA)	Highway-user revenues and general funds	Title 14, Chapter 246, Section 14-156
Delaware 1/	State Police Division	Chapter 83, Section 8301, Title 11 (DCA)	General fund	Title II, Section 8303
Florida	Department of Public Safety	Section 321.01 (FSA)	General fund	Section 321.09
Georgia	Department of Public Safety	Chapter 92A-105 (GCA)	Driver license fees through general fund	Chapter 92A-120
Hawaii 2/				
Idaho	Department of Law Enforcement	Section 19.4801 (IC)	Highway-user revenues	Section 19.4811
Illinois	Department of Public Safety	Chapter 121, Section 307.1 Supp. (IAS)	Motor-vehicle fees	Statute 127, Section 144.3
Indiana	State Police Department	Chapter 8, Section 47-846 (BIS)	Highway-user revenues and general funds	Title 36-2817
Iowa	Department of Public Safety	Section 80.1 (ICA)	General fund	Section 80.8; Chapter 1, Section 51, Laws of 1963
Kansas	State Highway Patrol	Chapter 74, Article 20a01 (GS-1949)	Highway-user revenues	Chapter 68-416a
Kentucky	Department of Public Safety	Chapter 17, Section 010 (KRS)	Highway-user revenues and general funds	Chapter 3, Laws of 1962
Louisiana	Department of Public Safety	Section 40:1301 (WLRS)	Driver license fees and general funds	Chapter 2, Section 32.412 and 426; Chapter 75, Laws of 1962
Maine	State Police Department	Chapter 15, Section 1 (RS-1954)	Highway-user revenues and general funds	Chapter 23, Section 133
Maryland	Department of State Police	Article 88B, Section 3 (ACM-1957)	Motor-vehicle revenues and general funds	Article 66.5, Section 341
Massachusetts	Department of Public Safety	Chapter 22, Section 1 (GLA)	Highway-user revenues and general funds	Chapter 22, Section 9B
Michigan	State Police Department	Chapter 24, Section 4.432 (SA)	General fund	Chapter 193, Section 1, Laws of 1961
Minnesota 1/	Highway Patrol	Section 161.47 (MSA)	Highway-user revenues	Section 161.47, Subd. 5
Mississippi	Department of Public Safety	Title 30, Chapter 2, Section 8078 (MC-1942)	Motor-vehicle fees through general fund	Title 30, Chapter 2, Section 8120.5
Missouri	State Highway Patrol	Title 5, Section 43.020 (VAS)	Highway-user revenues and general funds	Title 5, Section 43.100 and 43.180
Montana	State Highway Patrol	Title 31-101 (RSM-1947)	Driver license fees and general funds	Title 31-105 and 31-210
Nebraska 1/	Law Enforcement and Safety Patrol	Title 60.431 (RSN-1943)	General fund	Chapter 330, Laws of 1963
Nevada 1/	Highway Patrol Division	Chapter 481.130 (NRS)	Highway-user revenues and general funds 3/	Chapter 481.083 and 48:150
New Hampshire	Department of Safety	Chapter 106.A:1 (NHRSA-1955)	Highway-user revenues and general funds	Chapter 6.12
New Jersey	Department of Law and Public Safety	Chapter 52.17B-3 (NJSA)	General fund	Chapter 52.9H-2
New Mexico	State Police Department	Chapter 39, Article 2, Section 2, (NMS-1953)	Driver license fees through general fund	Chapter 39.2-22
New York	Division of State Police	Executive Law, Section 210	General fund	Chapter 147, Laws of 1964
North Carolina 1/	State Highway Patrol	Chapter 20-1 (GSNC)	Highway-user revenues	Chapter 20-194
North Dakota	State Highway Patrol	Chapter 39-03-02 (NDRC-1943)	Motor-vehicle fees and general funds	Chapter 39-03-08 and -16
Ohio	Department of Highway Safety	Chapter 5503.01 (ORCS)	Motor fuel tax and motor vehicle fees	Chapter 4501.6
Oklahoma	Department of Public Safety	Title 47, Chapter 2, Section 103 (OSA)	Driver license fees and general funds	Title 47, Sections 6-101, 14-116, 22.2; Chapter 296, Laws of 1963
Oregon	State Police Department	Title 18, Section 181.020 (ORS)	Highway-user revenues through general fund	Chapter 181.040
Pennsylvania	State Police Department	Title 71, Section 65 (P-P)	Highway-user revenues through general fund	Title 72, Section 3563a
Rhode Island	Division of State Police	Title 42, Chapter 28, Section 2 (GLRI) 1956	General fund appropriation	Section 42-28-32
South Carolina 1/	Law Enforcement Division	Section 46-851 (CLSC-1962)	Highway-user revenues	Section 33-287
South Dakota 1/	Motor Patrol	Section 44.06.03 (SDC-1939)	Highway-user revenues	Section 44.06.06
Tennessee	Department of Safety	Section 4.320 (TCA)	Motor-vehicle fees through general fund	Section 4.711
Texas	Department of Public Safety	Article 4413 (VCS)	Highway-user revenues	Articles 6687b(15), 6701d(141), 4413(26)
Utah	Department of Public Safety	Title 41-13-1 (VAC-1953)	Motor fuel tax and motor vehicle fees	Title 41-13-4
Vermont	Department of Public Safety	Chapter 111, Section 1811 (VSA)	Highway-user revenues and general funds	Chapter 252, Part III, Laws of 1961
Virginia	Department of State Police	Title 52, Chapter 1, Section 52-1 (CV-1950)	Motor-vehicle fees	Title 46.1, Section 167 (c,2)
Washington	State Patrol Department	Chapter 43, Section 43.010 (RCW)	Driver license fees and motor-vehicle fees	Chapter 46.68.30 and .40
West Virginia	Department of Public Safety	Section 1237 (WVC-1961)	Learner's permit fees and general funds 4/	Section 1721 (213); Chapter 12, account 570, Laws of 1963
Wisconsin 1/	Enforcement Division	Chapter 110.01 (WISA)	Motor-vehicle fees	Chapter 20.560 (73)
Wyoming 1/	Highway Patrol	Title 31, Chapter 2, Section 31.7 (WS-1957)	Highway-user revenues	Section 31-11

1/ Although these are secondary agencies, they represent the primary State agency responsible for law enforcement. In these States, the parent department is concerned primarily with activities other than police work.
2/ Hawaii has no State Police Organization; each island has its own police department.
3/ The nonhighway activities of the highway patrol, when authorized by the governor, are supported by the general fund.
4/ Learner's permit fees are deposited in the general fund to the credit of the State police.

TABLE 8

SUPPORT OF LAW ENFORCEMENT AGENCIES FROM HIGHWAY-USER REVENUES BY STATES THAT HAVE AND DO NOT HAVE GOOD ROADS AMENDMENTS

STATE	STATES HAVING GOOD ROADS AMENDMENTS				STATES NOT HAVING GOOD ROADS AMENDMENTS		
	CITATIONS OF STATE CONSTITUTIONAL AMENDMENTS DEDICATING HIGHWAY REVENUES TO HIGHWAY PURPOSES	AMENDMENTS PROVIDE			CITATIONS OF STATUTES AUTHORIZING ALLOCATION FROM USER REVENUES	"ONE-FUND" STATES 1/	STATUTES DO NOT AUTHORIZE ALLOCATIONS FROM USER REVENUES DIRECTLY
		FOR POLICING OR LAW ENFORCEMENT	FOR "SUPERVISION," "TRAFFIC SUPERVISION" OR "SAFETY"	NO SPECIFIC PATROLLING PROVISION			
Alabama	Amendment XCIII	X					
Alaska						X	
Arizona	Article IX, Section 14	X					
Arkansas					Title 76-309.3(c)(a)		
California	Article XXVI, Section 2(a)	X					
Colorado	Article X, Section 18		X				
Connecticut					Section 14-156		
Delaware						X	
Florida	Article IX, Section 16			X			
Georgia	Article VII, Section IX(b)			X			
Hawaii							X
Idaho	Article VII, Section 17		X				
Illinois					127, Section 144.3		
Indiana					Title 36-2817		
Iowa	Article VII, Section 8		X				
Kansas	Article II, Section 10			X			
Kentucky	Section 230	X					
Louisiana	Article VI, Section 23			X			
Maine	Article IX, Section 19	X					
Maryland					Article 66.5, Section 341		
Massachusetts	Article 78	X					
Michigan	Article X, Section 22			X			
Minnesota	Article XVI, Section 5			X			
Mississippi					Section 8120.5		
Missouri	Article IV, Section 30	X					
Montana	Article XII, Section 1(b)			X			
Nebraska							X
Nevada	Article IX, Section 5			X			
New Hampshire	Part Second, Article 6a		X				
New Jersey						X	
New Mexico							X
New York						X	
North Carolina					Chapter 20-194		
North Dakota	Article 56, Section 1			X			
Ohio	Article XII, Section 5a	X					
Oklahoma							X
Oregon	Article IX, Section 3	X					
Pennsylvania	Article IX, Section 18		X				
Rhode Island						X	
South Carolina					Section 33-287		
South Dakota	Article XI, Section 8		X				
Tennessee							X
Texas	Article VIII, Section 7a	X					
Utah	Article XIII, Section 13 (3)	X					
Vermont					Title 19, Section 9		
Virginia					Title 46.1, Section 167		
Washington	Article II, Section 40(b3)	X					
West Virginia	Article VI, Section 52			X			
Wisconsin					Chapter 20-560(73)		
Wyoming	Article XV	X					
Total		13	6	10	11	5	5

1/ In these States, road-user and other revenues are placed in the general fund. From this "one fund" appropriations are made for highway and other purposes.

> No monies derived from fees, excises, or license taxes relating to registration, operation, or use of vehicles on the public highways, or to fuels used for the propulsion of such vehicles, shall be expended for other than cost of administering laws under which such monies are derived, statutory refunds and adjustments provided therein, payment of highway obligations, cost of construction, reconstruction, maintenance and repair of public highways and bridges, and expense of state enforcement of traffic laws.

The aim of such amendments is to prevent future legislatures and special interest groups from diverting monies levied against road users to other than highway purposes.

Our attention herein is directed to those states having amendments that include or have been interpreted to include state traffic supervision with other highway expenses. Of the 29 states having "good roads" amendments, 13 specifically include enforcement of traffic laws, or policing, as a highway cost. In six states, the amendments provide either for "supervision," "traffic supervision," or "safety" on public highways as a sanctioned expenditure. Amendments in the remaining ten states make no reference at all to traffic supervision. The groupings of the states are shown in Table 8.

Of the first group of 13 states, all except Alabama and Oregon allocate highway-user funds directly for the motor vehicle and traffic law enforcement portion of their total budget. In the latter two states, also, the traffic law enforcement agencies are supported by user taxes; however, these tax revenues first pass through the state general fund where they are appropriated to the agencies.

All of the second group of six states except Iowa have passed laws authorizing use of road funds for traffic supervision. A case in point is the legislation creating the Colorado patrol. The passage says in effect that, it is hereby declared that expenses of the highway patrol shall be charged against the State Highway Fund as an expense of maintenance, preservation and supervision of public highways (4). There is no doubt as to the intent of the Colorado legislature in this particular case.

In addition to Colorado, the states of Idaho, New Hampshire, and South Dakota also support the enforcement agencies by direct allocations from highway funds.

Notwithstanding the fact that Iowa's good roads amendment includes "supervision" of public highways as a highway function, this term has not been construed to include patrolling, and the highway patrol is supported entirely from the state general fund. The amendment, however, does not apply to revenue from operators' and chauffeurs' licenses, and these fees are deposited in the general fund where they can be considered to provide substantial support for the highway patrol, although not earmarked for this purpose.

In the case of Pennsylvania, the monies are appropriated from the special motor license fund to the general fund, and then reappropriated to the policing agency. Even though the receipts pass through the general fund, they do not lose their identity. Therefore, they can be and are channeled into a specific agency for a specific purpose.

For the third group of 10 states, the amendments are silent concerning the inclusion of traffic enforcement as a highway cost. However, in Kansas and Minnesota, the amendments earmark highway funds for "highway purposes." It appears as though the framers of the constitutional amendment preferred to let others define or interpret "highway purposes." The Kansas legislature later provided for inclusion of traffic patrol, and Minnesota's Attorney General voiced the opinion that "the state could put the highway patrol under the Bureau of Criminal Apprehension and continue maintenance of the patrol out of highway department funds provided duties and powers of the patrol remain as prescribed by law" (5). The point made was that the patrol could be placed under any agency chosen as long as the duties remain the same. Thus highway patrolling costs were construed to be "highway purposes," and could be covered by highway revenues.

The remaining eight states either earmark funds only for highway construction, maintenance, administration, and debt service on bonds issued for these purposes, or exclude from the good roads amendments those road-use taxes received by police agencies, as in the case of Florida, Georgia, Louisiana, and Michigan. Although Florida and Georgia have amendments earmarking road-use monies, they apply only to motor-fuel tax receipts, and in Florida only to two-sevenths of the tax. The Florida Department

of Public Safety looks to the general fund for its support; however, driver license fees are deposited in the general fund where, as in Iowa, they can be considered support for the highway patrol. The Georgia Department of Public Safety also receives its support from operator's and chauffeur's license fees which are deposited in the general fund. However, here the department has first claim. The Louisiana amendment does not cover operator's license fees, which are credited directly to the law enforcement agency.

Michigan's amendment prior to April 1, 1963, earmarked motor-fuel taxes and vehicle registration fees exclusively for "highway purposes." In the opinion of the State attorney general, the phrase "highway purposes" excluded the activities of the Michigan State Police and payment from the highway fund for such purposes was considered to be unconstitutional (6). On April 1, 1963, the voters of Michigan approved a new constitution, which provided in Section 9 of Article IX that highway funds be used for highway purposes "as defined by law." This phrase removes the constitutional bar that heretofore restricted highway funds to construction, maintenance, and administration. Subsequently, Gov. Romney recommended the use of highway funds for the freeway patrol which will be discussed in depth later. In any event, the Michigan amendment does not specifically cover fees on operators' licenses and these are deposited in the general fund where they are drawn upon to support, in part, the state police.

The traffic enforcement agencies in Montana, North Dakota, and West Virginia look to the state general fund for the major part of their funds. Their amendments have not been construed to encompass traffic law enforcement as a highway cost element. However, in both Montana and North Dakota, income from operator's license fees is not subject to the purview of the amendment, and these revenues are deposited in the state general fund, from which appropriations are made for the enforcement agencies.

Nevada's good roads amendment includes "administration" in addition to construction and maintenance as authorized highway expenditures. With this flexibility, the legislature determined that the costs of the motor vehicle department (Table 2), which included the Highway Patrol Division, shall be deemed cost of administration with respect to operation of motor vehicles on public highways of the state (7). Consequently, the Nevada State Highway Patrol expenses are paid entirely from highway funds.

Generally speaking, if the constitutional amendments make no reference to law enforcement, there is little the legislatures can do in assigning highway monies to cover the highway share of police activities.

Although 21 states have no constitutional good roads amendments as such, most of these do, in practice, apply road-user tax revenues exclusively to highway purposes. However, 5 of the 21 states operate on a "one-fund" basis whereby all state revenues are deposited in a general fund, and appropriations for highways, including policing activities, are paid from the general fund. For these states, it is customary to consider that road-user revenues support policing and other highway activities to the extent revenues equal appropriations for these highway and related purposes.

In 11 of the 21 states, road-user revenues are allocated directly for support of the traffic enforcement agencies. In the remaining 5 of the 21 states, the agencies are supported almost entirely from general fund appropriations, although in each instance but one (Hawaii), the general fund receives operator's license or other road-user revenues that partially or entirely equal the amounts expended by the enforcement agencies, even though the linkage may only be implicit. The groupings of these states are also shown in Table 8.

In summary, the cost of enforcing state traffic and motor vehicle laws is clearly recognized as a highway expense by 21 of the 29 states having good roads amendments, by 11 of the remaining 21 states, and by a number of national organizations associated with roads and motor vehicles. This interpretation is shared by the federal government.

The Federal Viewpoint

The Bureau of Public Roads has for many years considered highway policing to be an essential and important highway activity, and has ruled that expenditures for that purpose are fully consistent with the policy statement in the Hayden-Cartwright Act (48 Stat. 993, approved June 18, 1934). In summary, the Act stated that it is unfair and unjust to tax motor-vehicle transportation unless the proceeds of such taxation are

applied for construction, improvement, and maintenance of highways and administrative expenses in connection therewith.

Inevitably, the choice of some terms required further elaboration as doubts or questions were raised as to their meaning or to the intent of Congress. The task of resolving these fell upon the Bureau's chief administrator through the General Counsel.

The term "administrative expenses" has been interpreted in a broad sense, not only to include the administration of constructing and maintaining highways, but to include the administration or supervision of highways in an operational sense. Thus, administration of highways should also include those measures necessary to insure the safe utilization of such highways, i.e., the enforcement of motor vehicle and traffic laws. It has been determined that this is the spirit that Congress had intended to establish in its wording of the Hayden-Cartwright Act.

Thomas H. MacDonald, former Commissioner of the Bureau of Public Roads, held on several occasions that highway-user taxes could be used for the expenses of highway patrols, as distinguished from general peace officers, and that a pro rata allocation of costs to cover highway duties was permissible where mixed duties were performed by motor police. On one of these occasions, Mr. MacDonald stated (8):

> Where a state highway patrol engaged in police work about half of the time, or to the extent of about one half of the force, if the entire cost of the patrol were paid out of the highway fund, there would be a question of diversion of such funds. If the highway patrol were used solely for highway patrol work for the protection of traffic on the highways, and if the cost were paid out of highway funds, it would not constitute diversion. A highway patrol may perform incidental general police work without its constituting diversion, but where the general police work constitutes a major part of the duties of the patrol, a proportionate part of the cost would have to be paid from funds other than highway funds, in order to avoid diversion.

In addition, the Commissioner stated that highway funds may be used for collection costs of the various taxes and levies, costs of examining and licensing vehicle drivers, and costs of inspecting motor vehicles for safety (9). That these expenses are legitimate highway costs and are in keeping with the intent of the Hayden-Cartwright Act seems to have been firmly established by the Bureau.

The judgments made above were all founded on the premise that where the user of highways or any commodity requires special services to insure the safe use of such services, then he should shoulder the costs incurred in carrying out these safety and regulatory measures. It has been pointed out previously that some of the states do not follow this policy. Some have excluded the highway patrolling function from highway purposes as interpreted by the respective state court or attorney general, while still others see fit to pay all police or patrolling costs from highway monies.

POLICE TRAFFIC SUPERVISION ON TOLL ROADS

A brief study of police traffic supervision on the major publicly owned toll roads in the United States should be useful because the operations are limited to a specific and identifiable mileage of highways handling precisely known volumes and types of traffic, so that the patrol activities can be measured and analyzed. At the outset, however, it should be borne in mind that the toll road provides special services at an extra fee, and that the pattern of such services may not necessarily be applicable or appropriate to tax-supported freeways such as the Interstate System.

The major toll roads are patrolled, generally speaking, by personnel from the state police agencies, and 15 of the highways have permanently assigned detachments. Each of the toll roads having a separate patrol unit for traffic law enforcement supports the patrol entirely from toll revenues paid by the users of that road. To put it another way, there are no known designated toll highway police supported from other than toll revenues. In many cases, however, the initial cost of the toll road patrol is paid by an appropriation of the parent law enforcement agency, subject to reimbursement by the toll road authority.

The total expended for toll road policing on 19 major toll roads (for which data were available) was over $11 million during 1964. What are the services for which these costs were incurred, and for which users of toll roads are paying? Are they the same as those given the motorist on toll-free highways? A survey of the annual reports of several toll authorities reveals some interesting facts. These patrols are almost entirely devoted to traffic law enforcement, which includes the maintenance of an orderly flow of traffic. Although some criminal investigating takes place, it represents a minor activity.

Maintenance of traffic involves, among other things, aiding motorists in their travel on the toll road. The very nature of a toll road causes special problems for the average driver, not to mention the possibility of a malfunction in his automobile. The physical aspects of such roads, such as widely separated interchanges and motorist service centers, create a need for some type of road patrol to help stranded motorists. Out of respect for those travelers who are apprehensive about the possibility of auto breakdown, the toll authorities have commissioned the state police and other service crews to assist them, as well as to eliminate traffic safety hazards. This theme of service to the motorist is evidenced in the promotional ads that say "You are never alone on the turnpike."

Although maintenance vehicles and other service and emergency vehicles are available, the patrol will generally be the first to render aid. If the emergency is minor, the patrolman will customarily handle it himself, but if the situation is serious he will radio for assistance. Some of the aids given motorists are gas, changing tires, calling service truck, mechanical aid, extinguishing fires, information, parking and U-turn permits, checking sleeping drivers, relaying persons, property, and messages, special escort services, removing objects from roadway, collecting unpaid tolls, checking abandoned vehicles, removing hitch-hikers, directing traffic, first aid, collecting fees for oversize vehicles, and many others. The first three or four aids mentioned are by far the most frequent.

Available data for comparing services between toll and toll-free highways are rather limited. However, New Jersey does furnish such information. The data listed below compare the operations of the New Jersey State Police on the toll (New Jersey Turnpike and Garden State Parkway) and nontoll roads during 1964 in terms of selected items of personnel and activities:

Item	Toll Roads	Percent	Nontoll Roads	Percent	Total
Uniformed personnel	202	24	644	76	846
Troop duty hours (000)	417	16	2,224	84	2,641
Mileage on patrol (000 vehicle-miles)	6,749	35	12,379	65	19,128
Road miles patrolled	309	2	15,142	98	15,451

Activities	Toll Roads	Per 1,000 Patrol Miles	Nontoll Roads	Per 1,000 Patrol Miles
Motor vehicle arrests	49,551	7.3	157,198	12.7
Aids to motorists	96,884	14.4	3,031	0.2
Warnings issued	43,409	6.4	45,357	3.7
Accident investigations	2,873	0.4	11,478	0.9
Other traffic investigations	6,631	1.0	42,240	3.4

These statistics show that in terms of the miles traveled on patrol, the incidence of vehicle arrests was higher on free roads, while the number of motorist aids was con-

TABLE 9

STATISTICS ON HIGHWAY PATROLS FOR SELECTED TOLL ROADS, 1964

Toll Facility	Number of Uniform Personnel	Road Mileage	Patrol Expenditures (Thousands)	Annual Vehicle-Miles of Travel (Millions)	Motorist Assists	Assists Per Trooper	Assists Per Million Vehicle-Miles of Travel
Indiana Turnpike	46	157	$ 556	612	22,018	4,786	36
Kansas Turnpike	23	237	303	341	14,855	6,459	44
New Jersey Turnpike	104	134	1,371	1,753	63,298	6,086	36
Garden State Parkway	98	175	966	1,552	33,586	3,427	22
New York Thruway	211	561	2,580	3,006	1/ 39,151	1,855	13
Ohio Turnpike	90	241	1,029	1,147	18,736	2,082	16
Dallas-Fort Worth Turnpike	13	30	137	197	13,097	10,074	66
Richmond-Petersburg Turnpike	19	35	193	213	8,523	4,486	40
West Virginia Turnpike	16	86	171	115	7,393	4,621	64
Total	620	1,656	$7,306	8,936	220,657		
Average						3,559	25

1/ This figure is the number of motorists with disabled vehicles aided by the Thruway Patrol. There were an additional 46,101 motorists assisted by the Thruway's emergency service crews.

TABLE 10

ACTIVITY STATISTICS FOR SELECTED TOLL ROAD PATROLS, 1964

Toll Facility	Miles Patrolled (Thousands)	Motorist Assists	Traffic Arrests	Warnings Issued	Assists Per Thousand Miles of Patrol	Arrests Per Thousand Miles of Patrol	Warnings Per Thousand Miles of Patrol
Kansas Turnpike	1,371	14,855	2,139	1,614	11	2	1
New Jersey Turnpike	3,349	63,298	33,695	22,639	19	10	7
Garden State Parkway	3,400	33,586	15,856	20,770	10	5	6
New York Thruway	8,346	39,151	57,838	31,299	5	7	4
Total	16,466	150,890	109,528	76,322			
Average					9	7	5

siderably lower. A review of the total activities of the toll road patrols in New Jersey indicates that 52 percent of their activities were devoted to motorist aids in 1964, compared to less than one percent for the other troops. In contrast, only 32 percent of the activities of the toll road patrols involved arrests and traffic investigations, while these activities accounted for 49 percent of the work of the remaining patrols.

Comparative data for road patrol operations are not available for all major toll roads. However, some comparisons can be made for selective troop activities (Tables 9 and 10). Table 9 includes information on numbers of personnel assigned, road mileage, patrol expenditures, vehicle-miles of travel and the numbers of motorist assists given by road patrols for nine of the Nation's major toll roads in 1964. An examination of the data included shows that patrol expenditures averaged about $12,000 per man. In addition, particular attention is given to motorist assists since this service constitutes a major part of the toll road patrol activities. Based on the information included in the table, each trooper averaged 3,559 assists during 1964. In terms of travel, 25 motorists required assistance for every 1 million miles of travel over the same period.

A segregation of these motorist assists could be obtained for a few of the toll facilities. Based on this information, it is estimated that the largest share of the motorist aids, 39 percent, resulted from mechanical failure of the vehicle. Tire failures ac-

counted for 20 percent of the aids and 14 percent of the aids involved vehicles that had run out of fuel. The remaining 27 percent covered the various other services the toll road patrols perform for the motoring public, such as relaying messages, issuing special permits, special escorts, rendering first aid, etc.

Table 10 gives three types of activities performed in terms of the mileage patrolled by the troopers for four toll roads. In addition to motorist assists, averages are computed for traffic arrests and warnings issued. In total, it appears that for every thousand miles of patrol, the trooper averaged 9 motorist assists, 7 traffic arrests and 5 warnings issued to errant motorists.

TRAFFIC LAW ENFORCEMENT ON THE NATIONAL INTERSTATE SYSTEM

The fact that tollway patrons are given a great deal of assistance by toll road patrols is well established in the case of New Jersey. It is not so well established that similar services will be necessary on toll-free expressways and freeways, or that they would necessarily be provided by patrol officers. If aids to motorists will be necessary, but to a lesser degree, on the nontoll freeways of America, the question arises as to whether such assistance should be offered by the State police or by some other highway agency.

A case in point is the recent exchange of views in Michigan. Gov. Romney stated in a special legislative message on traffic safety on January 16, 1964, that "freeways must be patrolled for the supervision, protection and assistance of our motorists." He made reference to the point that fewer traffic law violations occur on freeways, yet traffic supervision and police protection is still required—rather it is demanded in order to maintain an orderly and safe flow of traffic. He went on to say, "Assistance to motorists, while incidental to the performance of regular police duties, is closely related to the basic police function of public protection."

In July 1962, there were 100 state troopers assigned to patrol Michigan freeways. However, due to a ruling of the Michigan Civil Service Commission limiting troopers to a 48-hour week, freeway patrolling had to be discontinued as a headquarters assignment for lack of manpower. The responsibility was shifted to local post commanders to schedule freeway patrols as best they could. The net result was a sharp reduction in freeway patrols.

The need for freeway patrolling did not disappear. As a matter of fact, the state highway commissioner felt strongly enough about freeway service for stranded motorists that such service was initiated on a limited scale. The highway department planned to expand the aiding of motorists to include the entire 1,000-mile freeway system at an estimated annual cost of $943,000. Gov. Romney disapproved of this unnecessary duplication of service by two organizations, and subsequently the attorney general ruled that the service to motorists by the highway department was illegal.

The primary responsibility for public protection, at least in Michigan, rests with the State Police. The Governor's recommendation for fiscal year 1964-65 included an appropriation of $1,303,300 to finance the annual cost of 130 troopers for a freeway patrol, which includes aiding of stranded motorists. Further, it was recommended that the funds come from motor-vehicle taxes as a "highway purpose" rather than from the general fund. The proposal is especially significant in light of the previous discussion regarding Michigan's police financing policies.

At the time of this study, it is not known whether these recommendations were made into law. Nevertheless, freeway patrolling and aids to motorists are causing considerable concern in Michigan.

Toll road authorities have a freer hand in authorizing services of this order and covering the costs incurred with user charges. On the other hand, state highway departments and police departments, one of which must ultimately render these aids, have the problem of balancing the costs of such services against the need for funds for other highway and traffic-related functions. Even where charges are levied for these aids it is not known whether revenue raised covers costs incurred. As in the case of the New York Thruway, 10,000 of the total 76,055 aids to motorists were given without charge, and there probably exists a certain amount of fixed costs involved for the service crews that are not covered by charges. On the whole, these crews and the Turnpike patrol

are included in the normal operating cost of the road and are paid from the road's primary source of revenue—toll charges.

In any event, if this service is to continue, no matter which agency provides it, a substantial amount of money will be needed from highway users for patrolling the Interstate System.

FINANCING THE POLICE ACTIVITIES

A study of the financing of state law enforcement agencies is made somewhat complex by the variety of the organizational structures, and by the diversity of functions performed by the agencies. Moreover, many agencies maintain books of account on an object basis (i.e., salaries, supplies, equipment purchases, etc.) rather than on a functional or activity basis.

Where the parent or primary department has a division structure, and funds are budgeted and accounted for on a division basis, the costs of the enforcement (patrol) divisions can usually be identified. This may not suffice, however, to identify the costs of purely traffic supervision (which all such agencies perform) as distinguished from traffic-related activities such as driver license examinations and truck weighing, or general law enforcement. These functions are performed by some state patrols, but not by others.

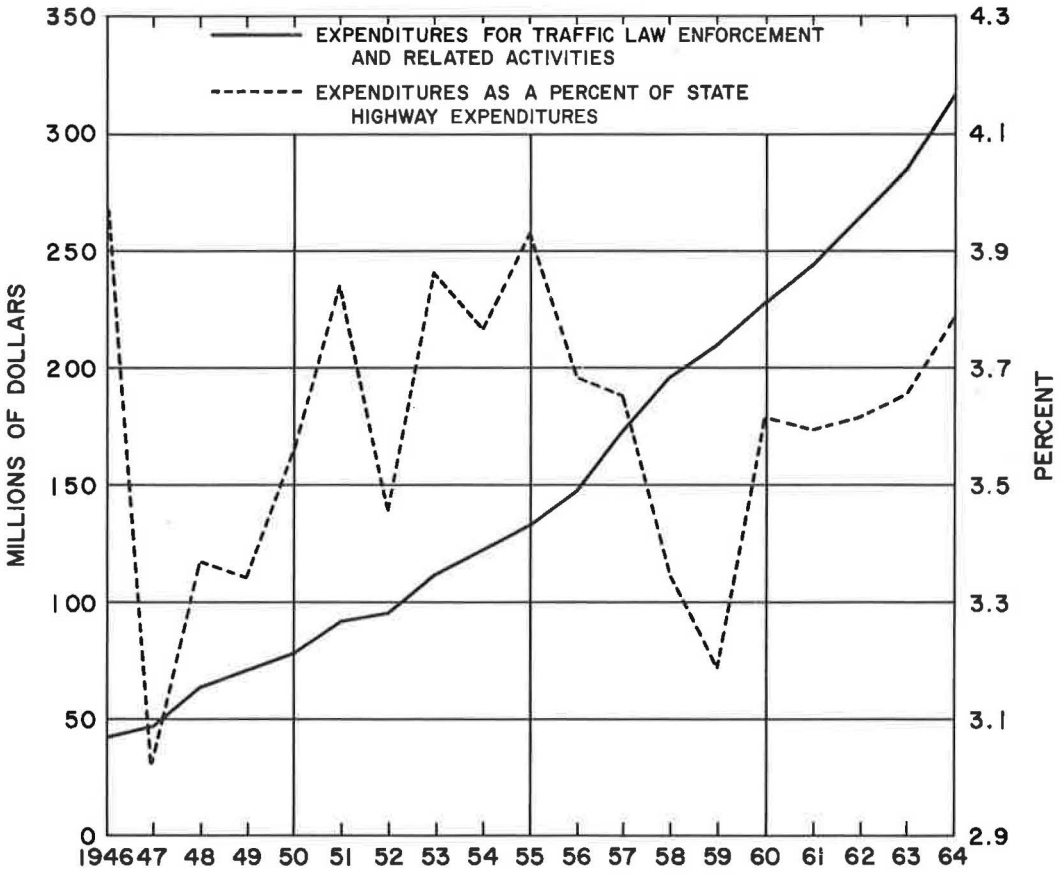

Figure 1. Summary of traffic law enforcement expenditures in dollars and as a percent of state highway expenditures.

TABLE 11

HISTORICAL SUMMARY OF EXPENDITURES FOR TRAFFIC LAW ENFORCEMENT AND RELATED ACTIVITIES 1/
(millions of dollars)

	Total	Traffic Law Enforcement	Safety Education	Size and Weight Enforcement
* 1946	41.3			
* 1947	45.9			
* 1948	63.3			
1949	70.2	67.8	1.3	1.1
1950	77.6	74.7	1.5	1.4
1951	91.2	86.2	2.6	2.4
Toll	(0.2)	(0.2)		
1952	95.5	89.2	3.8	2.5
Toll	(0.6)	(0.6)		
1953	112.6	105.2	4.3	3.1
Toll	(1.2)	(1.2)		
1954	123.6	115.7	4.7	3.2
Toll	(1.0)	(1.8)		
1955	135.5	124.4	6.3	4.8
Toll	(3.4)	(3.4)		
1956	151.6	139.0	7.4	5.2
Toll	(4.7)	(4.7)		
1957	178.3	162.1	9.3	6.9
Toll	(6.2)	(6.2)		
1958	202.3	183.3	10.6	9.8
Toll	(7.5)	(7.5)		
1959	215.7	192.3	14.4	9.0
Toll	(7.8)	(7.8)		
1960	235.2	208.9	15.9	10.4
Toll	(8.6)	(8.6)		
1961	253.4	223.6	18.8	11.0
Toll	(10.0)	(10.0)		
1962	273.2	235.5	24.9	12.8
Toll	(10.5)	(10.5)		
1963	294.2	246.8	33.3	14.1
Toll	(10.8)	(10.8)		
1964	326.8	263.1	48.4	15.3
Toll	(12.0)	(12.0)		

* No breakdown available
1/ Includes expenditures by State highway departments and other State agencies for traffic related activities.

Unfortunately, some of the law enforcement agencies do not have means of making an accurate allocation of costs to functional activities, and estimated assignments must be made on the basis of personnel or patrol man-hours, activity reports and the like.

For this report, law enforcement expenditures have been derived from statistics published by the Bureau of Public Roads. The Bureau has compiled annual highway statistics since 1921 and has identified expenditures for law enforcement beginning in 1925. In that year only three states, California, Maine, and Pennsylvania, reported expenditures for law enforcement activities, totaling $924,000. By 1934, with 34 states reporting, expenditures totaled $8,800,000. In 1941, police expenditures reached $29,400,000 in 47 states; and by 1950, with all states reporting, expenditures were $77,600,000.

The postwar boom in vehicle ownership, travel, and highway construction led to rapid increases in outlays for patrol operations, which doubled by 1956 to $151,600,000 and again doubled by 1964 to $326,800,000. As shown in Table 11 and Figure 1, expenditures for law enforcement have increased steadily since 1946.

Since 1949, the Bureau's statistics on law enforcement expenditures have identified three major areas: (a) traffic law enforcement, (b) safety education, and (c) vehicle

size and weight enforcement. However, the Bureau classifies expenditures without regard to expending agency. Therefore, the expenditures given in Table 11 are not necessarily limited to those of police agencies. Thus, the costs of certain services related to the general area of policing and safety will be included in Bureau statistical summaries, even though they were not incurred by the police agencies. An example of this is found in the costs of driver training programs, which are considered to be related to traffic safety programs, but which are administered in most states by educational agencies. Truck weighing in some states is done by highway department crews, rather than by enforcement agencies.

The inspection of motor vehicles may be done by patrolmen, or by employees of motor vehicle departments, or by private garages, with the public cost in any case considered by Public Roads to be a law enforcement expense.

In using the Bureau's statistics, some other precautions are necessary. The costs of examining applicants for operators and chauffeurs licenses is treated by the Bureau as an administrative, rather than as a law enforcement expense. In a number of states, these examinations are conducted by the patrols or state police agencies.

Finally, the Bureau does not record expenditures by police agencies for criminal investigation and other nontraffic-related activities when these are financed from general revenues, and identifies them as "nonhighway" expenditures when financed from road-user tax revenues.

As seen in Table 7, the two major sources of revenue used to finance police activities are highway-user imposts and general funds. Highway-user imposts are those levied on owners and operators of motor vehicles because of their use of the public highways. These imposts consist chiefly of motor-fuel taxes, registration fees, operators licenses, and other fees closely allied with the ownership and operation of motor vehicles. Also included are fines and penalties for registration violations and vehicle size and weight violations.

Methods of Supporting Police Activities

In each state, the financial support for the police agency is determined by legislative action. Three major methods of support for the police agencies are used. These are: (a) highway-user revenues, (b) general fund revenues, and (c) a combination of highway-user and general fund revenues.

Highway-User Revenue.—There are 21 state police agencies that are supported entirely by highway-user revenues. These monies are allocated by one of two ways. In the first instance, the funds can be readily identified as to source. For example, in Ohio, the Department of Highway Safety gets an appropriation from the motor-fuel tax collections and the proceeds of the operators and chauffeurs license fees.

However, in the second instance, the source of these funds is not known by the time it is received by the patrols. For example, in Arizona, the Highway Patrol receives an appropriation from the State Highway Fund, into which are deposited motor-fuel taxes, registration fees, operators and chauffeurs license fees and other highway-user taxes. Of the 21 states in this category, 16 are subordinate agencies. These include 6 departments of public safety, 5 highway departments, 3 motor vehicle departments and 2 other departments. The five independent agencies are 2 state police and 3 highway patrols.

General Fund Revenue.—The second way the legislatures have provided for the support of the state police agencies is the general fund appropriation, which is employed in 16 states. In this instance, these appropriations are derived from all types of taxes, fees and other income that are deposited into the general fund of the state, which, in many instances, include highway-user revenues. In any instance where the state general fund is used to support a highway patrol cost and highway-user revenues have been allocated to the general fund or for a nonhighway activity, the Bureau considers that the general fund appropriation was derived from highway-user revenues to the extent that the user revenues do not exceed the appropriation.

In six states, Alabama, Georgia, Mississippi, New Mexico, Oregon, and Pennsylvania, certain highway-user revenues are deposited into the state general fund or into

a special fund created within the general fund. These revenues are then appropriated by the legislature for police support or used to reimburse the general fund for monies previously allocated for police support. The basic difference between these states and the other 10 state agencies that are supported by general fund appropriations is that the laws establishing the financial support for police activities identify the source of the appropriation as highway-user revenues. Eight of the 16 state agencies in this group are departments of public safety, 2 are highway departments, and the other 6 are independent state police agencies.

Combined User and General Revenues.—The third method of providing financial support for police activities is the allocation of both highway-user and general fund revenues. There are 12 states that fall into this category. In two of them, Montana and North Dakota, the amount of highway-user revenues is a very small percentage of their total income. A portion of the drivers license fee in Montana is allocated to the police retirement fund and the North Dakota highway patrol receives a very small portion of the registration and other related fees for its safety program. The Maryland State Police, as a result of recent legislation, is limited to an annual appropriation of $8,250,000 paid from motor-vehicle fees. Expenditures in excess of this amount must be paid from the general fund.

In five states, the amounts paid from highway-user revenues and general fund revenues are based on percentages established by law. These percentages are as follows: Missouri, 90 percent highway funds, 10 percent general funds; Connecticut, Indiana, and Maine, 75 percent highway funds, 25 percent general funds; Vermont, 50 percent highway funds, 50 percent general funds. As discussed in an earlier section, the primary purpose for the appropriation of both highway-user revenues and general fund revenues is to use highway funds to support the traffic-related activities of the agency and general funds to support the nontraffic or criminal-related activities.

In Oklahoma, the Department of Public Safety receives the first $112,500 collected on the registration of commercial vehicles and a similar amount collected for overweight fees, in addition to 10 percent of the net receipts of the operator's and chauffeur's license fees for the pension fund. The remainder of the agency's support is from the general fund. In Kentucky, the Department of Public Safety has generally received the bulk of its support from the highway-user revenues deposited into the road fund. However, the appropriation acts passed by the 1964 General Assembly show that, for the next two fiscal years, the major source or financial support for the Department has shifted from the road fund to the general fund. For the fiscal year 1964-65, the general fund appropriation amounts to 56 percent of the total appropriation, and for the following fiscal year, 1965-66, the portion allocated from the general fund reaches 88 percent of the total budget. In Louisiana, support comes from a variety of user revenue sources, together with an annual general fund appropriation.

In West Virginia, the motor-vehicle inspection fees are used to support the Motor Vehicle Inspection Division. The remainder of the support of the State Police comes from the general fund. Within this group, four of the state agencies are subordinates of the department of public safety, five are independent state police, and three are independent highway patrols.

The interest of the Bureau in the financing of police agencies is confined to those activities that are highway or traffic related. As a consequence, the financial reports published by the Bureau omit both the allocation and expenditure of funds for nontraffic-related activities except in those instances where these activities have been financed by highway-user revenues. In these instances, the expenditure is not recorded as a police cost, but merely recorded as a nonhighway expenditure of highway-user revenues.

Table 11 shows the growth of expenditures for traffic-related activities over the last 19 years segregated into the three basic categories for which the data are compiled. It should be pointed out again that these figures include amounts expended by other agencies for such items as size and weight enforcement and safety education. For example, many highway departments perform the function of weighing vehicles and operating the port of entry stations and their expenditures in this area account for 60 percent of the total in 1964.

In the field of safety education, the large growth of expenditure is directly attributable to the current trend of financing student driver training programs with highway-user revenues and other state financial support. At the end of 1964, 24 states had enacted legislation providing financial support for driver training programs. The expenditures for these programs accounted for 52 percent of the total shown in Table 11 for safety education. In addition, the safety education programs of various motor vehicle and state agencies provided 28 percent of the total.

1964 Receipts and Disbursements of the Police Agencies

Tables 12 and 13 show, respectively, the receipts by source of funds and expenditures by function of the state police agencies. The differences between receipts and disburse-

TABLE 12

RECEIPTS OF POLICE AGENCIES FOR TRAFFIC AND OTHER RELATED FUNCTIONS, 1964
(000's of dollars)

STATE	IMPOSTS ON HIGHWAY USERS			TOLLS	TOTAL HIGHWAY-USER REVENUES	GENERAL FUND APPROPRIATIONS	MISCELLANEOUS RECEIPTS	TOTAL RECEIPTS	SUMMARY 1/		
	DEDICATED REVENUES		COMMINGLED HIGHWAY USER REVENUES						NET HIGHWAY-USER REVENUES	NET GENERAL FUND APPROPRIATIONS	MISCELLANEOUS RECEIPTS
	MOTOR-FUEL TAXES	MOTOR VEHICLE REVENUES									
Alabama						4,868	596	5,464	4,868		596
Alaska						657		657		657	
Arizona			6,519		6,519			6,519	6,519		
Arkansas		1,810			1,810			1,810	1,810		
California		43,211			43,211			43,211	43,211		
Colorado			4,505		4,505		109	4,614	4,505		109
Connecticut			4,469		4,469			4,469	4,469		
Delaware				153	153	1,388		1,541	1,541		
Florida				619	619	8,054		8,673	8,673		
Georgia						5,943		5,943	5,943		
Hawaii 2/											
Idaho			1,608		1,608			1,608	1,608		
Illinois		13,450		538	13,988			13,988	13,988		
Indiana			5,796	556	6,352	553		6,905	6,905		
Iowa						3,439		3,439	2,809	630	
Kansas			1,274	303	1,577			1,577	1,577		
Kentucky			3,652	101	3,753	1,822		5,575	4,472	1,103	
Louisiana		2,879	159	2	3,040	4,158		7,198	4,729	2,469	
Maine			1,490	12	1,502	117	32	1,651	1,502	117	32
Maryland		8,521		182	8,703			8,703	8,703		
Massachusetts			5,310	528	5,838			5,838	5,838		
Michigan						8,980		8,980	3,019	5,961	
Minnesota			5,255		5,255			5,255	5,255		
Mississippi						5,697		5,697	4,711	986	
Missouri			7,466		7,466			7,466	7,466		
Montana		126			126	1,655		1,781	1,696	85	
Nebraska						2,041		2,041	325	1,716	
Nevada			1,230		1,230			1,230	1,230		
New Hampshire			1,133	104	1,237		44	1,281	1,237		44
New Jersey				2,439	2,439	6,188		8,627	8,627		
New Mexico						2,711		2,711	2,711		
New York				2,615	2,615	17,117		19,732	19,732		
North Carolina			6,117		6,117			6,117	6,117		
North Dakota 3/											
Ohio	9,121	1,807		1,029	11,957			11,957	11,957		
Oklahoma		522		262	784	3,058		3,842	3,842		
Oregon						3,589		3,589	3,589		
Pennsylvania				2,117	2,117	15,004		17,121	17,121		
Rhode Island						788		788	788		
South Carolina			3,774		3,774			3,774	3,774		
South Dakota			1,181		1,181			1,181	1,181		
Tennessee						4,044	848	4,892	4,044		848
Texas		3,521	7,404	137	11,062			11,062	11,062		
Utah	1,854	666			2,520			2,520	2,520		
Vermont			713		713	319		1,032	713	319	
Virginia		7,945		226	8,171		188	8,359	8,171		188
Washington		8,745			8,745		26	8,771	8,745		26
West Virginia		97		171	268	1,417		1,685	533	1,152	
Wisconsin		3,712			3,712			3,712	3,712		
Wyoming			883		883			883	883		
Total	10,975	97,012	69,938	12,094	190,019	103,607	1,843	295,469	278,431	15,195	1,843

1/ Highway-user revenues are increased, and general funds decreased, to the extent that general fund appropriations can be considered as derived from user revenues placed in general funds.
2/ Not included in police study.
3/ 1964 expenditures were supported by general funds appropriated in 1963.

TABLE 13

DISBURSEMENTS OF POLICE AGENCIES FOR TRAFFIC AND OTHER RELATED FUNCTIONS, 196-
(000's of dollars)

STATE	TRAFFIC SUPER-VISION 1/	SAFETY EDUCATION	SIZE AND WEIGHT ENFORCEMENT	DRIVER'S LICENSE EXAMINATION	MOTOR VEHICLE INSPECTION	COMMUNI-CATIONS	TRAINING	ADMINIS-TRATION AND OTHER SUPPORTING SERVICES 2/	TOTAL TRAFFIC-RELATED DISBURSE-MENTS	NON-TRAFFIC RELATED ACTIVITIES	TOTAL DISBURSE-MENTS
Alabama	2,447	1,311		802					4,560	189	4,749
Alaska	657								657		657
Arizona	4,910								4,910		4,910
Arkansas	1,282	263		58					1,603	375	1,978
California	31,729	1,339	1,556			2,056	1,572	1,959	43,211		43,211
Colorado	3,854	5				328		427	4,614		4,614
Connecticut	3,525	161				344		439	4,469		4,469
Delaware	1,449	26							1,475		1,475
Florida	4,713			1,469		90		2,401	8,673		8,673
Georgia	3,851			958					4,809	1,366	6,175
Hawaii 3/											
Idaho	1,102	72	434						1,608		1,608
Illinois	12,448	244	684						13,376	612	13,988
Indiana	4,556	736	185					2,428	6,905		6,905
Iowa	3,022			417					3,439		3,439
Kansas	2,896							27	2,923		2,923
Kentucky	5,191	195		189					5,575		5,575
Louisiana	4,523	69	135	1,799	310			365	7,201		7,201
Maine	1,881								1,881		1,881
Maryland	5,036					355	181	2,772	8,344	359	8,703
Massachusetts	5,838								5,838		5,838
Michigan	7,096	286				369	87	2,142	8,980		8,980
Minnesota	5,214		41						5,255		5,255
Mississippi	3,179	121		309	93	332		787	4,821		4,821
Missouri	5,900	175	595	642				154	7,466		7,466
Montana	1,069			410				302	1,781		1,781
Nebraska	1,122	29				110	8	772	2,041		2,041
Nevada	637								637		637
New Hampshire	1,147	80				63		67	1,357		1,357
New Jersey	8,506		121						8,627		8,627
New Mexico	2,341	25		14		262	32	37	2,711		2,711
New York	19,345				387				19,732		19,732
North Carolina	6,117								6,117		6,117
North Dakota	709	15		37					761		761
Ohio	10,092	155		945				765	11,957		11,957
Oklahoma	2,941		236	372		246		47	3,842		3,842
Oregon	3,199					34		356	3,589		3,589
Pennsylvania	17,121								17,121		17,121
Rhode Island	788								788		788
South Carolina	3,314		87	373					3,774		3,774
South Dakota	996	45	116					24	1,181		1,181
Tennessee	3,452	90		480		77	6	787	4,892		4,892
Texas	6,597	194	750	2,853	668				11,062		11,062
Utah	1,663	23	375	373					2,434		2,434
Vermont	795	23	21			24		169	1,032		1,032
Virginia	6,077	167				835	250	1,058	8,387		8,387
Washington	3,663	270	654	808		1,108	79	1,105	7,687	694	8,381
West Virginia	1,588				97				1,685		1,685
Wisconsin	1,786		371			487	73	995	3,712		3,712
Wyoming	860	23							883		883
Total	232,224	6,142	6,361	13,308	1,555	7,120	2,288	21,385	290,383	3,595	293,978

1/ Includes all of the costs of the agency where itemized expenditures were not available.

ments in any state are due to fund balances which have been omitted from these tables. In compiling the figures shown in Table 13, several adjustments have been made to the amounts reported on Table 11 for 1964. The expenditures for traffic-related activities not conducted by the police agencies have been omitted from Table 13, and those activities performed by the police agencies which are considered administrative costs by the Bureau have been added.

Receipts.—The table of receipts was prepared along the lines of the previous discussion concerning the financing of the police agencies. The type of funds used to support the agency is identified as to source. The only additions are the toll revenues which are used to support those detachments of police officers who patrol the toll roads, and the minor items of miscellaneous income that accrue to the police organizations. As was pointed out earlier, the general fund allocations for nontraffic-related activities are omitted from this tabulation.

The summary columns are included to show the net contribution from user revenues and from general and miscellaneous funds after substituting, where possible, user revenues that had been deposited in general funds.

One other observation concerning the financing of traffic-related state police activities should be made. Previous discussions pointed out the merits of supporting highway activities, including police activities, with highway-user revenues. The following tabulation summarizes the financing of police activities from the data reported in Table 12 (in thousands of dollars):

Category	Highway-User Revenues	General Funds	Receipts	Total
Initial support (Table 12)	$190,019	$103,607	$1,843	$295,469
Offsets	+88,412	-88,412	—	—
Adjusted contributions	278,431	15,195	1,843	295,469
Nonhighway (Table 13)	-3,595	—	—	-3,595
Net adjusted contributions	$274,836	$ 15,195	$1,843	$291,874
Percent	94.2	5.2	0.6	100.0

It is noted that over 94 percent of the revenue allocated for traffic-related police activities was considered to have been derived from highway-user revenues. It is also noted that of the total highway-user revenues of $278.4 million allocated for police purposes, only $3.6 million or 1.3 percent was expended for nonhighway activities. This compares with the $6.3 billion of total highway-user revenues distributed in 1964, of which $625.7 million or 9.9 percent was allocated for nonhighway purposes.

Disbursements.—The table of disbursements (Table 13) itemizes some of the more important functions performed by the police agencies. However, it should be noted that every function listed in the table may not be carried out by each state police agency. In many states, some of these items are under the jurisdiction of another state agency.

Special Fees for Special Services

Up to this point, the discussion on finances has been directed at the ways and means by which the activities of the police organizations are supported. Within this framework, a different type of financial analysis can be made. This concerns the financing of activities or functions by a fee or charge established to support the service rendered. Among these functions are motor vehicle inspections and drivers license examinations.

There are 20 states that require a periodic inspection of all motor vehicles. In five of these states, the police agencies reported separately an expenditure of funds for this

function as shown in Table 13. In each of these states, except New York, the fee collected by the state for the issuance of the inspection sticker is allocated to the police agency.

There are 22 states in which the drivers' license examinations are conducted by the police agency. The costs of these examinations, together with other related administrative costs for 19 of these states, are shown in Table 13. Three states (Alaska, Pennsylvania and West Virginia) did not identify these costs. In six states, part or all of the revenues collected from operators' and chauffeurs' licenses is allocated directly to the police agency. In Utah, the amount allocated from these fees is used to support the Driver License Division of the Department of Public Safety, which conducts the driver examinations. In the other 15 states, the income from these fees is deposited in the fund that supports the police agencies. The operator's and chauffeur's license fee is also used as a means of support for driver training programs in 11 states, although this activity is not primarily a function of the police agency. It does help, however, to show the extent to which certain traffic-related activities are financed by a fee levied to support those activities.

Discussion of this type of financing is included here to show its use in financing some of the activities of the state law enforcement agencies. However, there are numerous activities performed by the police agencies that are and probably always will be supported by other means. It has already been pointed out that many states have adopted the policy of supporting the traffic-related activities of the police agency with highway-user revenues and the nontraffic-related activities with general funds.

Assuming that this latter method is the most acceptable one, there remains the problem of determining the type of highway-user tax that should be used to support the traffic-related activities. A study of this problem was made in 1964 as it related to the financing of the Washington State Patrol (10). Prof. Hennes was asked to comment on the equity of financing the activities of the Patrol from the vehicle license fee. In Washington, the State Patrol is supported by an allocation of $3.50 out of the basic $6.90 vehicle license fee levied on each vehicle registered.

Following the practice of allocating costs in proportion to benefits received, the first determination by Hennes was to estimate what percentage of the patrol costs was incurred for highway purposes and second, to estimate what percentage of these costs was a function of the amount of traffic which could then be expressed in terms of vehicle-miles. Using data from a prior study, he determined that 90 percent of the patrol budget was highway related. In addition, he also determined that 51 percent of the patrol's time was spent on traffic patrol, and the remainder split equally between traffic-related activities and activities more closely related to the distance they traveled (e.g., radio, vehicle inspection, licensing, weight control).

The separation of the total activity into these components became the basis for assigning income to support these costs. The traffic-related costs, constituting about 75 percent of the patrol's highway-related activity, would be collected from road-users on the basis of vehicle-miles traveled. This cost would be allocated to each class of vehicle by multiplying numbers registered times the individual miles traveled which would then be converted into the percent each represents of the total miles traveled.

Of the remaining 25 percent of the patrol's activity, the expenditure for weight control would be determined and this would be apportioned among commercial vehicles on the basis of the frequency they are encountered on the highways. The remaining cost would be allocated to the three classes of vehicles as a flat fee. The nonhighway costs would be supported by general fund contributions, if at all possible.

In summary, Hennes found that in Washington the heavy truck-over-10-ton should support about 3 times as much of the highway patrol budget as an automobile or light truck. However, the effect on the patrol financing would be very little because of the small numbers of vehicles in this class. A further suggestion by Hennes was to earmark a part of the gas tax instead of the vehicle license fee, especially since this allocation would increase with the amount of travel, as do the patrol activities.

CONCLUSIONS

Law enforcement, on or off the highways, is a never-ending process. It is in operation 24 hours a day, 7 days a week, 365 days a year. The state agency responsible for law enforcement has changed considerably over the years as more and more activities have been assigned to it. In many instances the increased activity has not always included an accompanying increase in personnel or the money to support it. Today, the problems confronting the traffic law enforcement agency are increasing along with the miles of limited access high-speed roads. A number of questions still remain to be answered.

The toll roads, through their advertising media, have placed considerable emphasis on their ability to provide all types of services and aids to motorists. The traveling public, or at least the segment that has traveled these roads with any degree of frequency, may expect to receive these services to some extent on any limited-access road. The extent to which these services will be provided along with the agency that will perform them remains to be resolved. If the responsibility for motorist aids is assigned to the police agencies, which, on the surface, appears to be a reasonable assumption, then it might be expected that additional manpower will be required.

The problem of getting manpower, in itself, is not an insurmountable one. Conversations with state police officials indicate that the recruitment of men is not difficult. There is generally an abundance of applications submitted by individuals eager to fill the vacancies advertised by the police whenever they occur. Personnel turnover, at least in the sworn uniformed category, is extremely low. So the job of filling the needs of the highway patrol agencies with efficient personnel would seem to be mostly a matter of time.

Additional manpower will also mean additional costs. Information contained in the questionnaires indicated that the needs of the police agencies by 1969 would require a 56 percent increase in total personnel. Based on current costs, this would require revenues of over $450 million in 1969.

As we have seen, the majority of the traffic law enforcement agencies receive their support from highway-user revenues. This is in the form of direct allocations from highway-user taxes or indirectly through general fund appropriations. With the needs of both the highway departments and police departments increasing, the proper allocation of the highway-user dollar will get more and closer attention than ever before. What percentage this allocation of revenue should be will vary from state to state depending upon the circumstances. However, certain observations can be made.

The support of traffic-related activities of the police agencies from highway-user revenues is recognized by the Bureau of Public Roads as a proper highway expenditure. For those agencies whose entire activities are traffic-related, it would seem reasonable to assume that their support would be from highway-user revenues. On the other hand, it would seem reasonable to expect that general funds support those activities that are not traffic-related. Some states have already adopted this type of financing plan.

A final point to be made on the adequate financing of highway patrols is the matter of safety. Even with the increasing mileage of divided highways, the number of traffic accidents and deaths each year is also increasing. There is no conclusive evidence that merely increasing patrol strength or activities would, in itself, reduce the number of accidents. The concern of the governors and legislators as evidenced by the requests for additional personnel at the beginning of the 1965 legislative year indicates a belief that such a correlation exists. If so, then the financial means necessary to expand these highway patrols would be money well invested.

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