

DEPARTMENT OF ECONOMICS, FINANCE, AND ADMINISTRATION

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OBJECTIVES AND FINDINGS OF HIGHWAY NEEDS STUDIES

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SYNOPSIS

In the United States today 145 million people own or are dependent upon some 41 million motor vehicles which this year will pile up a vehicle mileage of perhaps 400 billion on 3.3 million miles of roads and streets.

The gigantic problem of providing adequate highway transportation facilities is shared by the State, the cities, the counties, and in many cases, townships and the Federal Government. What is generally called the highway problem is actually made up of a number of problems; congestion, lack of parking and terminal facilities, inadequate surfaces, design deficiencies and high accident and fatality rates.

Fortunately, through the instrument of long-range highway planning, the responsibilities of governmental agencies can be quite sharply defined, and the wants and needs of people can be clearly set forth. The overall problem breaks down into manageable, understandable segments.

This paper covers those studies with which the Highways Division of the Automotive Safety Foundation has been associated during the last three and one-half years. It describes past practices and those to be applied in future studies, such as Mississippi and Ohio on which work was started recently.

Studies have been completed in California, Kansas, Nebraska, Oregon and Washington, where staff was loaned at the request of official legislative committees, and in Michigan, where the Foundation served as consultant to the study committee composed of statewide groups, including State, county and city officials and user representatives.

The scope and objectives of the highway planning studies now being made involve these principal elements, which are covered in detail in the paper:

Economics—thorough exploration of the importance of highway transportation, assembling all data which bears on the goal of determining what expenditures should be made to best serve the State's economy.

History—covering highway development with emphasis on legislative aspects.

Finance—a historical review of revenues and expenditures, as a measure of progress and to position recommendations for the future.

Federal Aid—history and influence on State's road development.

Road Use and Future Growth—determine characteristics of road and street use, and project trends of population, vehicle registration and miles of travel.

Traffic Operations—depict procedures to make utmost use of present and future facilities.

Classification—determine which agency of government should be responsible for each mile of road and street.

Standards—adopt recognized standards for new construction, and "tolerable" standards for existing facilities to assure maximum economy and yet adequately meet needs of each mile of road.

Administration—study of management with respect to efficiency and need for close cooperation between state, county and city, and between state and Federal Government.

Long-Range Highway Program—the end result, which is the total product of all of these inter-related elements.

There is a growing general realization that only by applying long-range highway planning, through proper legislation and efficient action, can the States and their local com-

munities hold their own and make headway against the sharpened demands of increasing numbers of road users.

Figure 1 depicts the seriousness of the problem from the quantitative standpoint. The depression of the '30s and the second world war brought only momentary pauses in national motor vehicle registration and in total miles traveled. What many people thought was just about the peak in vehicle ownership and usage in 1941 has been surpassed by a

one thing—man's ability to measure his needs, to plan, and to meet his requirements. Through the instrument of highway planning the wants and needs of people can be clearly set forth and the responsibilities in highway matters of the thousands of highway agencies can be accurately defined. The huge overall national highway problem—and the problem is national in a sense for the motor vehicle recognizes no boundaries—breaks down into manageable, understandable segments.

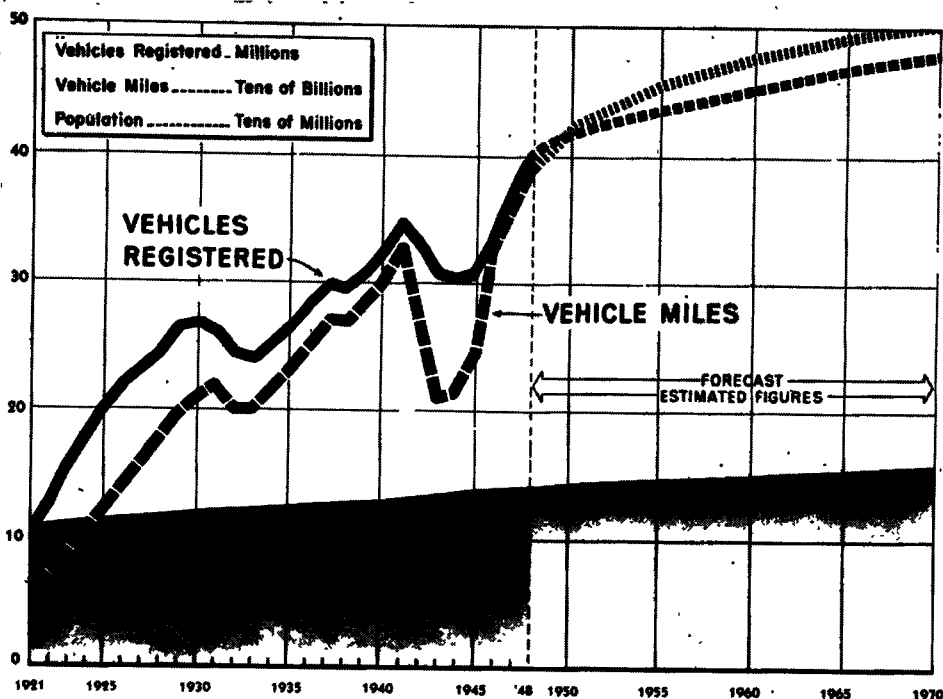


Figure 1. Vehicle Miles Expected to Reach 450 Billion by 1955

substantial margin since the end of the war. Late estimates for 1948 show that vehicle registration will reach about 41 million, and vehicle miles of travel about 397 billion. By 1955, miles traveled are expected to reach 450 billion.

The enormous national travel on the 3,300,000 miles of roads and streets of today, and projected for the future, naturally tends to make the problem of providing adequate arteries appear extremely difficult. The situation would be insurmountable were it not for

The trend toward long-range highway planning was described last year at the annual meeting of the Highway Research Board by G. Donald Kennedy. This paper today is confined to the six studies participated in through the loan of staff by the Automotive Safety Foundation during the last three and a half years.

These studies include those made in California, Kansas, Nebraska, Oregon and Washington, where Foundation staff was loaned at the request of official committees of the State

governments and in Michigan where the Foundation served as consultant to the study committee composed of statewide groups including State, county and city officials and road user groups.

Engineering studies participated in by Foundation engineers are made at the request of statewide study committees which represent State, county and urban interests and highway user groups. Experience has shown that studies made under legislative sponsorship provide the most positive approach to ultimate action. Also, we are assured that the planning committee will undertake separate statewide financial and administrative studies concurrently with the engineering study, with all three combined in the final consideration of the study committee.

The final product of the highway planning study is a document designed to enlist public understanding of the total problem and of the recommendations. Actually, the study is a tremendous undertaking. It must cover the whole ground so that all related and essential facts are presented logically and in as interesting a way as possible. If people won't read it, they won't understand it.

Aside from the pressures produced by sheer weight of numbers of motor vehicles, there are several interrelated reasons why states are turning to statewide, long-range, highway planning, and are seeking outside assistance.

One reason is the uncorrelated demands made by separate units of government. In some States the few large cities they contain may seek assistance, and do so justifiably. But their demands may be based on widely differing premises in regard to such things as locations, financing, and capacity and design. The same dilemma may be posed by groups of counties or sections of the state. Often, a State is confronted with the conflicting demands of urban areas and of rural areas. These studies provide for the first time a complete appraisal of all the needs of all units of government—State, county and city.

When a State lacks a long-range balanced highway program, and follows a policy that may not or cannot be understood by its people, then public misunderstanding is bound to result. People want to know why, in the face of large expenditures, certain roads are neglected or why certain sections of the State appear to get the "run-around."

Another factor is that the wartime suspension of highway construction, which added to the already large accumulation of deficiencies, has tended to crystalize demands. People have become well informed on the shortcomings of their roads and streets. They know what they want. But they do not realize the extent of their needs or the total cost.

Under the terms of the Federal Aid Highway Act of 1944, State highway departments are made responsible for the extension of Federal highway aid to secondary roads and urban streets on the Federal systems. This means that administrative agencies must have intimate knowledge of local road and street needs, as well as of State highway needs. Engineering planning must be extended to local roads and streets.

No statewide study can reach its greatest usefulness unless an organization is formed which utilizes all available talent and all pertinent information collected by the diverse agencies concerned with highway development. Committees must be formed representative of the State, county and city engineers to keep the study on a non-political basis and to bring the study close to local conditions.

The organization pattern, importantly, must be geared to make the best possible use of the services and information stemming from the Public Roads Administration. The statewide highway planning surveys initiated in cooperation with the States in 1935 provide an invaluable foundation through their continuing measure of road use, highway finance, road conditions, road life and through studies in many other fields. Also, PRA extends on-the-spot technical service which contributes immeasurably to the success of the study.

In the actual mechanics of making the study the staff of the highway planning survey, supplemented by technicians of other divisions of the State highway department and county and city departments, is relied on heavily.

Another vital element of the studies, is the counsel of the general public and road users which aids in interpreting the economic highway transportation needs of the State.

A starting point in the study is the economy of the State and the relation of highways to the economy. It is generally presumed that the economy of a State rests very largely on

highway transportation. However, an important question, and one which involves decisions in the final program determination, is, to what extent do highways serve the State economy? Will the economy of the State remain constant, or will it diminish or increase, placing greater or lesser demands on highway transportation? Just what size and character of highway plant will best serve the economy of the state? These are difficult questions, and to answer them requires extensive and expert research covering all services performed by highways. This is a field

requirements of the motor age begin? Under what basic plan and at what rate were travelers taken out of the mud and dust?

The highway study must embrace a historical review, largely legislative, since from legislation stems the establishment of systems, physical development, administrative organization and responsibilities, and finance; the latter being of such importance it is treated in a separate section. History reveals inter-governmental relationships and indicates the probability of improved or accelerated programs.

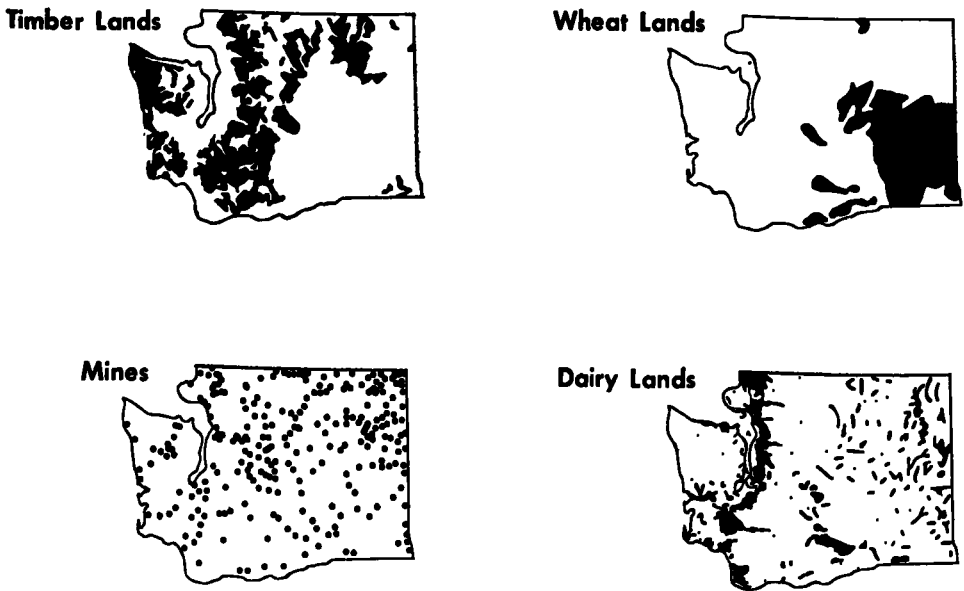


Figure 2. The Pattern of State Development

in which greater knowledge and improved techniques can well be developed.

Figure 2 shows stylized maps which picture the spread of four principal resources in Washington, each of which has important bearing on highway needs and use. Similar measurement of these and other elements were made in other statewide studies; with the timberlands of Oregon, the farms and livestock of Kansas, the automotive industry of Michigan, and the tourists of California, all positioned in the respective studies.

It is necessary to trace the physical growth of the road network by individual systems. When did improvement of roads to meet the

In the historical review of finance, which does not cover future financial policy, it is important to know where the money came from, where it was expended and for what. Only by such an analysis can the present development of each of the systems be determined. To ascertain the investment it is necessary to study such sources of income as Federal aid, general funds, property tax, fuel tax, motor vehicle imposts and so forth. Unfortunately, financial data usually are historically incomplete prior to the advent of the highway planning surveys.

The historical financial reviews portray significant changes in financial plans of the past

which have had great impact upon highway development and policy. The significant shift of the tax structure from that of property owner to motor vehicle user in the early twenties is apparent in nearly every State.

Historical distribution of highway revenues to State highways, county roads and city streets explains in a broad way the present state of improvement of each of the systems. Up to the present day, the trend toward rural road development has been emphasized as compared to relatively small urban investment, however, expenditures on city streets through local assessment districts is generally an unknown quantity.

Because of the vital role played by Federal highway aid, both in terms of financial assistance and technical and administrative progress, the complete engineering study must give full attention to the influence Federal aid has exerted on establishment and development of primary and secondary systems. In the different States, the mode of establishment of State highway departments, and of State highway systems, varies widely. The beneficial effect of Federal aid is shown by the study, for in most cases, a definite relationship exists between State legislative provisions and the establishment and broadening of Federal highway aid. The practical effect of Federal aid in a State, of course, is one of the benchmarks in the determination of the recommended annual highway program.

The forementioned phases of the studies largely constitute the historical positioning of highway transportation as a means of establishing a base for other phases of the studies which more directly determine current and future needs. Now we come to the road use phase which has the vital purpose of finding out the extent of travel within the State and into and out of the State, as well as of revealing the facts of vehicle registrations, traffic volumes, the types of vehicles and their use. Figure 3, from the Michigan study shows that all motorists use all systems and that by far most of the traveling is done by urban people. The road use studies, of course, go much farther; among other things determining the wide variations in travel on the various routes by hour, day, week and month.

Current movement of traffic over each of the systems is an essential basic factor in the long-range plan. Traffic flow maps reveal at

a glance the volume distribution. When future projections of the movement are made, they become the underlying guide to road design.

But we are not building highways just for today—the road use studies lead to projections into the future so that roads and structures built now will remain adequate for 20 or 30 or even more years. This requires projections of population, vehicle registrations, and annual travel, with consideration being given to persons per vehicle, and miles traveled per vehicle.

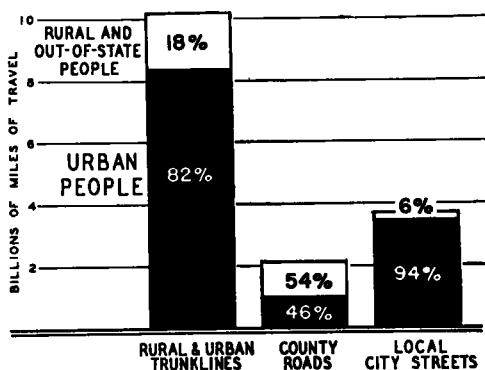


Figure 3. All Motorists Use All Systems

In making a population projection there are two approaches. One is the purely statistical method of projecting significant trends by use of Bureau of Census data. The other method is the use of the same basic information, but tempering it with a common sense economic analysis of the state's future. The conservative forecasts, made on that basis in the six studies, are not exact lines but trends, which are regarded as sufficient for the study objectives.

Registration projection is determined by the population trend and estimates of persons per vehicle with consideration being given to the per capita wealth in each state.

Then, by applying the expected miles traveled per vehicle to the other factors the annual travel is projected. In the case of Oregon, as shown in Figure 4, where all conditions are favorable to increased population, motor vehicle ownership and use, the total vehicle miles of travel by 1960 will be almost double the pre-war record set in 1941. This far exceeds the projection for the nation as a whole.

Another elemental factor in the determination of the highway future is traffic operation. Whether facilities are new or old, it is essential that the best possible use be made of them. Particularly, in cities, deficiencies in traffic operation exist which not only add to the cost and delay of vehicle use, but tend to give a false picture of physical needs. The objectives of engineering studies, therefore, embrace a three-step program, for all classes of roads and streets: (1) Make the best use of all facilities through application of all traffic engineering devices and procedures such as signs, signals and markings, and traffic rout-

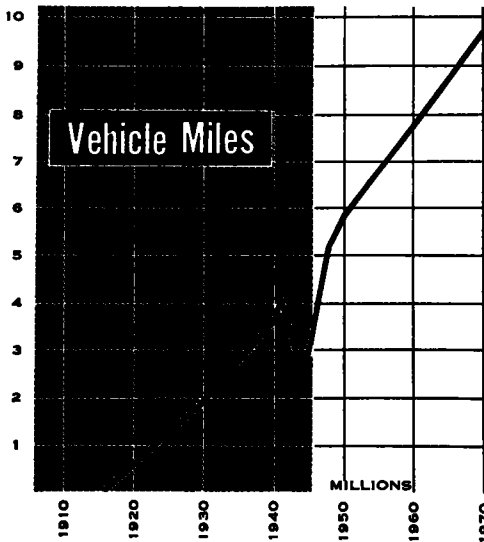


Figure 4. Projection of Vehicle-Mile Trend

ing; (2) Step-up present capacity and safety with improvements of a minor nature; and (3) Adopt a long-range plan, founded in fact, to provide major needed facilities. New facilities, obviously, should be carefully designed to provide the best operating results possible with available funds.

In the conduct of the engineering studies, every effort is made to carry forward the Action Program of the President's Highway Safety Conference. In addition to emphasizing traffic operations, the studies also consider the urgency of uniformity, not only in design standards, but in other aspects of the Uniform Vehicle Code, the Model Traffic Ordinance, and the Manual of Uniform Traffic Control

Devices. In the safety field, there is still a shortage of data on the cost of accidents and on the relation between accidents and highway design. However, future studies will make every possible use of the data obtained by the present cooperative work of the highway departments, the Public Roads Administration and the Highway Research Board.

Unless roads and streets are properly classified into manageable systems, according to the predominant types of service they perform, there cannot be efficient management, and equitable financing. The need for classification is dramatically told by the map (Fig. 5) showing all the roads in Kansas. This is not a map in the usual sense of the word, for not a single boundary line or geographic feature is shown. Those are all roads—130,000 miles of them, a mileage second only to that of Texas.

Order comes out of what otherwise would be chaos when the present Kansas system of state highways is superimposed, as is done in Figure 6. Proper classification permits the programming of improvements according to priority of needs and determines standards of design and construction fitted to the character of service to be given.

In determining the validity of present state highway systems, for example, roads are given section by section examination, with consideration of statewide aspects of service and mobility between major traffic attractions. Parallel routes and stub-ends, of course, do not belong on the state primary system. If a secondary system exists, it, too, is carefully examined and studied with relation to the primary system.

Possibly an even greater problem is determination of the status of county primary and local roads, for often these systems have developed without particular rhyme or reason, or perhaps little or no classification has been done. Figure 7 shows a portion of a Nebraska county. On the left is the present classification of four systems with much overlapping. On the right, is the proposed classification which the facts show would best concentrate available funds and serve the greatest number of road users for the greatest economic benefit.

So, by properly classifying the roads, preparation is made for that all-important next step, the establishment of standards of con-

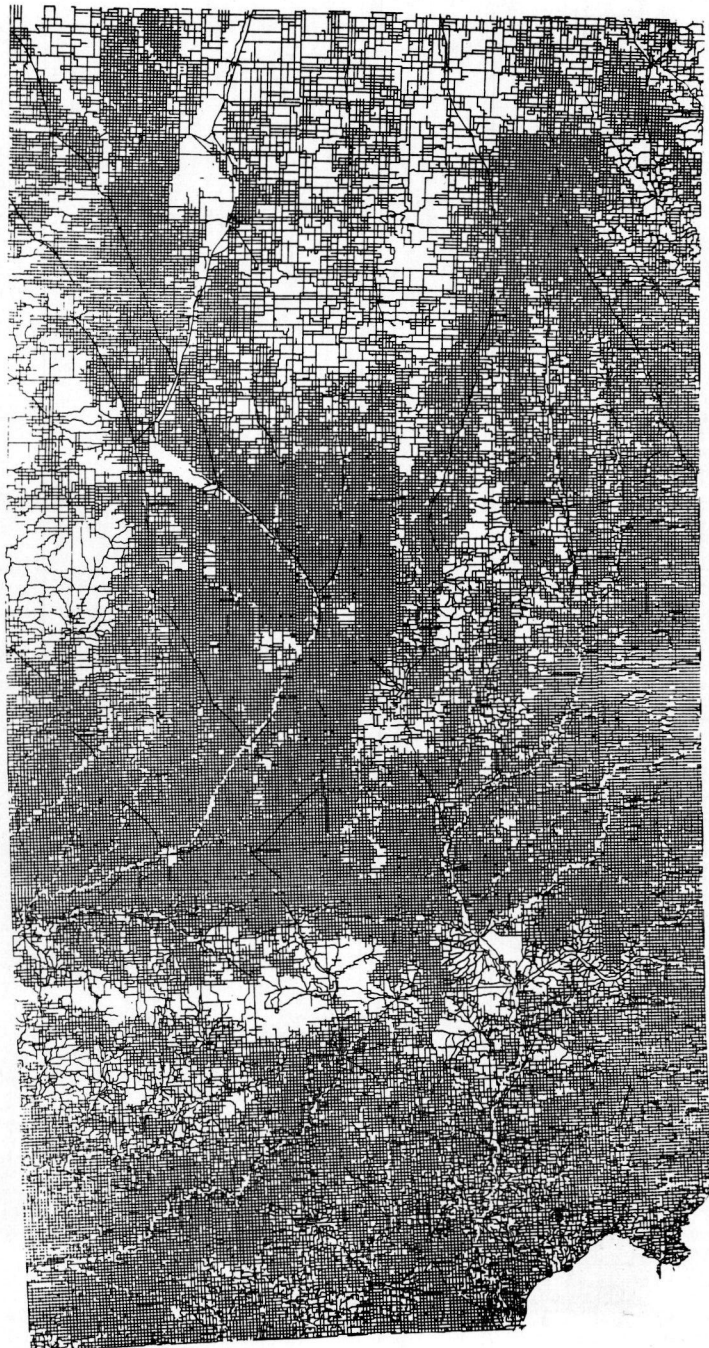


Figure 5. Complete Kansas Road Network

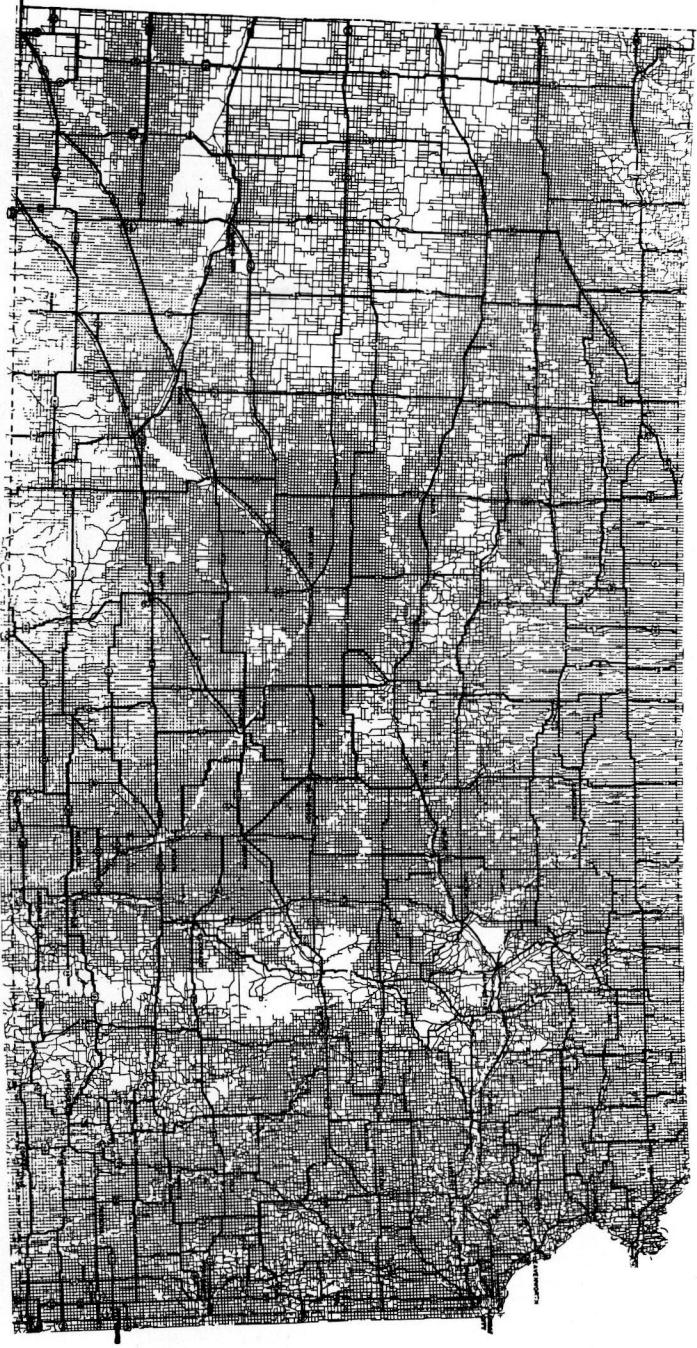


Figure 6. Kansas Network with Principal Routes

struction, which are fundamental to program determination. The policy followed in this vital work is to develop manuals for State, county and city with the cooperation of the State and local engineers. Establishing State standards, of course, involves little difficulty, for the national standards, which have been formulated by the American Association of

experience of local engineers. Final decisions rest with the staff.

Since it is not practical to expect all highways to meet present construction standards, sets of tolerable standards are developed for purposes of measuring deficiencies. Any road that meets the tolerable standards is not considered for improvement unless for some spe-

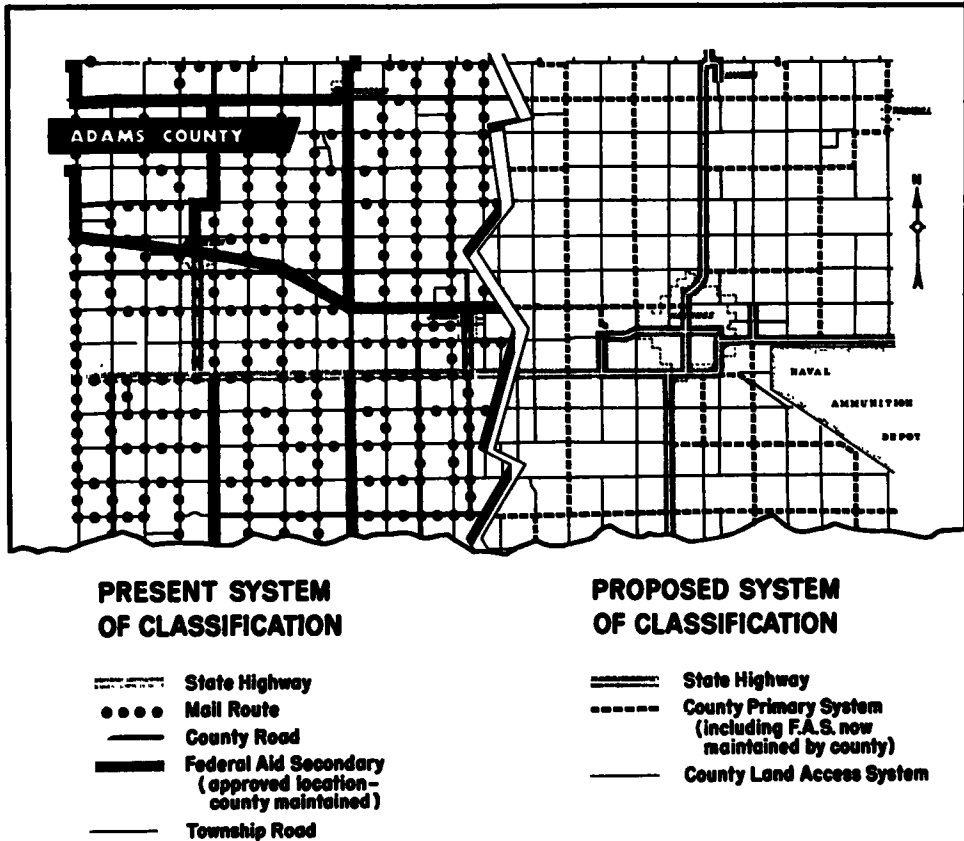


Figure 7. Reclassification Simplifies County System

State Highway Officials in cooperation with PRA, are used as modified to meet the conditions peculiar to each State. Similar design standards are prepared for county and city systems. To facilitate the work with counties and cities, committees of engineers for each are formed to help in working out preliminary standards. These standards are specifically designed to meet the great variations in requirements for county and city streets. Great dependence is placed upon the knowledge and

special reason. In this way, the door is kept open for retention of facilities which still provide valuable, although not the most desirable, service. In applying the tolerable standards, particular consideration is given to whether maintenance is good or the accident record bad.

The three sets of manuals on standards are complete and give detailed instructions which make it possible for engineers to determine the adequacy or deficiency of each road or street

PROJECT WORK SHEET

CITY STREET NEEDS

EXISTING CONDITION	
5	Length (in 0.0 miles)
6	Surface Type High Type..... <input type="checkbox"/> Low Type..... <input type="checkbox"/> Gravel and Stone..... <input type="checkbox"/> Unimproved..... <input type="checkbox"/>
7	Surface Width
8	Surfaced Area in Square Yards
9	Roadway Width
10	Approximate Age of Surface
11	Maximum Hourly Traffic
12	Trucks and Buses 0-10%..... <input type="checkbox"/> 10-20%..... <input type="checkbox"/> over 20%..... <input type="checkbox"/>

IDENTIFICATION	
1	Street name and location
2	Project number
3	Necessary now <input type="checkbox"/> Will become necessary within next ten years <input type="checkbox"/>
4	SYSTEM State Highway..... <input type="checkbox"/> Interstate..... <input type="checkbox"/> Major Arterial..... <input type="checkbox"/> Federal Aid..... <input type="checkbox"/> Secondary..... <input type="checkbox"/> F.A.S..... <input type="checkbox"/> Arterial..... <input type="checkbox"/> Other F.A..... <input type="checkbox"/> Industrial & Comm. Access..... <input type="checkbox"/> Residential Access..... <input type="checkbox"/>

DEFICIENCIES									
		Existing	Tolerance	Deficient			Existing	Tolerance	Deficient
13	Surface Type.....				17	Parking Lane....			
14	Number of lanes...				18	Gradient.....			
15	Lane Width.....				19	Controlled Access			
16	Median Strip.....				20	Traffic Control.....			

PROPOSED WORK	
TYPE OF WORK	
21	Resurfacing..... <input type="checkbox"/>
22	Widening..... <input type="checkbox"/>
23	Reconstruction-Present Location..... <input type="checkbox"/>
24	Construction-New Location..... <input type="checkbox"/>
25	Illumination..... <input type="checkbox"/>
26	Signalization..... <input type="checkbox"/>
27	Channelization..... <input type="checkbox"/>
STANDARD OF CONSTRUCTION	
28	Surface Type.....
29	Surface Width (in feet).....
30	Sq. Yds. Surface Improvement.....
31	Median Strip Width (in feet).....
32	Parking Permitted Yes... <input type="checkbox"/> No... <input type="checkbox"/>
33	Maximum Gradient.....%
34	Controlled Access Yes... <input type="checkbox"/> No... <input type="checkbox"/>

COSTS	
35	Right of Way.....\$ _____
36	Channelization & Signalization..\$ _____
37	Lighting.....\$ _____
38	Surface.....\$ _____
39	TOTAL.....\$ _____

NOTE: Include prorated engineering costs in above estimates. Use 1947 prices.

REMARKS: (Explain special conditions such as, bad accident record)

Figure 8

on a uniform basis. Figure 8 is a project work sheet for city streets.

It must be emphasized that every mile of road and street is given careful study to determine the improvement required (if any). Projects, which are submitted on prescribed forms giving complete details, are individually scrutinized by the engineering staff to determine eligibility for inclusion in the program; to determine that standards proposed are appropriate; and that cost estimates are accurate and reasonable. If found to be out of line in any regard, they are eliminated, adjusted or corrected by the staff.

people and the lawmakers, the projections of future road use, the importance of traffic operations, the classification of road systems, standards of improvement and recording of deficiencies—all bring up an immense amount of factual data which must be assembled, related, balanced and woven into the recommended program.

After assembly of specific project estimates covering existing deficient sections of roads, a further step is taken to insure completeness of the program. All mileages not contained in specific project estimates are analyzed to determine the future required program, based

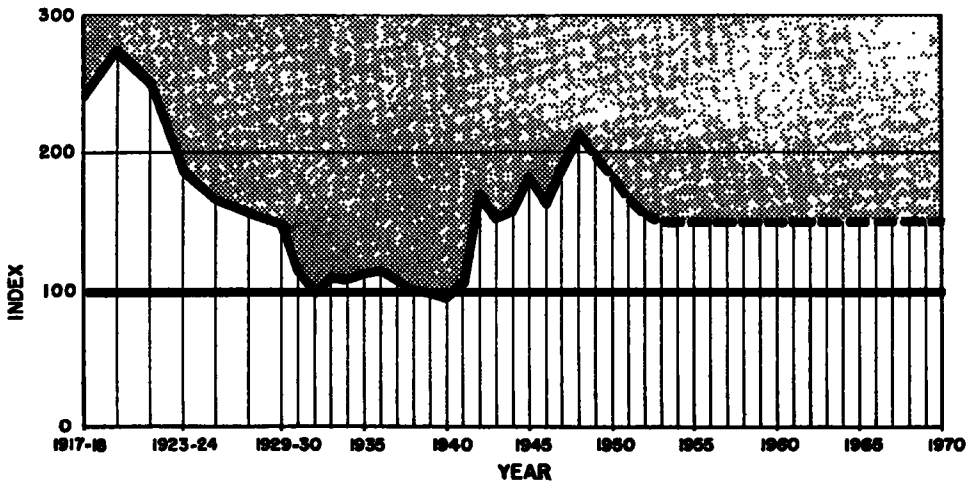


Figure 9. Construction Price Index—Base Period 1937-1941 = 100

All project statements submitted by the State and local engineers are carefully screened and processed by the study staff, and the information transferred to punch cards for rapid mechanical processing.

Specific attention is given in the reports to safety features in design. For instance, in Michigan an accident analysis revealed that the four-lane undivided highway has almost four times as many accidents as the four-lane divided highway.

State standards of vehicle sizes and weights are compared with AASHO standards. Recommendations are made for substantial conformance to AASHO standards.

Now we come to the final step—the formulation of the annual highway program. The historical background revealing the traditions and the procedures applied or preferred by the

on anticipated road life and character of present surfaces. Provision is made for any needed stop-gap improvements. Future annual maintenance cost requirements are also determined for each system.

In this final work, an important step is the determination of future costs. Since the general price level is determined by many variables, which are becoming more and more affected by world conditions, no exact means exist of pre-determining construction costs. Study of past construction price trends, and analysis of economic trends, indicate that today's inflated costs will recede within the next few years, as projected on the chart (Fig. 9) from the Nebraska study.

The summary chart (Fig. 10) shows the cost of the recommended annual program including maintenance and construction, for all roads

and streets in Michigan for program periods up to 22 years. The study committee selected a 15-year period to meet the accumulated and future needs. In all studies, programs are worked out for different periods, usually 10, 15 and 20 years, so that the committee and legislature may have all facts in making a choice of a program period geared to the state's ability to finance.

ment of highways, whether it be in state, county or city government, is a big job dealing not only with large sums of money but with the welfare and lives of all citizens. Consequently, in each study, important attention is given to administration.

Recommendations are made which the studies reveal will assure utmost efficiency in each level of government, and the utmost co-

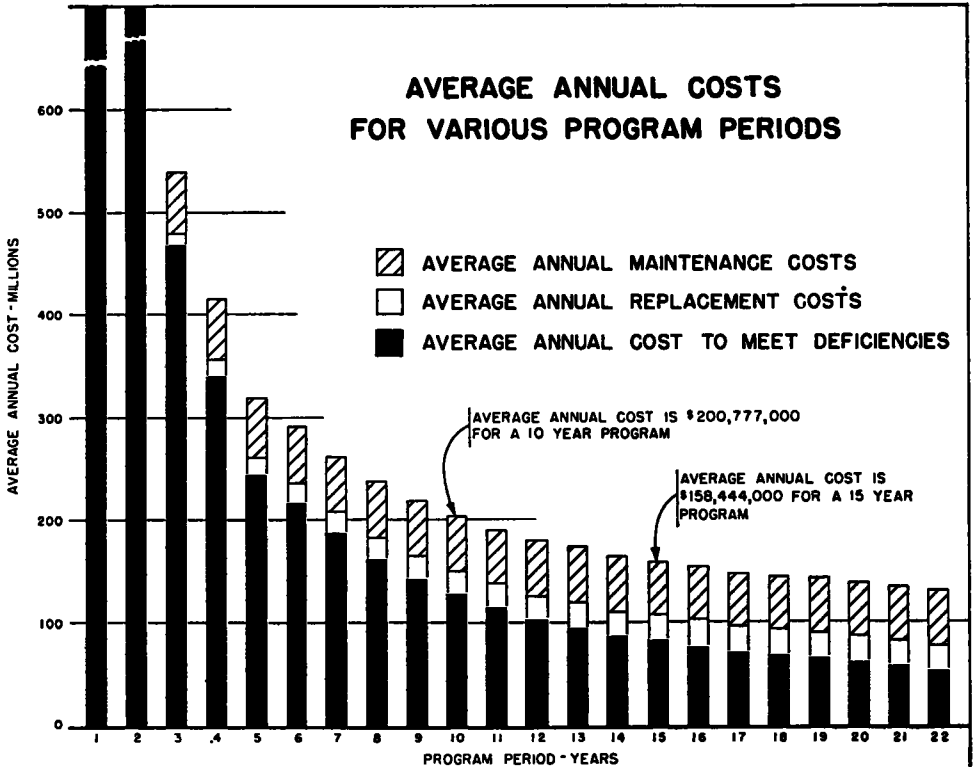


Figure 10

In all studies emphasis is placed on immediate needs. In the Oregon study current needs were highlighted by a map showing immediate needs on the state highway system. In that case, immediate needs comprise 18 percent of the total program.

The program developed by this painstaking, factually-founded procedure constitutes for a state the first measurement of its actual needs. The cost as measured in money is large, as may well be expected, for the usage made of the highways is tremendous. The manage-

ordination of effort between all governments involved in highway matters. The same splendid working relationships which exist between the Federal and state government, also should prevail between the state and local governments. In many cases, to achieve this statewide coordination, State highway departments should establish a county-city division or work out other means to closely cooperate with local governments, to assist in Federal aid projects of mutual concern, and to extend engineering services or advice to the many

communities which have no or inadequate technical staffs. Other challenging matters in the field of coordination confronting most states are: the need for uniformity and upgrading in accounting, planning, programming, research, and application of standards.

By no means is the engineering study the end result. It is an essential stepping stone to the adoption and achievement of a sound long-range highway program charted to best serve the highway transportation needs of all the people of a State. Other steps are writing the program into the laws of the State so that

it may be fully carried out. Periodic review and revision of the program should be made at say 10-year intervals. Meanwhile, the highway planning surveys of the Public Roads Administration and the States must continue to measure road usage, needs and technical advances. The full force of facts, technology and of cooperation between peoples and governments must be applied if there is to be rapid and satisfying progress in the provision of safe, economical and efficient highway transportation.

COORDINATION OF HIGHWAY AND CITY PLANNING

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SYNOPSIS

Major highway construction in an urban metropolitan area should be a planned unit in a well-balanced highway network which is both a terminal system for long distance traffic and an important part of a local transportation system. This requires three stages of highway planning: layout of an urban network; location and design of individual sections; and location and design of terminal and parking facilities.

Each part of the system should be designed to be useful for many years in the future. Therefore, standard measurements and descriptions of existing traffic and travel habits can not be a satisfactory base for planning. Cities are changing rapidly—expanding into the countryside with factories, homes, and shopping centers; growing or declining in population and industry; deteriorating in large areas as “blight” spreads; rebuilding and redeveloping new neighborhoods of housing or new industrial areas in formerly blighted districts. People of various income groups move and dominant centers of business shift as the city changes.

In determining highway needs prospective and planned changes in the amount and distribution of housing, employment, shopping, schools, and other major land uses should be considered together with possible changes in transportation habits.

Urban highways should be located and designed to influence city growth and development along desired lines and to fit in with other proposed public improvements. Major urban problems, such as central congestion, may be only intensified by centralized transportation facilities without appropriate land use controls.

Highway planning is an important part of comprehensive metropolitan city planning. It shares many of the same problems and needs, much of the same knowledge of trends. Because of conflicting local jurisdictions in metropolitan areas outside city boundaries, the best method of coordinated planning in most places is through voluntary committees including Federal, state, and local officials and using freely advice and participation of non-official agencies and interested citizens.

From the point of view of the highway official, highway planning seeks to develop a system which will enable traffic to move as easily, quickly and directly as possible, with

a minimum of friction and hazard, within limitations of economy and political feasibility. Considerations of major importance include: travel volume and desire lines, topog-