An Urban Transportation Research Program

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Introduction

While it is true that the primary function of the Bureau of Public Roads is concerned with the roads and streets of our nation, in recent years, it has become apparent that one cannot consider highway transportation without due regard to the total transportation picture. Even so, our emphasis is still with the motor vehicle—highway problems, with a concurrent long-range view of the transportation system which will evolve.

The Bureau’s program for R&D is undergoing a major transition which was initiated in 1962 with the formation of the Office of Research and Development. The primary change will be in the increased emphasis which will be placed on R&D. Paralleling this emphasis will be the efforts which we will make to rally all related interests in an appreciation of the values to be realized from research and to encourage joint efforts at both the national and local levels. One of the fine things about the Purdue Road School is that it brings together all of the interests—county, city, state, materials and equipment producers, contractors, and the university. We would hope that such an all-inclusive interest in highway research could be developed throughout the country.

It is recognized that the Road School is concerned with more than research, and this is as it should be. However, the opportunity is provided for discussion and stimulation and the mechanism is available for a truly joint effort in mutually important R&D matters.

My discussion of Urban Transportation Research will be devoted to (1) why do such research, (2) what type of programs are prevalent, and (3) the Bureau’s Urban Transportation Research program.

The Need

Everyone really believes in research—just ask them. Why then has so little research been accomplished? Or, more appropriately, why
have so few funds been made available? Such a statement leads to a very good argument—who says the program has been underfinanced?

Two factors suggest that a greater expenditure of funds for research in the past would have been helpful. One is the size of problems such as traffic congestion, materials problems, pavement design, and financing which are giving us real headaches; and two is the percentage of our funds which is being spent for research. In 1962, it has been estimated that $15 million were spent by government for research, while $12 billion were spent for design, construction, maintenance, operation and administration. Thus, approximately 0.1 of 1 per cent of our total expenditures went for research. A progressive industry spends between 5 and 10 per cent.

With such a low investment in our future, history would have predicted that we would get into serious difficulties. In fact, except where the item is critical, many industries are not able to survive without aggressive R&D efforts.

The question of past support is somewhat academic, however. All of us know the pressure which builds up for better roads and streets. The acuteness of the need for research just was not as great as the problem of making our available dollars go further.

Aside from this rather negative approach to the need for research, there is another more positive reason. Currently, our transportation system plays a major role in stimulating our economy. The stimulation occurs both locally and nationally. Locally it can be felt in the ability of manufacturers and producers to locate in small communities rather than joining the rush to the larger municipalities. Nationally, our present transportation system has permitted wide distribution of local products.

It has been suggested that the economy of our nation is being uniquely affected by transportation. In the early days, the ability to transport our natural resources to the producer and manufacturer produced much great wealth. Currently, however, the role is different. We have a high per-capita-income society which is spending approximately 20 per cent of its income for transportation. Said in another way, this means that after we have satisfied our basic need for food, clothing, and shelter, we have more left for luxury-type expenditures. This means that many products attractively packaged are on the market. It also means that automobile manufacturers can improve their products regularly and stimulate the purchase of new vehicles on a fairly regular basis. Insofar as transportation is able to contribute to these items which the consumer prefers, it is stimulating the economy.
The real significance to this changing role of transportation is the suggestion that if the consumer or user of our transportation system likes the service, the system will continue. If, on the other hand, he becomes dissatisfied, serious repercussions could develop. For example, if it is not possible for an automobile owner to drive where he wants to, when he wants to and within the amount of congestion and safety which he will tolerate, it is likely that he will not buy the second or third car for the family. The same type of example can exist throughout the manufactured products field in that increases in transportation costs can eliminate certain luxury-type items from the market.

Therefore, a good research program in transportation can lead to the steady improvement or at least maintenance of the present level of service as a means of continuing or improving the economics of our Nation.

**The Type of Program**

In order to describe our research program, may I mention briefly the general direction which transportation research must take. On the one hand we have the long-range problems associated with having a better idea of what the transportation system will look like 20 to 40 years from now. Certainly with the changing technology we would expect some rather radical changes could take place. It is generally agreed that such changes are likely to take place in a relatively slow evolutionary way rather than a radical shift. The slowness in this change will come about through the reaction of people who will not accept changes that are too extreme. In addition we will have investments, both private and government, which will tend to discourage abandoning the system for a new one which will require a new investment.

It is essential, however, that we study carefully how much freight will need transportation and the probable travel patterns of our society. Research on the transportation requirements of the future is under study by several groups around the country.

In addition, we need to know how both the human driver and the vehicle are likely to change. There are many possibilities for improved power systems and even a complete abandoning of wheeled vehicles. There are also those who feel that much of our transportation will not be tied to the ground and that safer individual transportation through our airways will predominate. It is extremely difficult or impossible to make a good judgment as to the rapidity and form which the technological changes will take. However, we are currently designing many
of our road and street facilities for a 20-year life. Are we sure what
the transportation system will look like in 20 years? Are we sure that
the present investments will be responsive to the demands for trans­
portation and the potential for the improvements which technology
can make?

While the flights of fancy into the future are needed, we have some
more urgent problems which also must be studied. Currently, in 1963,
the local, state and federal governments of this country are spending
$12.3 billion to build and operate highways and this does not include
repayment of $0.7 billion of borrowed funds. The increase in travel is
continuing and certainly the maintenance and operation costs are certain
to increase. People are becoming more desirous of using our highways
in all kinds of weather. Snow and ice are becoming intolerable on more
and more of our road and street systems. The speed of travel is in­
creasing and the need for better signs and signals is increasing in order
to maintain high volumes of traffic and safer conditions.

Research in materials, methods of design and construction and
techniques for improving flow and safety, should lead to keeping our
expenditures at the lowest possible level. Much of this research is of
the type which is needed immediately in order to improve our overall
efficiency. Possibilities for improving our situation immediately are
quite good with the technological gains in many areas of science. The
electronics field alone has hardly been tapped.

I have already mentioned the long-range program and the immediate
problem studies which could be of value. There are of course the inter­
mediate goals which would be concerned with changing our highway
system into the type of system which technology and the user will
require. To get a perspective of these problems, consider the changes
which might be desirable for the next 10 years. Assume for the moment
that we would like to incorporate all of the useful electronic devices
which will lead to safer, more efficient flow of traffic. If this were a
sound objective, we need to know a great deal about the reliability
and the characteristics of electronic devices. We need to know much
about the capabilities of the driver and his ability to utilize information
or controls which might be provided electronically.

There are many other examples of studies which would help produce
changes in our existing road and street system. Many such studies
would produce no immediate gain but would ease our financing prob­
lems 5 to 10 years hence. Some of these research projects will be rela­
tively fundamental but eventually some applied practical answers will
be needed.
The preceding discussion of program is oriented to highway transportation more than to the general transportation requirements. A good research program will include the relationships which exist between the results which we can achieve with the motor vehicle highway system in combination with other forms, particularly in urban areas. One of the key factors in the urban transportation problem is financing; the highway user, time and again, has displayed the willingness and ability to pay for value received. In some areas of our economy, such an arrangement is referred to as the “utility” approach. Thus when we pay fuel tax or registration fees, it is much like paying our telephone bill. The ability to expand the system is contingent upon obtaining the funds from the user. Under the utility approach one needs to be sensitive to the interests and preferences of the user, particularly as it is reflected in how much of a “bill” he is willing to pay.

In urban areas, particularly, substantial portions of the money used for highways come from property taxes and general funds. The need, however, is not only for highways but for all of the other government services which are vital. In addition the socio-economics and aesthetics are of greater complexity than in the rural areas. When a substantial portion of the financing is from the general fund, it is difficult to tell whether the users of roads and streets or, for that matter, users of any service are obtaining the facilities which they want and are willing to pay for. Financing from the general fund is therefore not a “utility” approach but one which places road and street financing on the basis of a “service” provided by government.

As one of the elements of service, roads and streets must take their place in line along with the other needs of the community. In addition the socio-economic and aesthetic values of the community become the dominant issue. It is somewhat difficult to obtain a satisfactory solution between the “utility” approach for one class of roads and streets and the “service” group which would be financed under a different philosophy.

Some useful studies could be conducted in this broad area of financing. In some respects, however, much clarity could be obtained by a decision as to which of the financing philosophies is to be adopted in urban areas. It is true that the presently available bases for such decisions are not exact. For example, if one wishes to use the service approach, how does one decide on a rational basis whether the funds should go for schools or for highways?

In summary, the type program needed in urban transportation research includes a wide range of problems from improvements in our
The Bureau of Public Roads Research and Development Program

The Bureau recognizes the wide scope in research needs. It also recognizes the tremendous size of the research problem, both in terms of staff and expenditures. Its present program centers around a philosophy of encouraging and interrelating the participation of research and development in both urban and rural problems. We would like to see all levels of government and all branches of industry actively engaged in that part of the problem in which they have unique interests and concern. Part of our mission will be to devise and improve methods for circulating the results of R&D efforts. We also have a strong interest in reducing the time between research concept and application of the findings.

In the specific area of urban transportation research, we have identified the problem of increasing the capacity of our urban streets as one of our major research and development efforts. The details of this program emphasis have not been completely developed. However, we hope to stimulate studies concerned with purely geometric improvements which will increase capacity with no loss in safety. Part of these efforts is purely development type which means that we need to apply many of the techniques already proven as feasible.

There will also be a major effort to make use of electronic devices. Certainly in the immediate future these devices can be used as a source of more information to the driver. In urban areas the driver is faced with a tremendous problem of assimilating information on traffic movement, pedestrian activities, and traffic control devices. If we can, through electronic means, provide either visual or oral information which partially assimilates conditions, we can improve on his operational capacity. In addition, more sophisticated control mechanisms can provide the maximum efficiency possible under the number of lanes and lane width restrictions which are present.

A closely related emphasis in our R&D program is that of safety. As we consider increasing capacity we are certainly going to be interested in maintaining and improving the safety conditions. There are two ways in which we hope to pursue safety problems in the immediate future.

One of the major studies will be in the realm of defining the driving task. Such work is already under way throughout the country. Of particular moment are such factors as the number and types of responses
which each of us needs to make as we drive. If you stop to think, you will realize that you are constantly making adjustments in the steering, braking, and acceleration of the vehicle. The manner in which these adjustments occur is a relatively underdeveloped area of science. If we are to be helpful in providing through electronic means information to the driver, we will need more information on the driving task.

Of more significance from an engineering point of view is another study area in safety which we are hoping to undertake. This study is concerned with a criterion for safety which will permit a rapid evaluation of changes in traffic flow which are made. At the present time our principal measure of safety is the number of accidents and particularly fatalities which occur. There is quite a long delay in developing a reliable accident history. In fact any time period less than a year is subject to considerable speculation. In the meantime the effectiveness of any corrective measures we take cannot be properly evaluated from the viewpoint of safety.

While it is recognized that accidents must be the ultimate measure of how safe the system really is, there are many problems in knowing how much of the hazardous condition can be properly attributed to the facility and its control system. Certainly the entire safety problem is influenced by the relationship between the highway, the vehicle and the driver. In addition, when two or more cars are involved, probability theory comes into play. Thus one can go through a red light without an accident if another car does not happen to be going through the intersection at the same time. The theory of probability tells us that if enough people go through red lights eventually a collision will occur.

Considering the complexities of the safety problem, developing the ability to measure safety is a most challenging assignment. Presumably multicar accidents occur because at least one driver is doing something he should not. That is, if all cars are in their proper lane following at the proper interval and not entering intersections improperly, no accidents would occur. One possibility for measuring the relative safety of a new installation would be to compare the number of "errors" being made by the drivers in the traffic stream. Based on the probability theory one would expect that a facility upon which the most errors were being made would be the most hazardous.

The Bureau's research program will include studies by its own staff, projects which are completed by contract with Bureau funds, and cooperation with the states through the federal-aid program. We hope that many states will be interested in participating in phases of the
urban transportation research problem and that we can assist through stimulation of projects and through prompt dissemination of the findings.

Concluding Remarks

I hope I have managed to pass along to you some of my convictions that a vigorous R&D program in urban transportation research is vitally needed. I hope also that I have indicated that all parts of the road and street interests have a place in the R&D program. In fact without the interest of all agencies, industry, and universities our ultimate system will be less than it should be.

Certainly there will be a different role played by the many groups which have an interest. The lack of staff and funds will limit some groups to more than a constant appraisal of the work accomplished by others and to the analysis of their own mission in terms of developments which are needed. Meetings such as this would then provide an opportunity for both getting up to date and passing along information to those who are conducting active research programs.

It is difficult to maintain a status quo in America today. Almost all activities are either going forward or backward. It would appear that it will take determined efforts for improvement even to maintain the status quo and quite extensive efforts to keep our system moving forward.