

need to support track/train dynamics amongst other programs. There is, in fact, a close liaison and several Canadians are members of the various committees and steering groups which supervise the AAR programs. Indeed, the chairman of their track/train dynamics steering committee is a prominent Canadian railroader. Track/train dynamics apart, there are a host of other improvements to the design of locomotives and equipment which could contribute to the reliability of railroads. Prevention of winter slush from entering the ventilation exhaust ports of traction motors, and prevention of leaks in braking systems are typical examples. There is nothing romantic about such projects. Researchers who work on them are unlikely to receive Nobel prizes. But if you knew how many traction motors Canadian railways change every winter, you would appreciate the virtue of such lackluster projects. You might also buy some shares in a company making copper wire.

Lastly, there is the need to give adequate priority to the development of railway equipment of kinds that are not able to be financially self-supporting. I refer, of course, principally to high speed passenger services. Here the railways of Europe and Japan appear to have left those of North America some way behind in the development of technology regarding the trains themselves and possibly concerning techniques to maintain track at reasonable cost to the quality needed for running at speeds of over 100 miles per hour.

Some organizational developments. During the early part of this talk I mentioned the reasons for cooperative effort between governments, railroads, railroad equipment manufacturers, and others in planning research programs of the greatest community benefit. During the middle part of the talk, I discussed some of the principal research needs and priorities. Now in the last few minutes, I should like to say something about the organizational means of directing the communal effort to achieve research objectives in Canada and also concerning the need for cooperation between our two countries.

Soon after I became chairman of the Railway Advisory Committee, I decided that the first need was to set up small task forces each consisting of seven or eight of the committee members most closely concerned with the specific problem. Each of these groups consists of hard headed practical railroaders including both operators and civil or mechanical engineers, senior public servants, trade unionists, and research specialists.

The task for each group is to recommend to the government of Canada the desirable content of research programs in their specialized field over each of the next several years. I hope that within the next six to eight months the first of these programs will have been formulated and discussed with the government. It does not, of course, follow that the government is under any obligation to accept the advice piecemeal—it may have its own priorities including some that are unknown to the members. But at least a mechanism has been set up which should be able to structure railroad research programs in a highly realistic manner and in a way which maximizes the benefit to both the community and the railroad industry.

To date, one of these groups is tackling the whole problem of railroad construction and maintenance; another is tackling all problems concerned with motive power and cars. A third is concentrating on problems concerned with track/train dynamics. I hope that by the end of the year, we shall have four or five such groups hard at work.

I personally believe that a closer liaison in railroad research in our two countries would be to

the benefit of everyone and will be necessary for the economic resurgence of railroading, which is both profitable and desirable. High potential energy efficiency was the original reason why railroads were built; it is likely to provide the rationale for development in the future.

I suppose that some large part of the difficulty in railroad research results from the maturity of our industry. During the latter part of the steam era, the railroads of North America attained a plateau of technological stability in terms of the design of cars and track—somewhat less so concerning locomotives. Compared with the automobile, trucking, air transport, or shipping industries between, say, 1920 and 1960, technical change was comparatively minor. Furthermore, research effort has been somewhat fragmented for reasons I have explained. As an industry, we ceased to be research minded.

Now the Sleeping Beauty period is over. The railroads have been awakened by the unwelcome kiss from the uncharming prince of mounting costs. We need a major effort to augment the rate of technological progress. Only by collective effort are we likely to succeed.

SOCIAL, ECONOMIC, AND ENVIRONMENTAL NEEDS

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It is a distinct pleasure for me to be here today and to participate on this panel to discuss with you perhaps an outsider's view of research needs and possibilities in the social, economic, and environmental area.

I say that because it appears that I am the only representative on the panel, with the possible exception of Mr. Smith, who comes from an organization that, in effect, is "on the firing line" with responsibility to the public for producing a product which involves planning, constructing, maintaining, and managing transportation facilities. Perhaps I can share with you from the standpoint of a state highway administrator some of the problems that we face which, in turn, may generate some ideas regarding research relating to transportation that will be worthy of consideration and helpful to those who are involved in implementation of a program.

The state of Washington recently concluded the longest legislative session in history, lasting 164 days. I understand that is typical of many states, but perhaps what is not so typical is that it was the most significant session in many years in terms of transportation-related legislation.

The legislature addressed an organizational structure for overall transportation programs for the state. The Department of Transportation will become effective September 21. It is organized similar to several other states in that it will contain Divisions of Highways, Aeronautics, Marine Transportation, Public Transportation, and Planning and Budget. There is established within the Department of Transportation responsibility and authority at the state level for developing transportation policies and a transportation plan.

Legislation also was passed to fund highways. There was \$135 million in bonds authorized for capital improvements of the Washington State Ferry System, which is an integral part of the state highway system and one of the largest public transportation systems in the United States. There also was legis-

lation for continued and increased assistance to local agencies for public transportation.

The motor fuel tax statute enacted by the legislature was very significant, not only for Washington, but other states as well, because it changed the motor fuel tax from 9 cents per gallon to a percent of the total price, excluding state and federal taxes. It is a tax that is responsive to economic trends within certain limitations. The 21.5 percent of the base price at the pump will reduce if the equivalent tax in cents per gallon exceeds 12 cents or if revenues exceed by more than 5 percent the legislative biennial appropriation. Those conditions prevent unlimited revenue windfalls being generated as a result of price increases, combined with continued heavy volumes of sales.

There also are floors built in to protect the motor vehicle fund in the event the volume of sales and the price were to reduce. The tax will not drop below an equivalent 9 cents per gallon, which also represented the existing tax at the time the legislation was passed. There was considerable support for the bill, which had been passed by the legislature two years ago but vetoed by the governor. This year it passed the Senate 35 to 10; it passed the House 58 to 33. Governor Ray endorsed the bill and signed it into law.

It is not a panacea that will do all things for highways. Many agencies are funded from the gas tax in Washington. The 20 percent of the gas tax that will be used for state highway construction will allow us to maintain the integrity of the existing system, complete the Interstate within the specified time frame of 1990, and to construct a few new projects outside the Interstate system, including park-and-ride lots and exclusive bus lanes for public transportation.

However, since the bill became law, there have been enough signatures collected to place an Initiative on the ballot for a vote by the people in November to repeal the additional tax. Some sponsors of the Initiative have indicated they want a strong highway program but no additional taxes. How does one respond to that type of dichotomy, especially with the inflation that has occurred over the last several years and obviously will continue to occur?

Many states have attempted similar legislation for increases in revenues. Most attempts have failed.

My point for dwelling on the subject of financial problems to this extent is because it appears to many there is a need for research to assist transportation agencies, legislators, and others in communicating to the people the importance of a good transportation system for continuation of the economy of the nation. I do not mean to limit the benefits of a transportation system just to the economy but also to the social and recreational activities of the nation today. If the public does concur with the need for a transportation system, it also would be helpful if policy makers were able to communicate to the public its responsibility for funding such a system.

I would also like to share with you some significant issues, concerns, or questions that were raised by the legislature, by the public, or by our department during the session. Many of these could be the basis for research activities.

1. The need for a defined energy conservation program. We in the state of Washington fully recognize the need to conserve our limited resources, including our energy resources. Many of us also feel it must be done in a manner that will not at the same time adversely affect the economy of the state or the nation.

The legislature and the public look to the trans-

portation systems and systems to manage that transportation plan. It is important that the transportation agency know what is the energy policy at both the state and the national level in order to plan for the future. There have been many declarations of policy regarding energy conservation, but there also has been public unwillingness to accept them in most cases. I imagine much of the opposition is our reluctance to accept changes that are required in our individual life style by reason of the policies. So nothing happens, and consumption continues to increase.

Perhaps research could be considered regarding attitudinal changes of the public to accept policies that are in the best interest of the nation.

2. Development of a transportation policy. Once an energy policy is determined and implemented, it serves as a basis for development of transportation policies. I realize it is beyond the scope of TRB to be involved in research for development of other, more efficient means of transportation. But is it beyond the scope of TRB to determine what types of transportation the public is willing to accept within resources available? Then while industry and government are hopefully researching the development of more energy-efficient vehicles and new energy sources, could the TRB be involved in research of systems that will accommodate the implementation of the findings of government and industry?

For example, we read that some companies have made significant progress in development of motor vehicles powered by electricity or other types of energy. If we continue to use automobiles, it will require highways. However, in most states, revenues for highways are generated from gasoline taxes. If electric automobiles do become feasible, what then are feasible alternative funding methods for states to use to maintain transportation facilities that historically have been financed from the gas tax? I realize there are many answers, but in reaching conclusions our legislators need information and facts that can be readily available to them.

3. Another issue is the efficiency of the processes associated with our transportation program. This is a problem about which I, as an administrator, have great concern. It relates to the effectiveness of regulations, laws, and procedures under which we currently operate. It would mean to some degree diverting some of our research efforts from new, innovative, and imaginative ideas to an evaluation of where we are today and to what extent actions in recent years have affected our efficiency and the cost of developing a product. If implementation of new rules and regulations continues to increase the cost of the product as in recent years, the public will soon refuse to pay for additional transportation facilities.

In recent years there have been many new laws, rules, and regulations adopted, primarily in the social and environmental fields. I recognize that a need has existed to develop evaluative methods, prescribe more precise procedures, and establish standards. Now that we have had more experience in identifying and evaluating impacts, it appears to me that research is needed to examine all of the 16 federal statutes and the numerous regulations that relate to some phase of social, economic, and environmental factors regarding public works and to determine how we can protect the environment and yet insure that necessary facilities are constructed in a timely manner. Obviously, this problem affects not only highways but all forms of transportation.

The state of Washington has attempted to recognize and respond to environmental concerns. In

doing so, we have tried to provide leadership wherever possible. The Department of Highways plans to maintain a very positive attitude in this regard. We fully recognize the need to conserve our very limited natural resources. There are very few areas that have the natural beauty of our state, and we want to make sure that his beauty is not destroyed. However, there must be a responsible attitude concerning the economy of the area and efforts to avoid inefficiencies and excessive costs. An adequate transportation system is, indeed, one of our basic resources and is an important factor in the total environment that must be protected. Our transportation plan will work toward the accomplishment of these objectives.

In the State Highway Department, we have reduced our total number of employees by about 1,000 or about 20 percent, in the last six years. Much of this reduction is due to management programs that have increased our efficiency in engineering and maintenance through development of work standards. Part of it is because of reduced workloads.

During the same time, we have had thrust upon us more than 350 manyears per year for new requirements, procedures, and tasks at the federal, state, and local level. We have identified those tasks and the resulting costs in both manpower and dollars. For example, 240 of those manyears are in the construction field alone, which includes design, right-of-ways acquisition, and construction. Included in those 240 are 70 manyears to accomplish the additional environmental requirements at a cost of \$1.4 million. The action plan costs \$400,000 and requires 23 manyears. Totally, the cost of the 350 manyears is \$6 million per year.

This does not include the cost of delays that occur by reason of some of these requirements, nor does it reflect the increased cost of the product resulting from lawsuits for alleged noncompliance. An example is a short section of Interstate 90 about 50 miles east of Seattle. The project was underway when it was enjoined from further work for noncompliance with NEPA. Because most of the work was underway, we could accurately estimate the cost of the project to be about \$28 million.

After three years of rewriting the impact statement and providing a 4(f) statement for an area that was not directly affected by the facility, the courts have authorized construction to proceed with almost identically the same design as was previously contemplated. The cost of the project today is in excess of \$45 million. The additional cost by reason of the delay was more than \$17 million.

It is one of the smallest of several projects that have suffered delays as a result of litigation. We also estimate, based upon projections of accidents, that if the delay on that one relatively small project had not occurred, there would have been 120 less accidents, there would have been 127 people not injured, and 7 people would not have died as a result of accidents during the delays. Delays and inconveniences to the travelling public during the period of the injunction was 60,000 manhours.

There have been several other Interstate projects held up for some two to five years by reason of litigation relating to environmental regulations and laws. Total costs today of those projects are about \$800 million. We estimate that at least \$300 million of that total represent increased costs by reason of the delays.

Should not research be conducted to determine if environmental laws are effectively accomplishing the intent of the legislation or if they are being used in some cases to bring about delays that have tremendous social and economic ramifications? The research

might also include whether it would be desirable for the litigant to assume some responsibility for increased costs in the event the agency has been found to be in compliance.

Again, let me say that the Washington State Highway Department shares a true concern over environmental damage, and we concur with the intent of legislation to protect the environment. The question we ask is whether that intent is being violated by reason of unnecessary regulations and delays that affect the efficiency and accomplishment of the intended purpose.

There is another activity implemented in recent years that, in my opinion, warrants examination of its effectiveness through additional research. It is the requirements associated with urban transportation planning.

I fully recognize and appreciate the need for close coordination of transportation planning with land-use planning and also the need for regional planning organizations. A recent study by the American Association of State Highway and Transportation Officials indicated that in fiscal year 1977 there was nearly \$135 million programmed for transportation planning in urbanized areas in excess of 50,000 population. Many of these regulations are time-consuming and require great numbers of resources to accomplish. The question I ask is whether the extreme cost is justified or could the job be accomplished more efficiently?

Public involvement is a very important element in transportation planning. Many requirements have been adopted to insure public involvement at all levels of transportation activities.

In the state of Washington, we have utilized various methods to involve the public in the development of individual projects, and we have been quite successful in most instances, although we have had some failures. In the program development phase, we have conducted meetings throughout the state, but various conditions prevented the use of the same type of approach that we have undertaken for projects. In the development of our program, last year we held 52 meetings. Attendance at these meetings ranged from 15 to 40 people. Approximately 1,200 people were in attendance out of a statewide population of approximately 2,000,000 adults. These meetings were duly advertised and publicized with the help of the news media. We need research concerning the effectiveness of public involvement programs, especially in program development.

We are planning now to utilize coordinated meetings with local elected officials, planning commissions, and as many citizens as will attend. By this procedure, we at least know we are communicating with local officials and their staffs, and hopefully we will receive more public input than we did under previous plans. But we recognize that a variety of different methods must be utilized if the public is really going to become involved. In the program development stage, we need to ascertain whether the public really cares, and if not, what methods will develop their interest at an earlier stage. We know from experience that various groups become involved very actively as projects progress through the planning, design, and construction stages.

Research concerning the effectiveness of public involvement schemes, in our opinion, is important. At the same time, perhaps we could find out if the public does really care and if not, how do we develop their interest at an early stage?

Before closing, I would like to share with you a rather unique process that was used in resolving a difference in opinion between various agencies affected by the construction of I-90 in the vicinity

of Seattle. The six agencies directly affected by the project have been in disagreement over the configuration and number of lanes since the late 1960's. The project has been in litigation since 1972 and enjoined by the courts from further right-of-way acquisition or construction since 1973.

Following completion in early 1976 of additional hearings ordered by the courts, it was apparent the disagreement among the agencies still prevailed. The department concluded that we needed the services of a professional mediator to try to resolve the differences and reach a common agreement.

Through the efforts of a local mediator that was sponsored through Ford Foundation and Rockefeller Foundation grants, we were able to reach accord with all of the involved agencies on a design configuration for the facility. A memorandum agreement has been entered into by the affected agencies that not only identifies the design configuration for I-90 but also obligates the agencies to work toward solving other transportation problems throughout the area.

With the agreement, the final environmental impact statement has been rewritten and submitted to the Federal Highway Administration and to the Department of Transportation for approval. Our plan calls for returning to the courts to demonstrate satisfaction of their requirements later this year and hopefully have the injunction lifted so that the project can proceed. Research relating to the effectiveness of formal mediation processes to resolve highway problems may be of interest to many states.

In summary, I suggest that we need to continue research to identify new and imaginative fields in all areas associated with transportation. In part, however, I feel we should be monitoring the effectiveness of what we are doing, what we have done, and what we are required to do. I believe that all agencies should be willing to honestly evaluate that research and be willing to change existing rules and regulations if it would result in more efficiency as well as being responsive to the nation's needs. The findings of the research, I am sure, also would be useful to those who are responsible for establishing the law of the land and whom I feel also are willing to evaluate its effectiveness and to respond to changes as may be needed.

TRANSPORTATION PROBLEMS AND RESEARCH NEEDS IN THE RURAL SECTOR

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The objective of this paper is to present a series of recommendations regarding research needs on social, economic, and environmental problems in rural transportation. To substantiate the need for the suggested research some background is presented describing the evolution of the rural transportation system and itemizing some of the present serious problem areas in the system.

The Evolution of the Rural Transportation System

Our rural transportation system has evolved in several stages which are distinguished by competition between the different modes of transportation. It also should be recognized that the development of our economy has been greatly influenced by the progressive development of the transportation system.

The Turnpike Era. At the time of the founding of the country, 200 years ago, the inland transportation system mainly consisted of a few north-south trails, suitable for horse and rider. Freight was principally moved on water, and the population was concentrated near ports along the Atlantic seaboard.

With the advent of the Conestoga wagon (around 1750), a means of land transportation became available, and the development of "Turnpikes" commenced, constructed both by the states and by private companies. The first involvement of the federal government in road building was authorized in the Ohio Statehood Act of 1802. It is interesting to note that three years ensued between the authorization of funds by Congress and the beginning of the route location studies. Planning continued for eight years and then the Cumberland Road was constructed for a distance of about 130 miles in less than four years, being completed at Wheeling on the Ohio River in 1818. It is not recorded how many pages the Environmental Impact Statement ran, but this pattern of "planning a road to exhaustion" has been carried over in federal-aid projects to this day.

The Water Transport Era. The invention of the steam engine permitted the development of steam-powered boats in the early 1800's. Soon thereafter a major effort was concentrated on the construction of waterways and canals, and by the 1820's the cost of water transport was less than half that of wagon transport.

The Rail Transport Era. Shortly after the middle of the 19th century railroads began to displace water transport as the most economical and hence most attractive mode. For example, tonnage on the New York State canals peaked in 1880 and began a decline which was not reversed until the 1920's.

As the mileage of railroad track began to mushroom in the last third of the 19th century, every city and rural hamlet wanted to be located on a rail line. Financial incentives stimulated frantic and excessive rail building which continued into the early 20th century.

The Highway Era. Throughout the period of development of water and rail transport in the 19th century, roads continued to be built. The road system grew from a few thousand miles of trails and turnpikes in 1800, to about 2 million miles in 1890, slightly more than half of the present road mileage.

The roads served mainly as feeders to the rail and waterways systems. Little or no attention was given to their engineering or maintenance, and as a result their trafficability was highly seasonal. Farm products could be moved to the railhead for shipment to market only at certain times of the year.

In 1893 Congress mandated rural free delivery of mail, contingent on the availability of improved roads. In 1895 Congress established the Office of Road Inquiry, which has evolved into the present Federal Highway Administration. By the turn of the century, the advent of the automobile and the truck had created further pressure for improved roads.

In 1905 there were 77,000 automobiles registered and 1,400 trucks. By 1916 those numbers had grown to 3,400,000 and 250,000, respectively. And in 1916 Congress passed the first Federal-aid Highway Act, for the purpose of financing post roads to facilitate rural mail delivery and to "get the farmer out of the mud." The highway era was well on its way.

Summation. It can be seen from the preceding brief review that the rural transportation system has evolved as the consequence of improvements in technology. This has resulted in an uncoordinated, multimodal transportation network in which one mode or another is overbuilt in some regions of the country. Responsibility for regulation of this system