HIGHWAY RESEARCH RECORD

Number 183

Shifting Emphasis
in
Transportation
and
Its Implications for Research

3 Reports

Subject Area

90 Highway Research, General

HIGHWAY RESEARCH BOARD

DIVISION OF ENGINEERING NATIONAL RESEARCH COUNCIL
NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

Washington, D.C., 1967 Publication 1514

Special Committee on Long Range Planning

(As of December 31, 1966)

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Foreword

The Executive Committee of the Highway Research Board has established a special committee to advise it on longer range research needs. Called the Committee on Long Range Planning, this committee proposed and sponsored the panel from which this RECORD originated.

Over the past ten years or so, the Highway Research Board has been steadily expanding its research interests to accommodate new problems. Many of these new problems have to do with densely populated urban areas, where highways are crowded and it is difficult to build new roads. Expanding highways and vehicle populations have raised problems as to the proper balance of services performed by the several transportation modes. More and more, transportation is seen today as a single function requiring a single responsible governmental agency directing the policies for improvement. The President proposed, and the Congress established, a new Department of Transportation. New Jersey, New York, California and Hawaii have established state departments of transportation. These new organizations reflect the awareness that transportation is a complex system. Viewing air, rail, road and water transport as a single system, new problems are quickly apparent, and most of these problems can be more effectively dealt with if sound research is available.

What are the new research problems growing out of this change in governmental organization? What are the needs and what are the subject areas that can profitably be attacked?

The Honorable Henry S. Reuss of Wisconsin has been one of the most vigorous Congressional advocates of well-aimed and judicious research and development efforts on transportation. He has reviewed Federal programs and has continuously pressed for attention to transportation more nearly like the attention being given to space programs. He reflects the lawmakers' view of this changing scene.

A. Scheffer Lang, Federal Railroad Administrator in the Department of Transportation, has had an illustrious career in railroads with the New York Central Railroad and as a professor at the Massachusetts Institute of Technology. Mr. Lang has been steadily at work on the organizational plan and the new needs of the Department of Transportation. He presents the views of the Federal administration on research needs as seen from the top.

Finally, Dr. William J. Ronan is a spokesman for the new state-urban concern with organization for transportation and the research needs felt at the state and urban regional level. Dr. Ronan has been Secretary to Governor Rockefeller and his chief transportation advisor. He is also Chairman of the new 'Metropolitan Commuter Transportation Authority which recently purchased the Long Island Rail Road. Furthermore, he is the originator and now Chairman of the Tri-State Transportation Commission—the planning agency for the country's largest and most complicated urban region. He describes research needs that will develop as the states and their urban regions try to achieve improved, efficient and balanced transportation systems.

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The Federal Government and Coordinated Transportation

HON. HENRY S. REUSS, United States House of Representatives

•A FEW weeks ago, in preparation for this meeting, I was privileged to inspect what seems to me the world's most marvellous transportation system. And I hope every breast here will swell with pride when I report that it was built by Americans, with 100 percent American materials, for Americans.

I refer, of course, to the 3,250-mile long, 24-foot wide Royal Road of the Incas, built through the Andes of Peru a century before the arrival of Columbus. And when I saw that magnificent transport system—every stone still perfectly joined after half a millenium, in a straight line up and down the highest peaks in the hemisphere—I said: "This is something I've got to share with my friends at the Highway Research Board Conference."

The ancient Incas solved their transportation problems. They even did it without the wheel, which wouldn't have worked on those grades, anyway. So my message today is: if the Incas could do it, we can do it. What's more, we have the wheel. We can do even better.

As a matter of fact, in many parts of our transportation system we've done amazingly well.

Take transportation by sea. The very first United States Congress, in 1789, enacted a tariff that gave a ten percent reduction in customs duty to goods imported into the United States on American vessels. In 1845, Congress authorized mail subsidies to United States steamship lines. Since the Merchant Marine Act of 1936, we have been providing liberal subsidies for both the construction and the operation of our merchant fleet. In recent years, we have been awarding close to $300 million a year in these subsidies, not to mention tax benefits, cargo preferences, and the sale of surplus ships at bargain prices.

Take inland waterways. From the original land grants of the last century to our present policy of building inland waterways and letting the users use them for free, we have built up the world's leading public inland waterway system. In the last decade alone, $5.6 billion in federal money has been spent on these waterways.

Or air travel? More than $6 billion of federal funds have been spent for air travel, more than $750 million in subsidies for local service airlines alone. We are now engaged in allocating an additional $1-2 billion for the supersonic transport, designed to lift you, complete with sonic boom, from Washington to Paris in three hours instead of seven. But until very recently—and I'll come to this in a moment—Uncle Sam's research interest in how to get you from the airport to your home, or how to get someone who lives in the central city to his job in a suburban factory, or someone who lives in a suburb into the central city, or how to get someone to another city 300 miles distant—was nil, null, and nonexistent.

What about automobiles and trucks? We started our federal road-building program with the Cumberland Pike, completed as far as Vandalia, Illinois in 1838 at a cost to the federal government of $7 million. In 1956, the federal government accepted almost exclusive financial responsibility for the 41,000-mile interstate network. To date, federal highway expenditures have exceeded $40.5 billion. An additional $48 billion will be spent before the I-system is completed.

Paper sponsored by Special Committee on Long Range Planning and presented at the 46th Annual Meeting.

But we've been remiss in developing transportation to serve the millions of people in the large cities or in the densely packed corridors with whole strings of cities, like the corridors from Boston to Washington, from Milwaukee through Chicago to Cleveland and Detroit, or from San Diego to San Francisco. To meet this gap in our transportation system, we ought to be working on wholly new transport systems.

Obviously, ocean liners, canal boats, or supersonic jets are not the answer. Propeller and ordinary jet airplanes are efficient and fast between airports, but not from midtown to midtown in large cities.

Nor is the automobile a complete solution. I am not against automobiles. I believe that our great I-highway system is indispensable in binding together the nation and its economy. But within the crowded cities, and between them in congested corridors, the automobile-highway system as a total solution can impose unacceptable costs. More expressways can bring on more congestion rather than relieving it. More cars using more expressways will greatly increase the menace of air pollution. And good highways for more cars will need more land where space is precious for many other high-priority purposes.

Already there are revolts against the automobile. In San Francisco, the county government stopped construction of the Embarcadero Freeway because the people revolted against feeding more of the city to an insatiable expressway system.

In my city of Milwaukee, one of our classically beautiful downtown buildings was the Layton School of Art, built in the 1880's by a meat-packing philanthropist. It was torn down ten years ago, to make a needed parking lot. Happily, a new Layton School of Art was built, a jewel of a modern building on the bluff above Milwaukee's lakefront. Now the expressway people are going to tear down the new Layton in order to build an expressway!

Because transport systems in cities and in inter-city corridors have broken down, we cannot fully and agreeably use our marvellous airplane service and our interstate superhighways.

We cannot make a forthright attack on poverty, because the poor who live in the central ghettos cannot link themselves to job opportunities elsewhere in the metropolitan area. The McCone Commission, reporting to the Governor of California on the Watts riots, pointed out that the despair which pervaded the area was "intensified by what may well be the least adequate network of public transportation in any city in America." As the McCone Commission pointed out, jobs, shopping, and medical care were inaccessible to the residents of Watts without an automobile. And so the Watts residents found themselves overextending their credit to buy automobiles, because they were the only means available to them to break out of their circle.

Until very recently, transportation within cities and along corridors between cities as a method of solving our transportation problem was effectively disregarded in the councils of Washington. I am happy to be able to report that times are changing. Let me tell you what is happening.

1. The bill establishing a Department of Transportation was signed into law by President Johnson on October 15, 1966. The President gave it what he rightly called "a mammoth task—to untangle, to coordinate, and to build the national transportation system for America that America is deserving of." To be sure, there are large gaps in the transportation authority of the new Department. The Maritime Administration, for the present at least, remains outside. But the new Secretary of Transportation will have under his wing transportation by air, by rail, and by highway, as well as the administration of the High Speed Ground Transportation Act. Alan Boyd has been hard at work for months on his difficult assignment, and I'd like to take this opportunity to congratulate him on his well-earned official recognition this week as Secretary of Transportation.

2. The high speed ground transportation program, enacted two years ago and to be administered by the Department of Transportation, is focusing primarily on the Northeast Corridor between Boston and Washington. Two of its demonstration projects are expected to become operational next year—high speed trains running between Boston and New York, and New York and Washington, to run at speeds of around 125 miles

per hour. The program also sponsors basic research to investigate unconventional transportation systems, such as 300-mile-per-hour vehicles operating in tubes or tunnels, and vehicles operating on air cushions. The know-how developed from these projects can help us in other crowded metropolitan areas.

The federal government is in the high speed ground transportation business because the job to be done not only crosses state lines, but transcends state and local fiscal resources as well. But the federal funds so far devoted to this program have been meager. The entire authorization for the three-year high speed ground transportation program was $90 million. But the appropriations have been much less—$18.2 million for fiscal 1966, and $22 million for fiscal 1967. Compare this investment, if you will, with the government's recent investment of $80 million in the biological satellite which was literally lost in space!

3. The new Department of Housing and Urban Development came about because of the congestion of our city streets and slums, the movement of the more affluent to the suburbs, mounting air and water pollution, increased crime and juvenile delinquency. The question of transportation within the metropolitan area is now in the Department of Housing and Urban Development. Within a year, the President must sort out whether urban transportation stays in HUD, or goes to the Department of Transportation. I suggest as the criterion of whether HUD keeps it, or DOT gets it, should depend on whether HUD's 1967 approach to urban transport is vigorous or lackadaisical. If the job is being well done by HUD, and coordinated well with DOT's intercity function, there should be no reason for a change.

4. HUD continues to administer the Urban Mass Transportation Act of 1964. This authorized $375 million in federal grants to states and localities over a three-year period to assist public and private transit companies in providing adequate mass transport in the nation's cities. The 1966 amendment to this Act authorized an additional $300 million for two more years.

Much of the federal help under this Act has gone to patching up existing inadequate systems of urban transport. In Peoria, Illinois, HUD saved the local bus system with a loan to make possible guaranteed seats and improved schedules. It has helped the Washington, D. C. minibus, a 138 horsepower vehicle which provides short rides for a nickel. Atlanta, Washington, and Boston are pressing ahead with plans for new or extended subways. In the San Francisco Bay area is the largely self-financed $1 billion Bay Area Rapid Transit (BART), where electronically-controlled, lightweight aluminum commuter cars will carry passengers at an average speed of 150 miles an hour within three years. In Pittsburgh, again with some HUD help, Westinghouse Electric Corporation is testing its new sky bus, consisting of 30-passenger, rubber tired cars on an elevated guideway. About $349,000 in federal aid helped put a five-mile extension in operation between Chicago and suburban Skokie. The number of daily commuters has climbed sharply from the original estimate of 1,500 a day to its present average of 7,000.

5. The trouble with the Urban Mass Transportation Act is that, by and large, it has helped out by providing for new buses and subway cars, but has done little or nothing to provide for wholly new systems of transportation. Without wholly new systems, I believe our cities are doomed.

I was unwilling to settle for the idea that the people who split the atom and are about to put a man on the moon are incapable of working out their transportation destinies here on earth. With this in mind, I have for the past two years pressed for legislation which would require the federal government to show the same research leadership in urban transport that it showed in the Manhattan District Project for splitting the atom, and in our space program. I asked that the Administration pull together the best brains from industry, government, and the universities and foundations, and block out a moon-shot-type of program for urban transport, and then come back to Congress in a year and tell us what private industry and local, state, and federal governments need to do to translate research, development, and demonstration, on a systems analysis basis, into a solution "that will carry people and goods within metropolitan areas speedily, safely, without polluting the air, and in a manner that will contribute to sound city

planning"—in the words of my bill. I am glad to say that the bill became law last October 15.

Today, under the vigorous leadership of Assistant HUD Secretary Charles M. Haar, HUD is well launched on the first phase of Operation Breakthrough. Universities, research institutes, corporations in the fields of transportation and aerospace and electronics, are now competing for contracts to show us how to improve present modes of urban transportation, and how to evolve radical new technologies and then combine them into entirely new systems.

Space-age techniques can help in Operation Breakthrough. Solid state circuitry can enable us to schedule and control vehicles to an extent far beyond our capacity a few years ago. Our new knowledge of aerodynamics and propulsion sytems can tell us much about ground operations at high speeds. Lightweight equipment for space vehicles can be applied to surface vehicles, thus substantially increasing the payload.

By the time the second session of the 90th Congress convenes next January, I am looking for HUD to table before the Congress a five-year breakthrough program which will make our space and atomic efforts look earthbound and old hat!

So, belatedly, Washington is moving on the transportation front. We have two new departments, concerned largely with the safe, swift, and pleasant movement of people and goods. We have a Northeast Corridor high-speed rail program, and a dramatic new research and development program which can lead to entirely new systems of mass transit within metropolitan areas.

Where do we go from here? I have two suggestions whereby our transportation people, in Washington and in the states and cities, can make these good research and action programs even better:

1. Research in Washington. As I have said, HUD, under Assistant Secretary Haar, is working on a massive new R & D program for new systems of metropolitan mass transit. Obviously, this will include many, many things beyond highways. But the urban highway is going to continue. Today the Bureau of Public Roads has some $14 million a year available for urban highway R&D. Of course, we're going to continue to need research on conventional problems of highway safety, highway design and engineering (better culverts and bridges), and traffic flow (computers).

But the new urban highways of the future must be part of the integrated urban transportation system, with all its new types of mass transit, that HUD is about to propose. The total complex will need, in addition to everything else, new forms of highways—automated highways on which new vehicles like the commucar can move, new propulsion systems for buses and automobiles which don't pollute the air, new methods of deep tunneling in highway building.

So, in at least part of its highway research effort, the BPR should get aboard the HUD team. An integrated transportation system for our cities needs, right now, integrated research by our various transportation agencies. Both HUD and DOT are enjoined in their Congressional charters to coordinate their research. Research into new systems of metropolitan transport is a good place to start coordinating.

2. Action by the states and localities. New systems of transport, within cities and between cities, are going to evolve as the research program progresses. The states and localities must pull up their socks and get ready to use them when they evolve.

Planners of the Boston-Washington high-speed rail corridor are finding that their biggest obstacle is governmental. From Boston to Washington, some 150 separate and independent political jurisdictions have responsibility for transportation planning. What shall it profit man to build a world-beater of a new high-speed system from Boston to Washington if it turns out to be incompatible with new local systems of scores of communities along the way?

If the states and cities want help from Washington in the months and years to come for their inter-city and intra-city transport, it will not do to hand out 1970 technology to 1870 administrative and governmental arrangements. Specifically, I would like to see the governors of the inter-city corridor states—and this means at least the Boston-Washington corridor, the Milwaukee-Chicago-Detroit-Cleveland corridor, and the San Diego-San Francisco corridor—and metropolitan-planning agencies in all the communities

big enough to have a mass transit problem, take action now to bring into being the governmental mechanisms that will be needed to translate new transportation systems into reality.

Magnificent research into new systems of transportation by Washington is of no use unless governments where the people who need the transportation live are equipped to use them. Vigorous action by the states and localities in solving the transportation muddle is of no use unless research develops these new systems. If the transportation people in Washington, and the transportation people in the rest of the country, will do the job I know they can do, the new Departments of Transportation and of Housing and Urban Development will prove to be not mere bureaucratic shells, but the best thing that ever came down the pike.

Discussion

QUESTION: What was the name of the law called "Operation Breakthrough?"

HENRY S. REUSS: That law was technically part of the Urban Mass Transportation Act of 1966. That Act did several things. One, it continued the existing program and put an additional $300 million into it for two years. Then it had a separate section providing that the Department of Housing and Urban Development should forthwith in conjunction with the industries, universities, and state and local governments of this country, block out within 18 months a 5-year program of research development and demonstration designed to produce entirely new systems of transporting people, and goods within cities and metropolitan areas, that would move people speedily, safely, without polluting the atomsphere, and in such a manner as to contribute to good city planning.

What we have set up is, first, a preliminary period of about 18 months, during which HUD decides what are feasible approaches to the actual operation. Then, HUD will come back to Congress to report to us what kind of a program there ought to be. Then, Congress will mull that over and, I hope, enact whatever is a sense-making program. This will need some money and there are competing demands for federal money. But I can't think of any research outlay that would be of more value to more people than how we move them speedily, safely, and in a pleasant manner around our cities.

E. H. HOLMES—Bureau of Public Roads: It seems to me that the efforts that we are making and hope to make in improving our transportation in urban areas are directed toward the expectation of continuing the city in its traditional form. I wonder if there is any reason to think that with the forms of transportation we might expect in the future, or perhaps even with those that we have available today with the present technology, there is equal reason to take a look at the form of the city we might have if we were to take full advantage of advances in transportation. Recognizing the increasing affluence of the nation in which we live, is there opportunity for improvement in the form of the city, and do we, in fact, need to preserve the traditional type of city that has brought to us the many problems that we are now trying to solve through transportation improvement?

HENRY S. REUSS: There is indeed. Included in the terms of reference governing this new research organization within the Department of Housing and Urban Development is not only a study of vehicles and needs for propulsion and all that, but also the basic question of whether, on a cost-benefit basis in a cosmic sense, we wouldn't be better off with new ways of living in our cities whether they be cluster cities, satellite cities, or corridor cities, decentralized cities or whatever the ingenuity of our city planners think up. Thus in the terms of reference the question of city planning is specifically listed, and I hope they will think big, as you suggest they should. That certainly was the intention of Congress.

QUESTION: In your comments you suggested that the governors and the administrative heads in major metropolitan cities start to prepare the groundwork for cooperative

effort. It appears that on the one hand you have technology beginning to develop which will enable the transportation and urban planners to develop techniques and tools leading to a systems engineering approach. On the other hand, it is eventually going to come down to the problem of raising money, a power usually vested in legislative authorities at all levels of government. I think there is a real communications gap between the technical side, in the one case, and the legislative side that is going to have to operate in many different political subdivisions. Do you have any further comments on how this gap can be bridged effectively in the public domain?

HENRY S. REUSS: You certainly appreciate perfectly what the problem is. The irony is that if we go on as we are going, we're likely to solve the more difficult problem considerably before we solve the relatively easier problem. That is, we are likely to make some scientific breakthroughs to new systems of transportation and new ways of building cities and thus come to grips with the dreadful muddle we now face. But then our cities and regions will lack the governmental and financial mechanisms available to take advantage of these new systems. So, what I have been urging this morning, and in some other speeches I have been giving around the country, is this: Let's allow our local people—our governors, our mayors, our planning directors of metropolitan areas—to begin now to make the most concrete plans for preparing their governments' organizations to handle these new transport systems and to supervise their financing properly.

Specifically, I mean that in the mid-western corridor starting in Milwaukee, Wis., and going all the way to Cleveland and Detroit, the governors of those six or seven mid-west states ought to be getting together right now and setting up at least an informal committee or at most a kind of interstate authority whose task it will be to work out the financing of future systems and work out the governmental mechanisms for operating them. Then, when the scientists place on the table the results of their research and development, we shall be able to use them. I should hate to see these precious years—the next two or three years or about five years—wasted at the local level. I am confident that they won't be. I might add that in the mid-west some things are already going forward along the lines of the idea I have expressed.

QUESTION: Do we have to wait for the individual localities or for the state governors? Isn't it possible, using the examples of the Tennessee Valley Authority or Appalachia, to form regional or even national authorities to deal with the complex problems of the great Eastern, Midwestern, and Pacific Coast urban corridors?

HENRY S. REUSS: Your question has to do with techniques of bringing about these regional and local governmental and national authorities which will be capable of taking hold of the new technology and translating it into reality. You have suggested that maybe we shouldn't wait until the state and local people do it, but take a lead from TVA, where admittedly Uncle Sam set up the authority because the states were disinterested or bankrupt, or even Appalachia, where Uncle Sam did take the legislative leadership although the states were very much in the picture.

Although I am listed in the books of political science as a liberal democrat, a believer in strong Washington government, I am not about to write off our state and local governments. I think that unless we in Washington start giving state and local governments some responsibilities of their own, they are soon going to atrophy. This would be a very bad thing for this country. Reapportionment in the state legislatures is now going on apace. The idea of metropolitan institutions in our big cities is now taking hold more than it has in the past. There is increased emphasis, in which you highway people play a big role, on planning. So, I would hope that these trends will stimulate some response to this plea which we are making here. I hope that states and localities will pull up their socks and start inventing new local or regional governmental and financial organizations equipped to receive the forward pass of new technology when it's thrown from Washington. If they don't, if our pleas go unheard, it will then be time to consider whether maybe Uncle Sam ought to step in. But I want to give an all-American chance to the states and localities before we come to that gloomy conclusion.

Shifting Emphases in Transportation

WILLIAM J. RONAN, Chairman of the Metropolitan Commuter Transportation Authority, and Chairman of the Tri-State Transportation Commission

"I WOULD first like to take this opportunity to commend the Highway Research Board for including in its program for its annual meeting this panel discussion. For its very inclusion represents an awareness on the part of those concerned primarily with highways of "the shifting emphasis from the specific mode of transportation to the total function and need for an integrated transportation system."

But I would like to slightly modify the topic for today's discussion and talk about more than one shift in emphasis in transportation. For besides the new emphasis on the integration of modes of transportation into a total system, there are, in my view, three other shifts of emphasis which are just as dramatic, just as vital, and have enormous implications for research. They too involve integration, but integration of another kind. These other shifts in emphasis are:

1. A recognition that transportation is basically a regional, rather than a local problem;
2. Transportation must be viewed in terms of its impact on the total well-being of the community it is intended to serve; and
3. Its problems demand a new order of intergovernmental cooperation for their solution.

A number of factors have been responsible for these shifts, but the major cause has been the changing nature of the transportation problem itself.

Up to the present, the major problem of transportation has been to move the products of farm, factory and mine to market, and people throughout the world. The emphasis has been on moving people and goods across oceans and land masses, from country to city and from nation to nation.

But today, the major problem is not spanning continents. It is not crossing oceans. It is not even landing on the moon and, even more importantly, getting back from the moon.

Rather, it is the problem of moving large numbers of people—millions in fact—from home to work, to stores, to school and to recreation within metropolitan areas; and of providing for the circulation of people and goods to, from, and within urban areas and the megalopolitan regions now emerging.

This problem—the metropolitan transportation problem—affects not only the truck or automobile driver, the bus rider, the subway strap hanger, or railroad commuter. It affects the total social and economic development of the metropolitan region.

And although the elements and often the intensity of the urban transportation problem vary in different sectors of the country, it is essentially a national problem, as about 75 percent of this country's population now lives in urban areas.

It is this change in the nature of the transportation problem itself which has sparked the shifts in emphasis in our approach to transportation and created the necessity for a dramatic increase in the kinds, degree, and scope of transportation research.

THE SHIFT TO A TOTAL TRANSPORTATION SYSTEM

In the past, the passenger by common carrier tended to think the most arduous part of his journey ended when he reached the terminal; the automobile driver when he

Paper sponsored by Special Committee on Long Range Planning and presented at the 46th Annual Meeting.

reached the boundary of a city. Today, the terminal or boundary line usually marks the beginning of the most trying—at times even the longest—part of the journey.

The same problems afflict freight movements. Freight generally moves swiftly and economically over the line haul only to find terminal costs and delays becoming more burdensome.

Much of this is the result of the fact that in the past we set policy and developed programs for railroads, for highways, for aviation, for water transportation, each separately, and more often than not, with little attention paid to the impact one would have on the other. There was no policy for a total transportation system.

Never did we carefully assess how each mode or combination of modes would best contribute in a particular area to the improved and more efficient movement of goods and people. The result has been a severe imbalance in transportation—some modes promoted; others regulated and some even penalized.

The task ahead is to achieve a balanced transportation policy. This involves rectifying the imbalances in transportation research as well as promotion.

Frankly, the technological revolution in the 20th Century seems to have passed by much of transportation. The railroad car operating today is basically the same as it was at the turn of the century. The commuter along the Hudson River in 1967 spends as much time on the train as did his counterpart in 1900. The city bus of today on Madison Avenue has become as inflexible as the trolley car of yesterday. Technological research on the short-haul movement of people and goods seems to have been overwhelmed by our fascination with covering long distances.

We are now about to spend billions of dollars of public funds on developing the SST to move relatively few people across the world, but the federal research and development program for urban mass transportation is almost infinitesimal, even though urban mass transportation involves the movement of millions daily. And what about the slow development of steep and vertical rise aircraft which could possibly provide improved service for short distance inter-city travel, or perhaps even for daily journey trips from outer suburbs to the city core?

Research for a total transportation system also requires that we carefully review technological advances in one mode to see if they can be adopted to another. In the New York Metropolitan area, the Metropolitan Commuter Transportation Authority (MCTA) has begun an eight-month experiment with a gas turbine-propelled passenger car. At its suggestion, and for the first time, the aerospace industry joined with the traditional railroad supply industry in putting together this interesting demonstration project. Preliminary results have been encouraging.

The MCTA has also been urging the transportation industry to develop a dual-drive commuter car which would run efficiently and economically on both third rail and through its own turbine power.

If adequate funds were available and if there were a concerted and coordinated research effort, I cannot help but think that the advances in the aero-space industry could be of greater benefit to transportation in general. Are we really doing all that is possible to see, for example, if the "power package" of the space craft could be adapted to provide liquid fuel cells for the automobile or bus? Could fuel cells be used to achieve an economic and high performance battery-powered rail car?

By calling for a balance in the allocation of resources for research and development, I do not mean to deny funds for space or the SST. But if we are to achieve a total transportation system, those elements of transportation which have been too long ignored must begin to receive their fair share of investment in research and development.

An integrated approach to transportation also requires that we investigate the possibilities of integrating modes of transportation if not actually physically, at least from the point of view of services. The concept of transportation centers located at strategic points along say a commuter railroad where the benefits of express and local rail service, convenient auto and bus access and ample parking, along with shopping and other service facilities, could be combined needs additional experience through experimentation. Such a transportation hub might serve as a convenient interchange between rail, bus, air and private auto transportation.

Research wherein we could apply systems analysis to transportation seems promising and needed. For once we view all modes as members of a composite transportation system, the question becomes how best to assemble all parts into a system that provides the best over-all performance. Research is required to define the means for evaluating system performance.

This research need is becoming more and more critical. The public though not using the term, is beginning to question the cost-benefit ratio of various modes, and as of yet, we do not have an acceptable way of measuring it. As public awareness of the problem grows, and as public involvement in transportation planning and development is increased, it is even more essential that we develop criteria or measures of effectiveness.

Just what for example will be the long range cost-benefit ratio of funds devoted to supersonic aviation if it takes the air traveler as long to get from the airport to his office or home as it does to get across the ocean.

And what frankly is the cost-benefit ratio of the multi-billion dollar six lane, super highway in an urban area jammed during the journey to work hours—some four hours each weekday and lightly used the remaining twenty hours? This every day sight has highlighted the need for good highway utilization studies and more effective traffic control. At present, highways are poorly utilized because of a lack of adequate traffic control.

The shift in emphasis to a total rather than fragmental transportation system has highlighted the need for a balanced research and development policy in the technology of transportation and for a better means to evaluate the productivity of each mode within a transportation system.

THE SHIFT TO A MORE COMPREHENSIVE APPROACH TO TRANSPORTATION'S ROLE IN THE URBAN ENVIRONMENT

The second shift in emphasis springs from our recognition of the intricate relationship between transportation and the entire community—its land use, its livability and its economic and social health. This inter-relationship is especially felt in urban areas where the scarcity of land and the high population density make the impact of transportation even more acute.

In a metropolitan area, unlike rural areas where it is a relatively simple and uncomplicated matter, the taking of land for transportation facilities in densely populated areas can have a serious impact on the total life of the community. It can involve the destruction of homes, the reduction of the real property tax base, the isolation and deterioration of neighborhoods, and the threatening of historical and conservation values.

Urban society not only depends on transportation for its existence: it is shaped in major dimensions by transportation. The dispersal phenomenon has been made possible by transportation, but extended suburban development has in turn created many of our problems, frustrations and challenges of today.

That transportation will continue to mold metropolitan regions is obvious. But the question before us all is how will it mold the future of these regions. Will it help enhance urban living or will it cause strangulation and stagnation? Can we make transportation a positive ally in our efforts to create a better urban environment?

The shift to a more comprehensive approach to transportation's role in the urban environment requires that transportation decisions in the future be made on the basis of research indicating the effect a particular facility will have on such factors as public health and safety and elements of land use such as trends in industrial development and employment, new residential developments and aesthetics.

Historically, transportation facilities have not been established with sufficient regard for their impact on population distribution and land use. Conversely, land has been subdivided and whole communities built without analysis of the burdens they would create on existing transport or the pressure for costly new transportation facilities.

But now, thanks to modern methods of data gathering, statistical techniques and electonic data processing, we are able to make reasonably good projections on what the

future population and its distribution in a region will be, given certain sets of circumstances. We can estimate, for example, the travel which is likely to be generated by different densities of land occupancy—the single family dwelling, the high rise apartment, "the apartment city." On this basis, we can project needed transportation facilities.

Conversely, we can also know the capacity of the existing transportation systems and what can be done to add to their capacity. We can also judge the probable impact of improved new transportation facilities on land use.

In the New York Metropolitan Region, the Tri-State Transportation Commission is conducting a long-range transportation-land use research program.

Information on travel patterns of people, movement of goods and uses of land has been compiled. All of these facts are presently being fitted into a plan testing technique that will allow the Commission to take alternative land use and transportation plans—add them to the existing inventory of information—and simulate the impact which they would have if plans were actually implemented.

For illustration, we shall be able to demonstrate what is likely to happen if the region continues on the basis of its past unplanned sprawl. We can indicate what would be likely to occur if severe restrictions were put on the use of present open space and were reserved for greenbelts—or if New York City added to its skyscrapers or if such suburban and ex-urban centers like White Plains, Mineola, New Brunswick, Bridgeport and the like became "hyrise" with so called greenbelts in between—and of course various permutations on these themes.

Armed with this research information, policy makers should be able to make more intelligent and rational decisions than ever before possible.

A comprehensive approach to transportation also requires increased technological research on ways of lessening the impact of adverse effects of transportation. Low cost tunneling methods for example would greatly ameliorate the disruption caused by new transportation facilities. And the increasingly important necessity to reduce air pollution caused primarily by the automobile would also improve urban living.

The total cost-benefit ratio of an investment in transportation must be measured then not only in terms of its contribution to the total transportation system, but also in terms of its contribution to orderly urban development.

THE SHIFT TO A REGIONAL APPROACH

The urban transportation problem is essentially a regional problem. It has little regard for the traditional lines of political jurisdictions. It spreads across towns, cities, counties, and, in some cases, states.

In our urban areas, individual local units of government cannot control many of the basic causes of their transportation problems, nor are they equipped with all the legal and financial resources necessary to cope with these problems which spread beyond their boundaries.

The New York Metropolitan Region, for example, is essentially one unit from the point of view of the demand for and supply of transportation facilities.

But though united economically by this and other factors, the Region is divided by numerous governmental jurisdictions. It embraces parts of three states, 22 counties, and over 1,400 local governmental units, not to mention the federal government with its constitutionally mandated concern for interstate and foreign commerce.

If metropolitan areas are to meet successfully the difficult challenges they face now and in the future, there is really no alternative to a regional approach. The regional approach obviously means that research must be broader in scope, but it also means that if we are to effectively utilize the modern computer and systems analysis techniques, we have to develop a more uniform basis for data.

One of the immediate problems is to develop a uniform geographic reference system which is not based solely on the boundaries of political jursidictions.

In the New York Metropolitan Region, for example, the Tri-State Transportation Commission has found it useful to devise, jointly with the U. S. Bureau of the Census, a new system which gives all locations a coordinate designation—longitude and latitude or X and Y positions. While the old names are retained, they now have an identification telling where they are.

The regional nature of the transportation problem highlights the whole problem of data comparability among states and areas. This problem is in some degree handled by the statistics of the Census Bureau and other federal collection agencies. The $8 million program to improve transportation statistics originated by the U. S. Department of Commerce is expected to produce a degree of standardization of statistics which will be of great use to all. Although this program, now being carried forward by the new federal Department of Transportation, will concentrate on inter-city transportation, the methods utilized will hopefully also prove useful in gathering information on transportation within our large metropolitan regions.

More research work also needs to be done on specific elements of transportation such as tracing the movement of commodity goods and inter-city bus travel.

Better statistical data will greatly help the metropolitan regions of this country in their efforts to more effectively formulate future land use-transportation plans on a regional basis.

THE SHIFT TO INTERGOVERNMENTAL COOPERATION IN TRANSPORTATION

Given the regional nature of today's transportation problem, its solution requires a new order of intergovernmental cooperation. It requires a new definition of public responsibility and new intergovernmental machinery to cope with this responsibility.

Fortunately, this is taking place. For a new level and new dimensions of meaningful cooperation between the local, state and federal levels of government have been achieved—a level and dimensions that only a few years ago would have been improbable and fifteen years ago impossible.

A number of factors have been responsible for this shift. On the federal level, for example, Congress has taken action to require regional planning activity as a prerequisite for federal highway aid and also for monies granted by the Department of Housing and Urban Development. Congress has also enacted federal aid legislation to specifically assist in meeting the capital needs of urban mass transportation. The creation of the new Federal Department of Transportation is a recognition of the importance of developing a comprehensive transportation policy.

One of the most important reasons for the increased intergovernmental cooperation in transportation has been the development of positive state leadership in transportation. This state leadership was not born out of, nor has it resulted in, any desire or action on the part of the states to usurp municipal or local transportation responsibilities. Rather, state leadership has been based on the recognition that the states must play a vital role in helping to meet the regional transportation problem.

The states are in the logical position to provide leadership in bringing about regional, local, state and federal cooperation. They can serve as the instrument for the coordination of the aspirations of individual localities and for the necessary federal support and participation looking toward a comprehensive program for total regional development.

This new era of state assumption of responsibility, leadership and concern for transportation which has developed over the past seven years or so, has resulted in dramatic, in fact startling, changes in the types of government structures involved in transportation. These changes have been and will continue to be a response to a type of research that I have not yet mentioned—research which is not social, not economic, not technological, but essentially political.

For the states, in researching—in searching for—new mechanisms to cope with regional transportation problems have brought about a profound and dramatic restructuring of public transportation bodies. The states have, in fact, displayed a degree of innovation, flexibility and breadth that many thought them incapable of achieving.

Indicative of this surge in state action is the fact that state Departments of Transportation have become a subject of discussion and action throughout the nation. New Jersey has one; Hawaii and Wisconsin have similar arrangements; and the Governors of Connecticut and New York have called on the state legislatures to create one—to mention but a few examples.

But even more dramatic has been the willingness and ability of states to develop new intergovernmental machinery to cope with regional transportation problems. For the

Boston, Atlanta and Philadelphia metropolitan areas, to cite a few examples, the states have brought about new inter-local cooperative arrangements often enlisting federal support and participation.

In the New York Metropolitan Region, we have been fortunate in the foresight and leadership of our state leaders, Governor Rockefeller in New York, Governor Hughes in New Jersey and Governor Dempsey in Connecticut, who five years ago established the Tri-State Transportation planning program.

The Tri-State Transportation Commission, charged with long-range transportation-land use planning for the entire 3 state, 22 county Region, represents a unique partnership of local, state and federal agencies. The members of the Commission are the very persons who have policy and operational responsibilities at the federal, state and local level, and the work of the Commission is financed with state and federal funds.

And now, there are in the three states, regional transportation operating agencies which have the power to implement the recommendations of the Tri-State Transportation Commission—the New York Metropolitan Commuter Transportation Authority, the Connecticut Transportation Authority and the New Jersey Department of Transportation, with its Commuter Service Agency.

As a next step, Governor Rockefeller has recommended a new program for the coordination of prime transportation agencies within the New York State portion of the New York Metropolitan Region. This would involve making the MCTA board responsible for unified regional policy direction and control by its assumption of responsibility for the activities of the New York City Transit Authority and the Triborough Bridge and Tunnel Authority.

In addition, Governor Rockefeller has also recommended a massive Transportation Capital Facilities Bond Issue in an amount sufficient to meet, on a balanced basis, transportation needs throughout the state.

I believe that these actions illustrate the sweep of the new state leadership in transportation. They represent the type of action which other states will, in all likelihood, take in the years to come.

The developing and increasing concern of the states for improving transportation and their willingness to develop new structures to cope with the problems bodes well for the future.

If new structures are to be effective, they must assure that planning for transportation, research on transportation, and the operation of transportation facilities are all closely related.

Unless planning and research take cognizance of actual operating conditions and problems, the potential contribution that sound planning and research can make towards improved transportation will not be realized. Conversely, unless those responsible for operations are receptive to the findings of the researchers and planners, the possibility of improving transportation services will be greatly minimized.

The Tri-State Transportation Commission is an example of an intergovernmental structure which links planning, research and operations. The functions of the Commission itself are planning and research, but its members are the very persons who have policy and operational responsibilities at the various levels of government. This structure thus provides for close relationship between those who are conducting the research and developing the plans and those responsible for utilizing the research and implementing the plans.

A true partnership of the three levels of government—state, local and federal—is essential for the achievement of a truly total, comprehensive and regional transportation policy. This, combined with the best efforts of the transportation industry itself, is the key to supplying the momentum needed to solve the metropolitan transportation problem.

Experienced research organizations such as the National Academy of Sciences and its Highway Research Board can be of great assistance to public transportation agencies. The collaboration of the states and the federal government through the Highway Research Board is an outstanding example of the pooling and exchange of research that has helped to make the American highway system an example for the entire world.

I am hopeful that a comparable, comprehensive effort on the urban mass transportation problem will hasten the time when we can point to equally visible results and take equal pride in accomplishment.

Shifting Emphasis in Transportation and Its Implications for Research

A. SCHEFFER LANG, Federal Railroad Administrator, U. S. Department of Transportation

•LET me state at the outset that I don't know whether transportation itself is changing in any significant way, but I am convinced that our view of transportation is changing. I think that we are now beginning to view transportation explicitly as a system phenomenon.

I mean more, here, than transportation as a physical system in itself. I mean transportation as an activity which is not only highly articulated as between its components, but is also highly interactive with its economic, physical, social, and overall institutional environment.

And I emphasize the word "explicity." We have always understood that these interactions were critical; but we have never before been so determined to reflect them explicity—even quantitatively—in our decisions on all transportation matters. We want an understanding, that is, which is both explicit and "operational."

We have always been acutely aware of the role which transportation plays in social and economic development. The policies at all levels of government have reflected this awareness.

We have, perhaps, been less aware of the role which transportation plays in our physical environment—but that awareness is now growing by leaps and bounds.

What seems different now is that we are no longer satisfied with a mere awareness and recognition of these interactions. We are determined to be very explicit about the nature of these interactions and to find ways to manipulate them rationally for the common good. And we don't want to describe and work with just some of these interactions. We want to deal with all of them simultaneously.

Perhaps this is just because as our society grows larger and more complex we can no longer afford the luxury of partial solutions. Perhaps it is because the tools of analysis and the techniques of decision-making we now have or can envision make this explication of subtle complexity so much more manageable. Or perhaps it is because we have become increasingly impatient with our past mistakes.

Whatever the reason for this emerging view of transportation as an explicit "system" phenomenon, it is with us, and we are working harder every day to come to terms with it! I think its implications for research are substantial.

First and foremost, because this view emphasizes the explicit understanding and description of complex system phenomena, research has become an unavoidable imperative. Research is the business of developing explicit understanding! (Admittedly, this may be a chicken-and-egg proposition. Research has come to play an increasing role in every area of activity, not just transportation. Perhaps we are now determined to develop more explicit understanding of transportation as a system phenomena just because we are committed to research in general. But I think it is more than that.)

Second, because this view is a "system" view, the research it dictates focuses relatively less on existing technology, techniques, and institutions and more on the "holes" between them, less on evolution and more on broad innovations—than has been usual with previous research.

Third, because this emerging view is one which emphasizes understanding as a means for facilitating systematized decision-making, our research is being structured

Paper sponsored by Special Committee on Long Range Planning and presented at the 46th Annual Meeting.

by a concept of new institutional arrangements for dealing with transportation problems.

I say, in fact, that just as we are trying to "systematize" our physical transportation activities with new hardware and more sophisticated operating techniques, so are we also trying to "systematize" our institutions that deal with transportation. We are trying to develop, in short, better ways for them to interact with each other in their respective decision-making roles—and where necessary we are ready to build new institutions to bridge the gaps between our present ones.

What do I mean by "institutions," here? I mean:

1. Private companies that own or operate transportation facilities.
2. Federal, state, and local governments: (a) as regulators or promoters, and (b) as planners, investors, or operators.
3. Users of transportation—public or private.
4. Non-users of transportation who are in some way affected directly by it.
5. Universities and other research institutions.

These institutions all interact in complicated and important ways; and it is this set of interactions which give transportation its "system" character every bit as much as the interactions between rail and truck, transit and auto, or urban and inter-city transportation operations. And, because we are now trying to be explicit about these institutional interactions, not just about the more obvious physical ones, we are changing the character of the total set. This, in turn will change the environment for research and will, I think give it a changing focus.

So our push toward an explicit and operational understanding of transportation as a system is having three effects on research.

First, it is making research more important. Second, it is giving research a more innovative and less evolutionary character. Third, it is causing research to respond to and live within a more complex and "systematized" institutional framework.

Let me try to give you some examples of what I mean. Take first the approach that more and more freight-hauling transportation companies are taking to the interaction between their operations and those of their customers. They have come to realize there is "system" here—and more and more they are studying this "system" in depth. To an academic, much of this study might not seem to be research, because the techniques are not sophisticated. But looked at in context, these companies are doing research, and it is on problems they really did not know were there before.

Look also at work being done on such subjects as the effect of public transportation service on the locational decisions of households. We want to be explicit about this interaction; and it is important enough to warrant research where even a few years ago it would have seemed unlikely.

So we are doing more research!

Look, then, at the kind of research being done under our High Speed Ground Transportation Program at the Department of Commerce. There we are supporting technological research that is focused less on the evolution and improvement of present transportation technology and more on identifying technology that does not exist. We are probing the "holes" in our present hardware spectrum. We are looking for ways to bridge the capability gaps and to stimulate the developments of a more fully articulated total transportation capability.

Or look at the program of urban transportation research contemplated by the 1966 amendments to the Urban Mass Transportation Act of 1964, amendments introduced and successfully championed by Congressman Reuss. This program, again, focuses on broad innovations in urban systems, innovations that can serve new combinations within the complex structure of urban needs, innovations which can better articulate our transportation with its physical and social environments, not merely with its economic imperatives.

So we are doing different research!

Finally, look at the kind of research we are trying to do in the context of our Northeast Corridor Transportation Systems Planning Study at the Department of Commerce. We are trying there to develop techniques that can support and make more explicit the

choice between alternative long-range investments that must be made by a literal host of institutions in the region: the Federal Government, state and local governments, and—equally important—private transportation companies. While we really are trying to come out with a usable analysis, this project is fundamentally research; for we are trying to learn, here, how to articulate better a multi-institution decision process. We look for this process itself to become more and more "systematized" (as I have used that word), and this means we must put our work in a somewhat new and different context.

And what we are doing is in the large very similar to what the Tri-State Transportation Agency is working on, an agency for whose efforts Dr. Ronan has been so largely responsible. They too are attempting to develop ways to articulate a far more complex transportation decision-making process than anyone has dealt with before—and to do this within an institutional working environment which is also new!

So we are doing research in a more complex, a more "systematized" institutional environment!

I made a special point earlier about our general attempts to put more "system" in those institutions which are collectively involved with transportation. You know, we have an example of that process right here in our midst; for never has there been more interest in broadening the view of the Highway Research Board to include not just highway problems, but those of all forms of transportation. This question has, in fact, occupied much of the attention of the very committee which is sponsoring this session here this morning.

And we have another example of the process of institutional systematization right here in town; the impending creation of the Department of Transportation. The legislative history of that development, moreover, says some pretty clear things about research: there needs to be more of it; it needs to focus more on the holes in our transportation capability and transportation institutions; and it needs to work within a more highly structured decision-making environment.

Now, you "systems types" in the audience may conclude that all I have said is that we need more "systems research." Don't stop there! This new determination to identify the system in transportation in explicit, operational terms means much more than that.

I urge you to think about it.

Discussion

WILLIAM J. RONAN: The more I live with this problem, the more I am convinced that there must be a very close working relationship between those engaged in research, those who are doing the planning, and those who are trying to implement the plans.

The feedback one gets when trying to put something into operation can cast a very different light on research and planning. It certainly can cast a different light on priorities in research and planning.

In the New York Metropolitan Area a few years ago, to cite one illustration, many researchers and planners had really consigned the Long Island Rail Road into oblivion. They viewed it as a rusting piece of rail. Some of its right-of-way, they said, ought to be used for highways; some of the facilities close to the city ought to be taken over by the subways; and, they were not quite sure what to do with the rest.

Viewed from an operating point of view, however, the feedback was quite different. Some of the facilities were in fact adequate; the right-of-way did exist. But above all the over-riding consideration from an operating point of view was what other means of transportation could be provided for the railroad's 260,000 daily passengers. With this operating consideration in mind, the suggestion of some researchers and planners that the railroad's right-of-way be used for highways became a practical impossibility. Even if it were possible to provide parking space in Manhattan for Long Island Rail Road commuters, the construction of highways to accommodate those using the Long

Island Rail Road, and the disruption to the communities of Long Island caused by such massive highway construction, would have been incredible—in fact unthinkable.

The research and planning effort, then, has to be closely related to operations. There is a danger, particularly in considering concepts such as new systems, that the research and planning efforts will become too far removed or divorced from the actual operating problems including economic factors such as the cost of operating a service.

I am all for the exploration of new systems, but if such research is done in a vacuum, without regard to how or whether it can be applied to an actual operating situation, it runs the danger of becoming solely an academic exercise.

JOHN C. KOHL—Executive Secretary, Division of Engineering, National Research Council: I think this point that Dr. Ronan has just made is a critical issue in the whole research effort. Mr. Lang referred to the present emphasis in transportation bringing about more research, but unless this research, as Dr. Ronan has so aptly phrased it, is carefully integrated with the planning and with the implementing of the plans, most of it I fear will lead to frustration rather than to constructive results. I think there is a tendency on the part of many, not only in the research field but in the planning field, to assume that they also will make the decisions. But the political structure within which we operate today is not of that order. The political decisions result from the interpretation which is placed upon the results of research and upon plans and not upon the decisions of the researchers or the planners themselves. This in itself is an area—this feedback, this relationship—in which there is much more to be learned.

MARVIN L. MANHEIM—Massachusetts Institute of Technology: I am a little bit perturbed by the trend of discussion here. The basic premise certainly is valid: over a relatively short period of time, we have seen a rapid flow of ideas from the research community to the institutional establishment, with research results being used for analysis of policy issues. One consequence of this, as you clearly point out, is that we have had to become a little bit concerned over the relative roles of the decision-maker and of the researcher who provides him with information for decisions. But there is a deeper, more fundamental problem which the panel has not yet addressed: do we have enough research "capital?" True, there is a certain body of research results ready to be tapped and brought to bear on policy issues. In urban transportation particularly, we can expect fairly rapid transference of a lot of technology—both hardware and software—and analysis techniques from, for example, the aerospace industry. However, the depth of our knowledge is really fairly shallow, in terms of a basic understanding of transportation technology and of the interactions between transportation and the socioeconomic system. While it may be true that at present we can tap a certain body of knowledge for research results which bear on public policy issues, are we not very much in danger of rapidly exhausting our intellectual capital? Don't we need to strengthen our "basic" research in these areas, so that the pipeline from the research community to the institutional decision-makers doesn't dry up five or seven years from now?

A. SCHEFFER LANG: I do not see how anyone can argue with what I think was a bit more of a position statement than a question: namely, that we have to strengthen our basic research efforts in both the hard and soft sciences. Otherwise, if we were merely to increase the rate at which we exploited our present knowledge and capability, we may find ourselves running out of gas in a few years.

I think, for instance, everyone would agree that those who are interested in and capable of doing research on some of the very fundamental questions in transportation face a special problem with regard to data. In particular, if these people are to get into some of the social science questions (which I think on the whole have been more neglected than the physical science questions in transportation), they have to have a lot more to work with in the way of data than they have today. Now, this is a chicken-and-egg proposition. There have been relatively few people from the social sciences involved in some of the basic areas wherein we still have so much to learn if we are not to "run out of gas" in the next few years. One might say that fundamental lack of

data which describe the phenomena with which we are dealing may have not been overcome because there were so few to tell us what data were needed. Or you can look at it the other way around and say that the people were not there because they could not get the data which they needed to work with. Whichever happens to be the case, I think that this problem has become fairly clear now to a great many people.

This is the kind of area in which we ought to concentrate a great deal more of our attention than we are today. Collecting the basic data which researchers need if they are to build a solid base under what we want to do in the years ahead is a critical but typical problem.

WILLIAM J. RONAN: I would agree. Unfortunately, while there has been a lot of research—a lot of reports in libraries and so on—a review of it shows that much of it is worthless.

When one looks for this kind of research talent, one is appalled by the lack of talent that is available for this purpose.

This poses an interesting question to those of us who find ourselves in the operating and planning functions. How are we going to stimulate the kind of research that is needed? What can we do about the problem? We begin talking to university people—that is usually a slow process—but the problem usually gets thrown right back at us.

What should we do about stimulating research? The last thing that I think public bodies charged with providing transportation services have been created to do, is to establish a substantial research organization within their own organization. (I am talking about the operating side now.)

I think you have raised a crucial point. I think that as a matter of public policy, we are going to have to try to encourage some of those with the best minds that are being trained in the social and physical sciences to devote their attention to transportation. Otherwise, we are just not going to have the backup knowledge we need.

JOHN C. KOHL: I believe Professor Manheim refers also to the situation that certainly pervades Washington now where the emphasis is on applied research solving today's or yesterday's specific problems rather than making funds available for some of the free-wheeling investigation taking off into the blue without a specific direction at the time the thought is initiated. It is this that I think is in danger of being depleted—this new concept—new thought that is in danger of drying up at this stage with the present popular emphasis upon more research to solve yesterday's problems.

JOHN WALKER—Albuquerque Metropolitan Transportation Planning Department: In speaking from a technician's point of view, one thing that disturbs me today is the apparent trend, at least in the business of transportation studies, of losing good technicians to administrative roles, while at the same time not replacing these people.

WILLIAM J. RONAN: I think we do tend to involve technicians in on-going programs and to make administrators of them. There is a great danger in this in that we stifle a talent that should be developed. More talent in technical areas is needed. I think we need to be sure that in setting plans and implementing them, we develop an ever-continuing pipeline of technical talent.

I think it is inevitable, however, given the very limited group of competent people in the technical field, that some will become involved in administration. If you look at industry, you will find, interestingly enough, that a research director of the corporation became the Executive Vice President and, a few I could mention, are Chairman of the Board by virtue of the fact of having been in research. Being familiar with the techniques of research, they develop authority with respect to what they say. They have capacity to judge what comes before them in terms of the technical processes. The unsophisticated person would find this more difficult. I would look for no dilution of the using of technicians to become administrators. Therefore, new talent must be developed.

LADIS H. CSANYI—Iowa State University: Mr. Lang spoke of institutional relationships, Dr. Ronan discussed the implementation of new concepts developed. So far no one has mentioned what research is being conducted to determine the reaction and acceptance of the plans by the public who after all must foot the bill and live with them. All the research and planning discussed will be for naught if the public will not accept nor abide by them. Has any research been done and coordinated with present research and planning to determine public attitudes to the cost and character of the plans?

A. SCHEFFER LANG: Certainly in some of my own work on the interaction between different forms of transportation it has become clear that the researcher and many of those responsible for designing and operating transportation systems have a different view of what transportation is about than do their customers, particularly when that customer is an individual traveler in an automobile. Of course, this is an area wherein the need for research is quite general and not unique to transportation. Nonetheless, we have to develop a better awareness on the part of people who are users of transportation (regardless of whether they are individuals, corporations, or whatever) of what transportation means to them. And we have to find ways to communicate this awareness to researchers and designers, as well.