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Foreword

Over the years, transportation planning at the state level has undergone significant changes in emphasis, planning processes, and organizational structure. For many years, highway planning was conducted in relative isolation from other modes. Even during that period, there were major changes in planning requirements and approaches as states shifted from an emphasis on state road construction to the concentrated and extensive requirements associated with the planning and development of the national Interstate highway system begun in the mid-1950s and now essentially completed. Transportation needs and planning approaches for urban areas were also changing, with greater emphasis being given to cooperative efforts by state highway agencies and local governments.

Since that time, during a period beginning in the late 1960s, the federal government and the states have recognized the need for improved multimodal planning and changed their organizational structures and procedures accordingly. Highway departments have become departments of transportation, and these new agencies have given greater attention to the relationships among the modes while planning new facilities. When the U.S. Department of Transportation was created in 1967, only three states had transportation departments. Today there are 44. Significant accomplishments have been registered by these state departments of transportation. They have developed and implemented plans in the areas of rail and aviation, prepared unified transit programs, examined environmental and land use aspects of alternative transportation policies, and continued to improve highway planning and programming methods.

Looking to the future, transportation planning at the state level must continue to adapt to changing transportation requirements. Although future requirements are not easy to predict, there are several national efforts under way specifically aimed toward that objective. The 2020 Transportation Consensus Program, initiated by the American Association of State Highway and Transportation Officials (AASHTO) and a number of other organizations, is attempting to determine the nation's surface transportation requirements over the next several decades. The Transportation Research Board (TRB) conducted a conference on June 22–24, 1988, as part of the 2020 effort, to determine the potential impacts on the nation's future surface transportation system of such factors as changes in demographics, life style, urbanization, new technologies, and energy demands. Other "futures" conferences and activities are being held by various national organizations and agencies.

AASHTO's Standing Committee on Planning asked TRB to review the results of the various efforts currently under way in the 2020 Transportation Consensus Program and to conduct a conference to help states assess the implications for statewide transportation planning. This conference was cosponsored by AASHTO, the Federal Highway Administration (FHWA), the Urban Mass Transportation Administration (UMTA), and the Massachusetts Department of Public Works. The conference was held May 14–17, 1989, in Boston, Massachusetts.

The results of the conference suggest that we may be facing a new "3C" planning process in the 1990s. This new process is one in which transportation planners need to be creative in a credible way and to be able to communicate effectively with decision makers. Creativity, credibility, and communication—these will be the challenges of transportation planning as we head into the 21st century.

Contents in this Record include papers by both current and former chief executive officers of state departments of transportation giving observations concerning planning and its role in the decision-making process. Also included are presentations on the state of the practice, consumer/user group reactions on the effectiveness of transportation planning, future directions and issues that will face state transportation planning, the future of transportation technology and its implications, and, finally, most important discussions concerning the staffing needs (for engineers and planners) at the state level.

Future of Statewide Transportation Planning: Overview

MICHAEL D. MEYER

For the past several years, most major national transportation agencies and associations have been actively seeking to identify future directions for, and desired characteristics of, a national transportation program. Motivated in part by the completion of the Interstate highway program and the beginnings of the date of "What comes next?" that occurred during the passage of the 1987 Surface Transportation Assistance Act, these groups have begun to lay the groundwork for the next federal transportation program that will be defined by Congress in the early 1990s. Many of these organizations have joined in the 2020 Transportation Consensus Program to agree upon a set of principles and policy characteristics that will be considered seriously in the development of this program. As part of this effort, numerous "futures" efforts have been undertaken to identify the likely characteristics of the future, those relating to economic conditions, technology, demographic changes, institutional arrangements, and environmental concerns, among others. The TRB Committee on Statewide Multimodal Planning felt that given the level of interest and amount of effort relating to the future of transportation, it would be timely to hold a conference on how statewide transportation planning should respond to and guide considerations of transportation's role in the future of our country. This Record includes the presentations made at the conference and a summary of key findings.

More than 100 people attended the conference. Special efforts were made to attract representatives of "consumers" of the information produced by state transportation planners. Such participants included current and former directors of state transportation agencies, a state legislator, a vice president for logistics of a major U.S. corporation, regional and local planning officials, and representatives of other government agencies. The conference was cosponsored by the American Association of State Highway and Transportation Officials (AASHTO) and was held concurrently with the annual meeting of its Standing Committee on Planning. Therefore, many state directors of transportation planning also participated in the conference. There was also representation from universities and consulting firms. In sum, the conference registrants represented the key groups participating in state transportation planning and the consumers of the resulting information.

The conference was organized to emphasize several aspects of statewide multimodal transportation planning. The general conference strategy was to have about 2 hours of panel or formal presentations followed by smaller discussion groups. This gave participants the opportunity to highlight what they

thought were key issues or to disagree with the observations and conclusions made by the speakers. The panels and presentations focused on several issues:

- How is state transportation planning viewed by agency directors?
- What conclusions can be drawn from the futures work under way and how do they affect state transportation planning?
- What do the consumers of transportation planning think about the planning process and the resulting process?
- What are examples of good statewide multimodal planning practice?
- What are the likely key issues and challenges for statewide multimodal transportation planning?
- What impact will future technological change have on transportation and thus on transportation planning?
- How will professional and human resource needs affect the ability of state transportation planners to do their job?

The results of participant deliberations on these issues are found in this Record. However, several key concepts emerged from the conference discussions that nicely summarize the challenges facing statewide multimodal transportation planning. These concepts are discussed in the following paragraphs.

The most important concept was *vision*. There was a sense that instead of relying on expertise and the planning process as had been done in the past, plan recommendations and the plans themselves really need, in the future, to grab the imagination of the decision maker. One participant stated that the 1982 five-cent gasoline tax increase was "sold" on the basis of potholes (i.e., infrastructure deterioration) and that it was not likely that future legislation could be similarly packaged. There needs to be a vision, some concept to justify to decision makers the level of expenditures requested. One conference participant suggested that the positive benefit of transportation investment on economic development might be one such concept.

The second key issue is *credibility*. One participant mentioned that the primary purpose of planning is to advise. If, in fact, planning is the provision of information to decision makers, then that information needs to be credible. Lowell Jackson provided a good illustration of this concept. As he stated during his presentation, when he first became Secretary of Transportation in Wisconsin he went to a legislative appropriations committee requesting additional funds for highway construction. The committee asked him to justify the request. He responded that the highway program was needed to enhance and maintain economic development. Their response was, "Prove it." In other words, the committee did not view as

credible his justification for the program expenditures. Similarly, one state department of transportation representative discussed the danger of overestimating program needs and the credibility problems that result when such expenditures are not likely to be forthcoming politically. In this case, the state official concluded that because the state legislature considered the needs estimate to be unrealistic, it questioned the viability of the entire state transportation program.

The third issue is *management*. The term "management" was used throughout the conference in discussing the management of the physical transportation system, the institutional system, the administrative system, and the planning system (including the sources of data). With regard to the physical system, the conference discussed such things as incident management, access control, corridor conservation and preservation, and high-tech corridor management. Many of these techniques have been discussed for many years in the transportation profession. There was general agreement that more attention was needed to bring those responsible for operations, traffic engineering, and maintenance together with planning officials so that a coordinated comprehensive approach to the transportation systems could be developed. In particular, given the tremendous problems of urban congestion, joining planning and traffic engineering more closely seems like a useful thing to do.

Management of the institutional system is critical to a successful implementation of the programs that emerge from statewide multimodal transportation planning. Institutional issues seemed to be one of the important issues continually discussed at the conference. One discussion group, for example, suggested that there needs to be an examination of how to forge (or force) a process of cooperation between the different governments and sectors. One participant, representing a local government, said that if you cannot lead or do not want to lead, then get out of the way because there will be a lot of other people trying to get things done. The message to state agencies seemed to be: do not become a barrier to progress.

Administrative management was discussed mainly as strategies for "working smarter." Executive management information systems, vehicle location and monitoring, and other technological innovations will likely make our jobs easier than they have been in the past. The challenge, however, is to identify the most appropriate use of this technology and let it work for us rather than the other way around. The discussion on administrative management also included management of the planning system, most often data base management. Geographic Information Systems (GISs) were identified as one of the technology applications that will help a great deal in this regard. One of the interesting questions with regard to GIS relates to the institutional issues discussed before. Will the need to combine the data bases from many different agencies force a greater amount of cooperation over time?

The fourth major issue is multimodal planning. Several states made presentations at the conference on their attempts at corridor-level multimodal transportation planning. One discussion group concluded that it was much easier to plan for multiple modes than it was to plan multimodally. The major issue is how to identify the tradeoffs between the modes. Such a question could be a very interesting research question.

The fifth issue is the land use/transportation relationship. Whether defined as economic development or something as simple as trip generation, the land use/transportation rela-

tionship is fundamental to the transportation planning process. For many years, those transportation planners involved in air quality and transportation planning have been exposed to the term "consistency," which is the determination of how consistent the transportation plans are with air quality goals. There was general agreement that in the 1990s transportation planners might be exposed to another "C" word, "concurrency," which requires that transportation infrastructure be in place before land use is allowed to be developed. Such a process is now in place in Florida, and conference participants felt that other parts of the country would see something similar.

The sixth issue was not discussed in great detail, and as one discussion group noted, the fact that it was not makes it an important issue. The issue was how transportation relates to the environment. It seemed to many participants that the 1990s will see greater emphasis on environmental quality. In particular, air quality and transportation's role in air pollution will likely receive greater attention.

The next issue was communication. Transportation planners have been greatly interested in communication with the general public. Conference participants felt that transportation planners have often done a poor job communicating with decision makers and other key constituency groups. To have some impact on the outcome of the decision-making process, planners need to communicate effectively with these groups.

The eighth issue was personnel or professional needs. An effective institutional structure and strong technological support are useless without the right people. One session was devoted to this subject and there was a general consensus that educating transportation planners and engineers, and providing opportunities for continuing education for those already in the profession, will be an important challenge to the profession in the 1990s. At the state level in particular there are many obstacles to finding well-trained planning professionals.

The final issue was technology and the role it will play in the future of transportation. There was some concern expressed that the transportation profession could suffer a credibility gap if it "oversells" the potential of technology. Most participants agreed that in-vehicle navigation and control are going to be a very important contribution to a more effective transportation system. There was some caution, however, about what could realistically be expected from the road system technology (the "smart" highway), at least in the near future. We need more research both on the technology side, but also on how this technology relates to institutional structure, economics, society, etc. One participant concluded that the profession seems to be "stuck" between the great leaps in transportation technology. The internal combustion engine revolutionized transportation over the past 80 years and we are now waiting to see what the next technology will bring. The participant suggested that we continually redefine the important issues facing transportation, but that the underlying issues stay the same. It was suggested, however, that another explanation for the sense of being "stuck" was the very nature of planning. Planners always like to think that planning comes first, followed by decisions. As we know, however, policy comes first and is defined on the basis of a common understanding of technology and the existing characteristics of society. Given the rapid change in society, in particular the information processing aspect of our work, it is not surprising that there are many questions on what we should be doing as a society.

It was interesting that two chief executive officers used the term "policy planning" in describing their planning processes. In one case, the distinction was made between policy planning, system planning, program planning, and project planning. Perhaps this distinction between policy planning and system planning that at least seems to be made by agency directors is one reason for a feeling of frustration on the part of planners.

In summary, the results of this conference suggest that we may be facing a new "3C" planning process in the 1990's. This new process is one in which transportation planners need to be Creative in a Credible way, and be able to Communicate effectively to decision makers. Creativity, credibility, and communication: This will be the challenge of transportation planning as we head into the twenty-first century.

Defining the Future: Transportation Challenges for the Twenty-First Century

LESTER A. HOEL

My task is to provide a brief summary of the key characteristics of the future as outlined in some of the recent studies and reports that seek to define where we are, where we are going, and how we should get there.

The process that has been used to develop plans and proposals for the future of U.S. transportation comprises three distinct steps. The first deals with determining trends in our society that will influence the travel requirements of the nation; the second seeks to understand and define the nature of transportation problems as seen by the users and providers of the system; and the third attempts to formulate a program of transportation improvements that responds to these societal changes and needs.

In this paper I attempt to summarize key elements of what has been said in each of these three areas, as they are intertwined in our effort to define the future. We must know what the trends are, be aware of the shortfalls that exist in our present systems, and then decide what to do about it.

Let me illustrate with an example. The fact that our population is aging is accepted as true because we can accurately forecast demographic trends. Our surveys also indicate that many seniors drive and that the numbers are on the increase, but traffic signs, markings, and the like are not designed for them. As users of the highway they are at greater risk than others. There are many possible alternatives, and the ultimate outcome will depend on our ability to define and implement those that are feasible and cost effective.

TRENDS

To begin, let us look at the future from the viewpoint of trends in society that will influence travel requirements for the next 30 years. I would recommend three reports that contain considerable documentation and analysis of the most relevant characteristics that help to define our nation in the future. These are TRB *Special Report 220: A Look Ahead: Year 2020 (1)*; FHWA Interim Report *America's Challenge for Highway Transportation in the 21st Century (2)*; and American Public Transit Association (APTA) Interim Summary Report *Transit 2000 (3)*. Let us review some findings of these reports.

The TRB report examined future trends in terms of economic growth and vitality, demographics and lifestyle, energy and environment, patterns of future development, commer-

cial freight transportation, personal mobility, new technology and communications, and resources and institutional arrangements.

The FHWA Interim Report identified five key variables that affect future highway activity. These are demographic and economic forces, energy, technology, and the environment.

The APTA report identified the most significant of the forces and factors that will influence the transit environment to be congestion and auto dominance, suburban growth and development, threats to the environment, and threats to energy independence.

A careful reading of these reports shows a considerable amount of overlap and duplication, which I would interpret as agreement regarding some basic emerging trends. We do appear to be "singing from the same hymnbook" as far as what we think future demands may look like. What we do about it is, of course, another matter. To avoid saying the same things over and over, I have selected several of the key issues and summarized these from one or another report.

Demographic and Economic Forces

The FHWA report (2, p. 19) states:

Demographic and economic forces will play a primary role in shaping transportation demand over the next 30 years. Although population growth will continue to be slow, total population will still increase by 47 million persons between 1990 and 2020, an increase of nearly 20 percent. While this is roughly one-half the percentage increase in population that occurred over the past 30 years, population increase will continue to be an important, though declining, source of transportation demand through the year 2020.

More important than changes in total population will be changes in the characteristics of the population. Of particular importance will be the maturation of the baby-boom generation. The baby-boom generation will be middle aged in the 1990s, providing an experienced and productive labor force to stimulate economic growth. At the same time, the cohort following the baby-boom generation will be significantly smaller in number, creating the potential for severe labor shortages in entry-level age categories. Lack of growth in the younger age categories and the accompanying slowdown in creation of new households can be expected to influence consumer expenditure patterns, with the strong potential for slower growth in expenditures for housing and durable goods, such as automobiles.

Interregional migration and changing urban settlement patterns will also exert important influences on future transportation demand. The West and the South will continue to be the growth leaders, attracting population from other regions

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and from outside the United States, though regional growth disparities are expected to gradually diminish over the next three decades. Concentration of growth in the largest metropolitan areas is expected to continue, and an increasing number of suburb-to-suburb trips, center city-to-suburb trips, and intrasuburban trips are likely to characterize the future pattern of travel within metropolitan areas. The density of suburban residential development is likely to increase as apartments and townhouses account for a rising share of new housing construction in response to higher land and energy costs and declining average household size.

The trend toward increased globalization of all domestic economies is most likely to continue into the foreseeable future. This trend may affect the total demand for freight transportation, and it will certainly alter the pattern of commodity movements that formerly moved between domestic origins and destinations and now move across the international border. The newly industrialized countries, or the countries of the third world, may become an increasingly important market for U.S. consumer goods in the 21st Century. Globalization of the economy has also fostered international movements of passengers for business and personal travel. The impact of such travel is generally not noticed beyond border areas, but is growing in importance to transportation and economic development planners.

Energy

According to FHWA (2, p. 24),

Forecasts by the Department of Energy and others reflect a general agreement that the transportation sector's consumption of energy will continue to grow throughout the remainder of this century, and into the next, though growth rates are likely to be lower than those experienced in the past. Improvements in fuel efficiency are expected to largely offset increases in travel demand.

Although improvements in fuel efficiency have made an important contribution to energy conservation in transportation, the overwhelming reliance on petroleum for meeting the demands of the transportation sector is expected to continue into the foreseeable future. As pointed out in a recent report by the U.S. Department of Energy (4),

Pushing fuel economy farther and faster could help (reduce transportation's demand for oil), but not much. None of the efficiency improvements envisioned would affect the continuing 97 percent dependence of the transportation sector on oil-based fuels, factors that affect the future supply and demand for petroleum will be important determinants of the future price and availability of personal and commercial transportation services.

Environment

The FHWA report (2, p. 32) notes:

As a major consumer of petroleum, the motor vehicle, or, more specifically, the gasoline-powered internal combustion engine, is a major contributor to urban air pollution problems. This knowledge, and growing concern about the degradation of air quality in urban areas, has resulted in a succession of federal laws designed to limit air pollution from motor vehicle sources. The Clean Air Act Amendments of 1970 and 1977 shaped major national programs designed to control stationary and mobile sources of air pollution. These programs included requirements for the development of emission control devices that dramatically altered the emission characteristics of motor vehicles, and requirements for development of plans by the

states to assure the attainment of National Ambient Air Quality Standards.

Over the past several years, public demands and government regulations have spurred the development of much less polluting automobiles than were previously produced. In 1970, the average car emitted 85 grams of carbon monoxide per mile, compared to the current level of about 30 grams per mile. Carbon monoxide emissions are expected to drop another 50 percent by 2000. Efforts to improve the fuel efficiency of automobiles have contributed to a substantial reduction in the average fuel consumption per mile of travel, although much of the efficiency-related reduction in fuel consumption has been offset by increases in travel. Efforts to shift automobiles from petroleum consumption to consumption of alternative fuels have also been promoted as a means of reducing air pollution, although the least-polluting method of producing methanol, the most viable of the fuel alternatives, results in emissions of "greenhouse" gases that are comparable to gasoline combustion.

Life on earth is dependent upon a variety of atmospheric gases, such as carbon dioxide, nitrous oxide, chlorofluorocarbons, methane, and ozone. These gases are critical to the earth's climate because they trap infrared radiation reflected from the earth's climate surface, thereby raising the temperature of the planet. Because the clear atmospheric gases permit radiant light to pass through, while trapping the reflected heat in a manner similar to the glass panes of a greenhouse, these gases are commonly referred to as "greenhouse" gases. The warming effect they have on the earth's climate is called the "greenhouse effect."

Since the time of the industrial revolution, when the world's economies began to base their prosperity on the burning of fossil fuels, and settlement of forest lands and prairies began to remove the plant life that was part of a natural cycle of carbon absorption, the waste products produced by the burning of fossil fuels have produced a dramatic increase in the volume of greenhouse gases. Atmospheric scientists and climatologists are convinced that the volume of greenhouse gases will continue to rise during the next century, and will result in a worldwide increase of from 4 to 15 degrees Fahrenheit, unless immediate steps are taken to conserve energy, develop alternative fuels that do not contribute to the greenhouse effect, and reestablish forest cover. Many experts feel, however, that there is a low probability that these remedial measures will be undertaken in time, or to a sufficient degree, to forestall the greenhouse effect. Many believe that even if Draconian measures are taken to reduce the volume of greenhouse gases, the best that they can do is to delay global warming, and, perhaps, keep the temperature rise at the low end of the range of possibilities.

Congestion and Auto Dominance

The APTA *Transit 2000* (3, p. 13) report agrees with others regarding trends in auto usage, stating:

No doubt exists that the private automobile will remain the central means of mobility in the coming years. Doubt does exist however, over whether or not the current level of reliance on single-occupancy, private vehicle use can or should be sustained indefinitely, and what the consequences may be. This is a central question for the decades ahead in light of the following: Increasing congestion and delay are now a common feature of urban travel; Household auto ownership is expected to increase past the point where, on average, an automobile will be available for every employed person; Congestion will increase more than 400% over the next 20 years on the nation's freeway systems and over 200% on nonfreeways, according to the Federal Highway Administration, in areas under one million population, freeway congestion will increase over 1000%; Total travel is expected to increase a minimum of between 1-2% annually adding to the current roadway system over the next 32 years the same amount of new traffic that has been

added in the last 32 years; actual growth in travel demand could be twice this conservative estimate.

The implications are clear. Auto availability will continue to increase, but the cost and convenience of auto travel will deteriorate significantly in an increasing number of areas.

Suburbanization Growth and Development

The APTA report echoes the findings of others with regard to the changing pattern of land use expected in the future. The report (3, p. 15) asserts:

Rapid suburbanization of jobs and housing in recent decades has resulted in highly scattered trip-making. The patterns and nature of this explosive growth in travel has overwhelmed street and roadway capacity and in many instances cannot be accommodated economically by traditional transit services. The suburban phenomenon is characterized by typical low density development, a patchwork of buildings and land uses on specific sites, the absence of effective coordination of land use with transportation and other infrastructure investments, and an imbalance between the location of jobs and housing.

Typical suburban densities in most areas are 25 times lower than in our downtowns, and while it is true that the explosion in suburban growth is expected to continue into the next century, the problem is more complex.

Overlaying the low-density development pattern is the emergence of major multi-use centers and "urban villages" that, in many cases, are approaching the densities of typical downtowns. In addition, the traditional form of suburban development is being subtly altered by a number of factors including congestion and limited access, mounting labor shortages, changes in tax laws that spurred recent suburban office growth and by environmental concerns.

Suburban labor force shortages, the strong growth of service industries in central cities, and other factors indicate that an increasing premium may be placed on employment locations that are accessible from throughout a metropolitan region, influencing further growth in central city and CBD areas where services, infrastructure and amenities already exist. The suburban phenomenon is not as simple as it first appears, but requires the continued attention of public transportation experts.

Economic Growth and Vitality

The TRB 2020 Conference focused on a broad range of issues that may influence the incentive for additional investment in transportation facilities. In addition to those cited earlier, the impact of investment in infrastructure was considered as it relates to the overall economy. The report (1, p. 6) stated:

A 2.6 percent growth rate in the gross national product (GNP) is forecast for 2020 in terms of labor force and productivity. However, to sustain the current U.S. standard of living, the level of economic activity needs to be 3.5 percent. In order to close the gap, increased rates of capital investment are needed by both the private and public sectors.

Higher rates of capital investment are key to future growth of productivity and income for the nation. Investment in transportation has certainly contributed to this country's growth during the first three-fourths of the 20th Century. Such investment has declined as a portion of the GNP and as related to the increase in vehicle miles traveled. Additional transportation investment is necessary, in a form that will yield improved productivity from more efficient technology.

Commercial Freight Transportation

The TRB 2020 Conference attempted to describe the environment for commercial transportation in the future. Many unknowns exist, however. The report (1, p. 11) noted:

Although the GNP will grow more slowly than in the recent past, industrial production is expected to increase, and thus demand for rail and motor carrier transportation services should expand. A major unknown is understanding how rail-truck competition will be resolved during this period. Changes in governmental policies may influence the competitive environment. Policy areas in which such changes have occurred or may occur include regulation, abolition of the Interstate Commerce Commission, truck access to the interstate system, size and weight laws, use of twin trailer trucks, urban truck bans, new sections of the interstate, and the quality of the highway system.

The rail and trucking industries have changed dramatically because of the recent deregulated environment. In the 1950's rail car was the standard mode for transporting manufactured products. The construction of the interstate highway system and deregulation underlie the shift from rail to truck, which is the major competitive change affecting the freight industry. Intermodal transportation represents the cutting edge of rail-truck competition and consequently the hope for future growth of earnings for the rail industry. New intermodal technology such as the RoadRailer could revitalize a portion of the rail market. Although the past has seen slow growth in the industry and movement has been from rail to truck, these trends could be reversed as demand increases and competition grows.

New business organizations that may evolve to handle freight constitute a separate issue, and changes are already taking place. For example, short-line railroads have emerged since deregulation. The larger railroads have spun off low-density lines into separate businesses that have reduced their labor costs and adjusted their overall cost structures. "Total" transportation companies that might arise to utilize both rail and motor carrier modes are certainly on the horizon, but even these will have to decide how intensively to use each mode.

New Technology and Communications

Underlying all of the forecasts is the expectation that new technology and communications will play an important role in the future. The FHWA report identifies five specific areas where technological development may have a significant impact on the future of highway transportation. These are automobile, motor truck, traffic controls, telecommunications and computers, and highway materials and construction. The TRB 2020 report (1, p. 12) identifies similar areas and states:

Because the computer-control revolution is just beginning, one can only guess at its effects, but the pace of such change will quicken. Industrial plants can be much smaller. Factories can be located wherever there is good transportation, even in places that are not yet cities. Freight movements will be diverse and time-sensitive. Although these changes appear to favor trucking, new technology, such as the "carless piggyback" or RoadRailer, and logistics control systems will help the railroads to compete.

It is unlikely that many more expressways will be built to reduce congestion. There will be a trend toward working at home, but transportation will not be affected significantly by this trend in the near future. Half-width vehicles have been developed that could increase the throughput on existing highways, and electronic guidance systems will help drivers locate new destinations. In the discussion of automatic vehicle control (AVC) and similar vehicle guidance systems, it was concluded that obstacles to their development are more institutional than technological. Improved traffic signal systems have been developed to increase speed of traffic flow and reduce the time and fuel involved in travel.

Improvements in vehicle technology are also anticipated. Fuel economy gains will continue and new materials that reduce the weight of the car may be used, although this could increase the price of the car by more than the savings in fuel costs. However, the cost of these materials will decrease with time and experience, and new materials will be widely used by 2020.

The internal combustion engine is approaching theoretical propulsion efficiency limits, and it will be difficult to obtain further improvements. Fuel cells, a potential replacement for the battery, use an electrochemical process, but low-cost catalysts are needed to make them economically feasible.

PROBLEMS

The second phase of the future's process is identifying the current state of transportation services and the critical needs as defined by those who use, operate, and are responsible for system delivery. Scattered throughout the reports cited earlier are proposals for how both transit and highway should position themselves for the future. Another report however, takes a "grass roots" approach and summarizes the findings from 65 public forums held around the country between August 1987 and May 1988 (5). More than 2,300 individuals testified at these forums, representing 49 states and the District of Columbia (Pennsylvania furnished information from earlier public hearings.) As was expected, numerous specific proposals were received, many dealing with short-term concerns. The major items, listed by urban or rural location, are remarkably similar to those identified in FHWA, APTA, and TRB reports. They indicate a recognition of the problem and the need for the private sector and government to respond.

Major Concerns of Transportation Users: Urban

- Transportation facilities in the larger urban areas are heavily congested, and congestion is likely to increase in the future. This trend is adversely affecting commerce, and stimulating further suburban spread.

- Population growth has been heaviest in outer suburban communities, which is changing the nature and direction of transportation demands. The once dominant suburb-to-city center commute is now only the third largest movement.

- The physical condition of transportation facilities—especially expressways, city streets, and transit—is deteriorating. There is a universal desire that the essential service provided by urban Interstate highways be properly protected.

- Needed new and expanded facilities, whether highway, transit, or rail, are not being provided in time.

- The future U.S. population will be older than today's; thus, transportation issues will be different.

- Transportation investments will be needed to rejuvenate portions of older urban areas.

- Traffic engineering improvements (signals, signs, markings, parking, high-occupancy vehicle lanes, turning lanes, etc.) should get more attention.

- Private and governmental organizations must cooperate more to further reduce the extent of single-passenger commuting.

- Deliveries of goods and supplies to urban commercial establishments is becoming more difficult, particularly as the "just-in-time" delivery concept spreads.

- Traffic congestion is adding to the costs of transportation service, creating another impediment to national economic health.

- Access to airports and waterports must be improved.

- Long-term availability of domestic petroleum products is a worry. Conservation, alternative fuel development, com-

plete exploration of domestic sources, and options to the single-occupant automobile are called for.

- The transportation planning process must be improved, and better coordinated with land development schedules.

- Environmental goals, particularly for clean air, are a continuing concern.

- The federal government appears to be neglecting urban transportation issues, as funding of all programs has been reduced and funding for one mode has been forced to compete with another.

Major Concerns of Transportation Users: Rural

- The Interstate Highway System is the backbone of long-distance service, but many segments are outmoded and newly developed areas are not well served. High-quality access routes to the Interstate system are a major need in many states.

- Major farm-to-market roads are deteriorating under heavier use because of rail branch line abandonments.

- Rural shippers often find no competition between railroads and trucking.

- Local rural governments have difficulty in meeting needs for bridge replacement and other relatively high cost capital investments.

- An aging rural population will need better public transit.

- Transportation development must respect the character of the area traversed and protect it.

- Road access to national parks, forests, and Indian reservations is getting worse. The economic importance of tourism and recreational driving demands greater attention to improving scenic driving opportunities.

- New road facilities are needed to serve expanding recreational and economic developments needs. Cities must be better connected with growth centers and resort areas.

- A network of scenic byways is needed in every state to serve tourists and recreational travelers.

- Rural transportation safety is a concern.

- The federal government appears to be neglecting rural transportation because of competing budgetary pressures.

PROGRAMS

The final element in the future's process consists of defining a strategy and a program that responds to the societal changes and needs that have been identified, and then proceeding with their implementation.

It is not my role here to describe the various programs that have been developed by APTA, AASHTO, FHWA, and others, as these will be scrutinized by public officials and political leaders, who eventually must decide (2,3,6,7). Then the actions taken will serve to incrementally add to our nation's extensive transportation system, either by rehabilitation or adding new capacity. I would, however, like to identify several basic viewpoints that are relevant for us to consider as we move into this new century of transportation.

Three individuals who have written perceptively on this topic are Peter Koltnow, Tom Larson, and Daniel Brand. Each presents thoughts worthy of consideration, that should be included in the process of identifying alternatives and recommending action.

Koltnow (8) makes the point that we should not be timid or pessimistic in our expectations of the future. He illustrates this by citing the many changes that have occurred in the past 30 years, many which were unanticipated, and claims that we have responded to these challenges remarkably well. He lists tasks for the next three decades, including new capacity in the suburbs, retrofitting of safety features, substantial miles of new roads, modern traffic control, and new communications and guidance systems. He states, "None of these measures will gain necessary support without leadership. If those responsible are shortsighted or out of touch, they forfeit their right to direct the next generation of transportation progress."

Tom Larson (9) reminds us that three elements are necessary if we are to effectively deliver new transportation services. In addition to a vision of the future, we require an "authorizing environment" (i.e., support of the people for our new product) and an organizational capacity to deliver that product. Without these three in place, we are likely to be unsuccessful with new ideas. This approach suggests "incremental change" which he believes in, "but with enough excitement and challenge to keep us enthused and regain and maintain public support for something we all know to be useful to our society."

Dan Brand in his excellent summary of the TRB 2020 Conference (1, p. 22), described the three stages of innovation to buttress his call for automation as a direction for the 21st century:

The first stage of innovation typically occurs when an invention performs an existing function better than before. The early motor was faster and pulled more weight on dry roads than the horse, but its function was the same as that of the horse.

In the second stage of innovation, the invention has been improved and new uses have been found for it. In the case of the motor car, self-starters were developed, vehicles were adapted to move goods as well as people, and chauffeurs were added to create the motor bus.

In the third stage of innovation, the structure of the surrounding system, in this case the city, adapts so that the innovation can perform at still lower costs and increasing gain to individuals.

What does this mean to the application of computers in transportation? An entrenched third stage of innovation cannot fight with another third stage. The structure of the system in which the motor car operates has adapted to the motor car. There must be a return to the first-stage innovation: to perform an existing function better than before.

Computers are well suited to enhance or take over part or all of the existing guidance and control functions now per-

formed by humans. Automated highways, or more logically, automated guideways of an intermediate-stage dual-mode system, could well be the next transportation engine that drives the economy. Transportation speeds and throughput could be markedly increased. The market for microprocessors in this application would certainly dwarf the few million personal computers now in use.

Are we on track for developing the transportation engine for economic growth in the year 2000? Brand thinks we probably are. "Transportation should get on board and try to drive this development in the public interest."

"We can only wonder and speculate on what the second and third stages of innovation would or will be—the new uses for the innovation, and how the structure of the surrounding system would adapt." Brand demurs and does not speculate further. Analogy has carried us to the point where automation as a research direction appears as an eminently logical response to the nature and level of demand for future highway and public transit services. The rest is left for history.

So there you have it. We have made great strides in defining those factors that will govern our future. What the future will turn out to be, however, will depend on our actions, vision, and leadership as we seek to develop a new program of transportation suitable for the needs of a new century.

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The Year 2020

STEPHEN C. LOCKWOOD

We are gathered here in Boston today in the year 2020 at the behest of two organizations, one called the Transportation Research Corporation, a privatized version of what used to be known as the Transportation Research Board (TRB), and the other one called AAPPMO, the American Association of Public and Private Mobility Officials, which used to be the American Association of State Highway and Transportation Officials (AASHTO) back in the twentieth century.

I am pleased to be here to talk to you today in 2020, and to have been invited by you to review the history of surface transportation in the early part of the twenty-first century, especially the last 20 years.

In preparing my history of the twentieth century portion of the last 31 years, I found a kind of schizophrenia when looking back at the transportation sector in the 1990s. Certainly on the passenger transportation side, public sector institutions were frustrated by lack of progress.

The eighties and nineties seemed to be a low point in productivity increase, owing in part to static institutions, unyielding stakeholders' positions, rigid program structures, lack of program structures, lack of technical innovation, declining investment, and all being held hostage to a funding system that was mired in national and state politics.

Perhaps more important in the eighties and nineties, the provision of public infrastructure—transportation infrastructure and services, highway and transit—was isolated from the economic expression of consumer demand and from effective means of responding innovatively to its market.

As the service economy continued to evolve during those decades, and as the new economic geography continued to scroll across the landscape and new society and lifestyles emerged, transportation appeared to stand still.

In the freight transportation sector, deregulation in the eighties and nineties had unleashed some enormous private-sector entrepreneurial energies. The freight transportation industry, in dramatic contrast with passenger transportation, had substantially reorganized, with blurring and consolidation among modes and service providers, and rapid market entry and departure. It invented new forms of service and value-added niches, incorporated new technology, and passed on substantial savings to shippers.

Thus, consumers of publicly provided transportation infrastructure and services in those days appeared to view the transportation system more as a problem than as an opportunity. They saw it as simply an obstacle to be overcome. In the face of growing congestion, the transportation sector appeared to have no clear program to increase speed, reliability, or comfort. Rather, it was faced with a growing backlog of physical deterioration and a history of underinvestment.

In retrospect, it should not be surprising that America's business leadership, once aggressive supporters of major new public investment in transportation infrastructure, saw the transportation structure program as just another form of pork, based as it was on formula entitlements.

With 20-20 hindsight, we can now state the key question that actually faced us. It was, in fact, facing transportation professionals at the close of the twentieth century. That was, what kind of a transportation system did a postindustrial service economy, geography, and society really need, and how was society going to shape it and pay for it?

It's pretty clear from our vantage point in 2020 that the twentieth century institutional structure itself was a major impediment to the new system which has been developed. The old structure, in fact, lacked several key characteristics that we in the year 2020 now take for granted.

What are these? The ability to detect and respond to different market segments seeking a range of service attributes and the ability to build those into our overall system. We in 2020 take for granted

- The dominance of a management perspective oriented to operating our transportation systems at maximum efficiency;
- The rapid incorporation of the best available technology with minimum disruption of our infrastructure and services;
- The ability to harness entrepreneurial energies and place the major components of our transportation system on a profit-making basis;
- The ability now to mobilize substantial capital on an international basis relatively independent of politics; and
- The substantial differences in approach from region to region around our country.

Given where we are today, the big story must have been how the dramatic transition took place from the twentieth to the twenty-first century in transportation. It is perhaps no surprise that, given the state of the system back in the dim years of the late eighties and early nineties, the focus was on preserving infrastructure and maintaining existing levels of service just to cope with existing demand.

Despite that pessimistic outlook, three areas had major progress. The first was the partial completion of what turned out to be the last great round of federally sponsored interregional highway and transit development. Limited in scope as it was (because it turned out to be based on the last of the great federal fuel tax increases), it nonetheless contributed substantially to the nation's economic development. In some ways, the fortunate delay in implementing this program permitted the concept of systems operation and management to penetrate more thoroughly into highway agencies as efficiency became a precondition of federal aid. Highway agencies became

increasingly led and staffed by MBAs, electrical engineers, logicians, and economists.

The second major achievement of the nineties related to what came to be known as the "Metro-Flex Program," that is, the increasing ability of metropolitan areas to expand and extend their systems. This process, which took various forms around the country, did not follow the handbooks, and it was funded by a dazzling array of new financing sources at the state and local levels.

The flexibility and the discretion that was built into the legislation of the late nineties expressed itself in some very unusual ad hoc and custom approaches that squeezed new capacity into constrained environments and dissolved most internodal barriers. These approaches brought new transit service products that turned regional transportation agencies into service managers and brokers.

At the same time, converging state and local attitudes on land use control and transportation facility development, together with new funding sources, facilitated the emerging "concurrence concept." An ability to balance supply and demand emerged at last.

While these two program activities dominated transportation infrastructure development and resources in the nineties, a third and parallel activity was taking place, although it had very little impact at the time. This was the gradual extension of advanced traffic management systems on an areawide basis and state and local acceptance of responsibility for system operation. Conventional forms of traffic operations and driver information systems were installed on a widespread basis, and an entire new array of methods to avoid and minimize incidents developed. My favorite was the famous flying traffic crane to lift out-of-gas vehicles off congested freeways.

Let me now, however, turn to the twenty-first century proper, because by this time the potential of an entirely new type of synergism had become apparent: a new interplay between demand, supply, and institutions. We here today in 2020 are so accustomed to these changes that we have forgotten how unanticipated they were in the past.

First, I think we have to remark on what had become known around the turn of the century as the "economic geography." In its spatial guise, this was the postindustrial service economy with lighter, higher-value products moving around with global sourcing, a more dispersed pattern of production in small units, and a more direct producer-consumer linkage.

Combined with the need for low-cost land for affordable housing, this trend encouraged low-density development dotted with service nodes. It took advantage of abundant, cheap, attractive land suitable for development, land that was a major resource in North America.

Together with this spatial extension, the new economic geography was also based on time shifting. The continuing penetration of information technology contributed to fundamental changes in temporal activity patterns, especially with regard to the organization of work. The dominance of the office complex and the urban landscape ceased altogether. District clerical brokers employed exurban work forces and small groups linked electronically to decision makers in the few remaining central cities. Time-shifting technologies eroded the need for physical and temporal assembly and more and more workers made their own hours, their own days, and their own seasons.

The third major change was social. I will not go into this in any depth, except to remind you that there was a period

when it was very difficult for the elderly and the young to attain personal mobility as the spatial extent of development increased.

The forces and the early effects of these changes interacted in a variety of patterns that were difficult to anticipate, and they were, in a large sense, visible before the turn of the century. The relative importance seemed obscure at the time.

These demand-side changes, were taking place simultaneously with new concepts and technologies on the supply side. These included improvements in traffic management and driver information, advances in technology and automatic vehicle controls, institutional acceptance of the concept of system management and market responsiveness, and radically changing roles for the public and private sectors. The interactions among these concepts in technology have made the 20 years between the year 2000 and today most interesting.

The intelligent vehicle and highway system technology was introduced initially in the nineties to reduce congestion when peaks, as they were known in those days, were still a major problem. Interestingly enough, the intelligent vehicle highway system did not take off until the privatization of major highways began. Private sector entrepreneurship, and international capital and innovation and management, seemed necessary to make this work. The need for entrepreneurial leadership and the importance of common ownership of guideway, hardware, and software, coupled with the problem of assigning liability, led to major private consortium involvement, which I will discuss shortly. Privatization was actually postponed until the direct user charges became more widely used. Road pricing, as it was then known, in turn became increasingly attractive. Fuel and excise taxes became increasingly unreliable sources of revenue as alternative fuels became necessary and vehicle efficiencies increased.

Fortunately, about that same time, automated vehicle identification and credit card technology made equitable transportation user fees possible; road owners, many of whom were private by this time, could bill road users directly. The potential of road pricing for improving productivity was only gradually realized, however, and its introduction was uneven. As we know, substantial portions of local systems continue to be funded by nonuser fees today.

Interestingly enough, the major impact of this technology in some areas was to improve efficiency through better use and better user information. Nonetheless, the continued decline in densities, which I already mentioned, and the introduction of road pricing had almost an equal impact on improving service levels. Indeed, the interactions of the intelligent vehicle highway system technology, road pricing, and lower densities eliminated substantial capacity constraints on all but some of the oldest and largest traditional cities by 2020.

Surprisingly enough, the same technologies actually had a much greater and less expected impact in other areas: safety, freight operations, and speed increases.

From a safety perspective, it is hard to imagine today how our adolescents and elderly would have achieved the mobility required in today's society without the automated vehicle operation that allows both 14-year-olds and 84-year-olds to operate vehicles.

Another interesting side effect of the technology was the great speed war of the teens. Improved crash avoidance and crashworthiness technology, together with smarter roads and vehicles, encouraged higher speeds. Spurred on by competition from Japan, the United States, and Europe, major speed

breakthroughs were made after 50 years of almost continually lower average speeds.

The first speedways around 2015 were private speedways, that required special licenses but offered speeds of 120–130 miles per hour. The impact of these new speeds, along with the reduced need for living near one's place of work, had an enormous impact on urban geography. Urbanized areas were extended rapidly along the speedways as commuters' lifestyle options expanded dramatically. Commuting from a vacation home was now possible. Welcome the twenty-first century metroplex of exurbs, reburbs, and distinct lifestyle villages, all on less than 2 percent of the nation's land.

The evolution in freight technology that took place was also strong, but I will only touch on that lightly. Developments included internodal blurring. Major road/rail companies ran their in-train, multiunit, multiwheeled turners on exclusive freight ways. Penetration of what used to be airline corporations and the major inner-city ground transportation took place. All of these developments obviously had a dramatic impact.

Thus, these developments indicated the potential of a real market in transportation services and spawned the various kinds of specialized facilities that we enjoy today. The speedway, for example, and the shareway (you can guess what that was), and now the freightway and the parkway.

Although I will not discuss each of these today, they represent an important matching of the smart vehicle/smart road technology, with an individual market in terms of a specialized facility. Each had a dramatic impact on the mobility of our society in the early part of this twenty-first century.

Let me just finish now with a brief discussion of institutional evolution, which in many ways was a necessary precondition for introducing these new systems and services.

In one way, the institutional structure that we have in the twenties—that is the 2020s—represents continuity with the past. There is a division of roles between the public and private sectors, between individuals and businesses, and between governments.

In the twentieth century, guideways were a public monopoly financed by taxes and users and determined by the political process, as was the nature and distribution of service. Vehicles were produced by large private corporations, but they were

owned and operated by individuals and were regulated primarily by state and local governments.

The irony of the twenty-first century has been that the old system has literally been stood on its head, reflecting the logical outcome of our capitalist and federalist system. First of all, road pricing reduced the need for government finance, particularly for the upper-level and specialized systems. Indeed, the great road asset sale bonanza of the 2020s fueled the bailout of the Social Security system that was desperately needed at that time.

At the same time, the closely linked vehicle guideway technology, with its operating requirements, liability problems, and dynamic technology, made privatization both a necessity and an opportunity. It was simply a course of action that government could not keep up with.

It is not surprising that the major transportation corporations, the internodal carriers who combined with the major airlines and evolved into the first major service provider consortiums came in with important players from both the vehicle and electronic industries. We had great corporate giants that we take for granted today: CSX-Ford dominating the Northeast, GM-IBM dominating the Midwest, and TransWorld-DEC dominating the Southwest.

Each of these competing transportation corporations owns and operates the speedways, the shareways, the freightways, and even the parkways. Federal and state governments now, as we know, play a largely regulatory role. The upper-level systems, of course, organized by the 12 federal economic development regions, like so many other services have replaced the role and function of state governments.

Local governments, both urban and rural, still struggle with local access roads, although divestiture has substantially reduced their burdens and better pricing has improved their economics.

The regional mobility corporations of most metropolitan areas work with the major road transportation corporations to supply the array of transit services now available in most areas.

These are just some of the highlights, and I could go on and on to bring you up to date and even speculate a little bit about tomorrow; but, of course, that would be dangerous. I will just call it a day here because I have to catch the Stratoliner back to Paris for my afternoon meeting.

Chief Executive Officers' Viewpoints on Transportation Planning

FREDERICK SALVUCCI, DUANE BERENTSON, WILLIAM K. HELLMANN, AND LOWELL JACKSON

FREDERICK SALVUCCI

This panel should be a lot of fun. The idea of having a number of chief executive officers, who work with or who have worked with very different institutional arrangements across the country should be interesting. Some of us are still in government and some of us have gone to the private sector. Therefore, we should be able to bring both a public and private sector perspective to the topic of statewide multimodal transportation planning.

The Boston metropolitan area underwent a major reexamination of its transportation planning process in the late 1960s. Called the Boston Transportation Plan Review, this effort has influenced to a large extent my thoughts on how planning should be conducted and how important it is that planning produce the information needed for decision making. The major elements of the plan that resulted from this effort, our game plan so to speak, can be seen in place today or under construction. The basic concept was that, given its demographic and transportation system characteristics, the region should concentrate its highway resources on expanding the center of the system where the most significant problems were occurring. Hence, you see today the widening and construction of a new tunnel under the existing central artery in downtown Boston and the construction of a new tunnel to Logan Airport. A parking freeze in downtown Boston was designed to discourage the use of the private automobile or at least limit any increase in its use. This freeze went hand in hand with major investment and reinvestment in the regional transit system, in both construction and renewed support for system operations.

The process incorporated many concerns that at the time were relatively new. For example, much effort went into incorporating nontransportation concerns such as environment and community into the planning process. In addition, the economy in Massachusetts was in bad shape; the unemployment rate was significantly higher than the national average. Because of this, elected officials were greatly concerned about the vitality of the city and potential disinvestment in

our urban area. Even though many in the professional planning community did not think that public investment could arrest the decline of the center city, some officials viewed transportation as a major impetus in helping to revive the economy. From some points of view then, the political leadership was way ahead of the professional planning process.

An incremental planning approach bases future projections on the characteristics of the immediate past. Thus, the critical question people were asking in the early seventies was, will anybody use the transit system? Now, the question is, how do we provide sufficient capacity to handle all the people who want to use the transit system? Thus, transportation planning needs to break away from basing its major ideas on the past. We need to be strategic thinkers, looking to the future and asking what we want for our city, region, or state.

Many in this country are now closely linking transportation investment with economic development. On the basis of our experience in Boston, one can come to one of two conclusions. Either investment in downtown system capacity and in the transit system was a major factor in the economic prosperity that we now enjoy, or it had little or no impact. I would submit that the major expansion of business activity in downtown Boston and in the suburban fringes could not have happened without major transportation investment. Quite simply, the city streets in downtown could not have handled all the traffic that would have been generated without significant increases in transit capacity.

Let me end my comment with an analogy. Columbus is famous for discovering America. However, one of the major consequences of Columbus's voyage was the dramatic change in agriculture that occurred when he took back to the Old World the vegetables that he "discovered" in the New World. Imagine the Italians without tomatoes; the Russians, Germans, and the Irish without potatoes; the world without string beans or peppers. The economic prosperity and ability to feed the world's population that resulted from the trip was a dramatic, but totally unexpected, result. Was Columbus lucky? Were we in Boston during our transportation planning review just lucky to be in the right place at the right time? I would like to think that there was a game plan, and not a game plan extrapolated from past trends. And this is the lesson I learned about the importance of transportation planning. It is important to explore alternative futures, to identify major societal trends, to examine the consequences of different courses of action, and to put in place actions today that will provide a better society for our children tomorrow. Who better than transportation planners to provide this vision?

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DUANE BERENTSON

It is obvious that transportation problems facing the states are not just ours but are shared by cities and counties, developers and builders, freight movers and people movers. We all recognize that the future of transportation services and programs will depend largely on our ability to communicate with one another and coordinate our efforts so that we can cooperatively respond to our present and future transportation needs.

In Washington State, we recognize that our state transportation policy plan should be a tool for decision making. It is a tool that we will use for our department, but it is not just a Department of Transportation plan. It is a statewide transportation policy plan that is policy oriented, not project oriented.

Such a planning effort is a participatory process. I emphasize process here because that is what is important to the results. Documents that make up the plan will communicate the results to the state's policy makers.

Before I start discussing the policy planning process, let us remind ourselves why we need to be good transportation planners.

ISSUES

Urban Congestion

In Washington State, we are experiencing increasing traffic congestion and gridlock. Futurists tell us that significant changes will occur:

- Dramatic population increase,
- Changes in work places,
- Changes in the nature of the work trip.

In the twenty-first century, flex-time and flex-workplace will have a major effect on our transportation needs.

Economic Development

Importing and exporting is the heart of our state economy, an economy that requires rapid movement of goods. More than 12 million tons of grain are shipped from our state's ports, of which only 2 million tons are grown in Washington. The rest of the grain is produced in other states. Washington is about halfway between Pacific rim and European markets, making our state a major gateway in the global economy.

Financing

Because the transportation financial picture is uncertain, new financing methods are being studied and new sources of revenues being proposed. On the federal level, we are all participating in the effort to determine the future of the Highway Trust Fund.

Land Use

How our state develops and what role transportation and land use regulation will play is important.

STATE TRANSPORTATION POLICY PLANNING

With this in mind, let me brief you on our state transportation policy planning process. In 1977, the Washington state legislature required a state transportation plan to be developed and updated every 2 years. The Washington State Department of Transportation is responsible for developing that plan. In the past, the plan was primarily a compilation of highway projects for the near-term future, and some general statements about other modes of transportation. Public input into the process was minimal.

In 1987, we decided that we should take a new approach to multimodal, statewide transportation planning. Our aim is to develop a state transportation policy plan to provide statewide policy direction to all transportation providers.

Let me again emphasize that recommendations in the policy plan address all levels of transportation programs in the state, not just that of the Department of Transportation. A policy-level approach adopted at the state level should set forth the roles and goals across all modes for those responsible for providing transportation. As you can appreciate, this is no small undertaking.

Key Points

I want to emphasize some of the key points in our new planning approach. We have created an ongoing process that will be documented and adopted by our transportation commission every 2 years and sent to the legislature. Too often in the past, we focused on producing the plan document and ceased planning once the document was produced. We are now firmly convinced that we need an ongoing process to address transportation issues as they emerge. This process will set that agenda for the department's and the state's transportation programs for the future.

Our planning process is based on creating a forum for discussing transportation issues and reaching collaborative decisions on how to proceed. To this end, we have created a state transportation plan steering committee that includes representatives from state and local government, the private sector, legislature, regional planning organizations, the governor's office, ports, environmental groups, citizens' groups, transit operators, universities, and transportation user groups. The steering committee reflects the complex nature of transportation decisions, and the realization that the Department of Transportation cannot, and should not, make these decisions on its own.

The planning process is issue based, not transportation mode based. We recognize that many issues, such as economic development or urban mobility, involve many modes of transportation, and that the way to effectively plan for the future is to identify the causes of the transportation problems and plan for transportation solutions to address them. Thinking only in modal terms perpetuates the past. Rather, we should

search for the best transportation solutions for the future. At present, we have 10 issue subcommittees, which cover issues such as preservation, freight and goods movement, intercity mobility, and urban mobility. The number of subcommittees may expand as more issue areas are identified or it may contract as issues are resolved. The process is designed for this flexibility.

Our new approach views Public Involvement from a much broader perspective. For our 1980 plan, we held 30 public hearings across the state on a completed plan document, attracting a total of only 150 people. With our new approach, we have integrated public involvement into the process of developing recommendations. This is done by

- The broad representation on our steering committee.
- The subcommittee structure, which is set up to investigate individual issues and involves between 10 and 30 people in each group.
- Monthly status reports, which are sent to 3,000 Washington State residents and organizations.
- A series of regional forums that have been scheduled.

All of these steps are part of the process to get information out to the public and to receive input from the public. In addition, we are developing a video that will help explain the policy issues at the regional forums and other presentations.

Finally, because our planning process will be leading us into the future, it is focused on action. It is not enough for our plan to make recommendations that sit dust covered on a shelf. We want our plan to be a living document that responds to new challenges with specific recommendations for action, whether it is a policy change for the department or new legislation.

Strategic Management

Our organization has been preparing itself for this challenge through the strategic management process. We started developing this process 5 years ago, and the management team views it as an opportunity to anticipate the future, rather than to react to current events.

As policies flow out of the planning effort, we will be able to take those policies and translate them into objectives and tasks, and establish performance measurements for the department. This process will help us identify problems that we may encounter in implementing the policies, and positively influence entities outside the department.

Funding

Funding must be a critical element in getting the job done. We believe that with this new planning process we will identify policies and needs that will convince the public and the legislature to fund transportation programs. With these three components—transportation policy plan process, strategic management, and funding—we have a planning and implementation process that is continuous, ongoing and always being reviewed to see how well we have done and where we are going in the future.

SUMMARY

We have developed what we believe to be a good planning process that involves a broad range of people and interests in identifying and reaching collaborative recommendations for action. It is a flexible process that can deal with our uncertain future and give broad direction to our transportation programs. It is aimed at leading, rather than following or simply reacting. I believe that this is the direction that will set a firm foundation for the twenty-first century.

WILLIAM K. HELLMANN

Flying up on the plane yesterday, I thought to myself—why has Maryland's planning process worked? Why has it been successful? I came to the conclusion that it has worked because of several factors; the first being that the department has the legal responsibility and authority for multimodal, statewide transportation planning.

It also has dedicated the fiscal resources to implement the results of statewide planning. So, you don't just plan. In Maryland, you really have the ability to plan and implement that which results from the planning process.

The structure of the department is also set up in a way that is conducive to statewide multimodal planning. It is a mandatory process in Maryland. Now, perhaps that sounds like a negative statement, but it isn't. Maryland law actually says in general terms how statewide planning is to be conducted. And it is a good law. I think that the people who wrote it did the citizens of Maryland and the members of the department a great favor.

The final ingredient needed for successful statewide planning is strong support from the top. I will explain why that is important in a minute.

When the Maryland Department of Transportation (MDOT) was established in 1971, it was put together with all transportation elements. Maryland's department is broad. It has a Highway Administration that is responsible for a 5,000-mile state highway system. It has a transit element, the Maryland Mass Transit Administration, that owns, operates, builds transit facilities in Baltimore, including bus, heavy rail and a soon-to-be-constructed light rail network.

The department also has responsibility in the port. It runs the major marine terminals in Baltimore. It has aviation responsibility for a statewide small airport program and also owns and operates Baltimore-Washington International Airport (BWI), a large international airport. It has rail responsibility, providing commuter rail service between Baltimore and Washington and an area called Brunswick, northwest of our nation's capital.

It is responsible for licensing drivers and registering motor vehicles. And, finally, it is responsible for the seven toll facilities around the state.

The department has two dedicated trust funds. All normal motor vehicle fees go into the MDOT trust fund, including gasoline tax, registration fees, licensing fees, titling tax on automobiles, etc. Also, fares from transit, revenues from the port facilities, and revenues from the airport go into this fund.

A second trust fund in Maryland called the Toll Facilities Trust Fund includes tolls from Maryland's seven facilities. The

toll facilities are established independently under the law; that is, they are not subject to legislative budget approval. Toll facilities are run by the Maryland Transportation Authority (MDTA), consisting of five Maryland citizens appointed on rotating 4-year terms by the governor. The Maryland secretary of transportation is the chairman of the authority. So, the toll facilities come under the ultimate control of the department.

Maryland has conducted statewide multimodal transportation planning since 1971. As I mentioned earlier, it is important that the process have strong support from the top. If it doesn't, the modes will tend to go off on their own and do their own thing and not work together with other modal administrations.

In Maryland, that was a problem in the early years of the department. Seven independent agencies were suddenly under the umbrella of a department of transportation. Strong guidance from the top was required to make the system work and to convince modal administrations that they were now part of a comprehensive department. The department had to demonstrate the advantages of multimodal planning and its ability to do what is in the overall interest for the citizens of Maryland.

The statewide planning process in Maryland has really been a blessing, not a burden. It has provided an opportunity to plan all modes in a comprehensive manner. It has made us aware of all transportation needs. I think it has made us better transportation engineers, although I would grant that it does certainly complicate your life when you are trying to decide whether to spend available funds on highways, port terminals or improvements at the airport. It is still, in my opinion, a superb setup and a superb process.

The process is generally stipulated in Maryland law. It requires that our 6-year consolidated transportation program (CTP) be updated each year. I assume that at this point all states have such programs. They generally include a list of all the projects that are going to be planned, designed and constructed over the next 5 or 6 years.

Volume I of the CTP in Maryland is called the State Report on Transportation and is a policy report, a strategic planning report. The report says very briefly where we have been, and then focuses on where we are and where we are going with the various transportation modes. It is a report that gets wide distribution to all state and local elected officials, and appropriate organizations. It discusses MDOT headquarters issues and issues relating to each of the modes. I required that each modal administrator write his or her particular section of Volume I that indicates where each of the modes is going. I believe that the document is positive in that it establishes in writing the direction for the department and how the department is going to get there.

Each year Volume I, the policy document, and Volume 2, the program or listing of projects, are distributed to all local and state elected officials. The document distribution is followed by a tour. We are lucky in Maryland to be small geographically so that we can visit all 23 counties each year to sit down with elected officials and discuss their problems and needs. We share with them our problems and our needs, and we have an exchange of concerns and ideas and solutions.

The fall tour of the counties seems burdensome. The department is preparing for the General Assembly and there a million other things to do, but it is time well spent. It is

time for understanding, time to develop grass-roots support for the transportation program. It has accomplished that in Maryland.

The year that I resigned, we went after a 5-cent increase in the gas tax. We got it with very little opposition or debate. More than 100 of the 144 House of Delegates members supported the gas tax. I think the reasons included luck and good timing, but I also think it had a lot to do with a grass-roots, statewide, multimodal planning process and an awareness by local elected officials and citizens of what we are doing and where we are going.

The planning process in Maryland also has another step. After we draft the program and take it around on the tour to each of the 23 counties, we submit it to the governor for final approval and then to the General Assembly. The General Assembly can only cut projects. They cannot add projects. This allows for a balance of power between the legislative and the executive branches. The legislators are fairly reasonable to work with because they know that the only way their project is going to get into the program is if the secretary and the governor include it. That makes the legislature think seriously before it starts wholesale cutting of projects in the program. In the 3 years that I was secretary, the General Assembly never cut a project from our program.

Maryland's planning process has stability because it has two dedicated trust funds. Furthermore, if the legislature were to cut a project out of our program, the associated funds would revert to the trust funds. It is a nice system.

Because of the multimodal setup, Maryland's process has tremendous flexibility. Let me give you a couple of examples where we used that flexibility to our advantage.

When I first became secretary, three or four projects were identified as very serious statewide needs: a freeway in Western Maryland called National Freeway, and a bridge on the Eastern Shore over the Choptank River, a major structure. As we reviewed our program, we noticed that a major bridge project that was going to be built by our Toll Facilities Administration really wasn't needed for several years. Because of our flexibility, we built a major port facility that needed to be accelerated with the toll funds from the delayed toll project. We then used the funds that we had freed up by revenues and built the freeway in Western Maryland and the bridge on the Eastern Shore.

I will give you another example. Piedmont Airlines told my predecessor, Lowell Bridwell, who was the second federal highway administrator, that they wanted to establish a hub operation. Piedmont was trying to decide on BWI or Dulles Airport. They needed the necessary facilities to be operational in less than 9 months. Dulles was under the control of the Federal Aviation Administration (FAA) at the time, and had to go through the federal appropriation process to secure construction funds; Maryland did not. Lowell Bridwell loaned himself \$20 million from his Toll Facilities Trust Fund (not subject to General Assembly appropriation), told the General Assembly leadership what he was doing, and asked them to agree to pay the fund back during the following year's session. The General Assembly leadership during off-session agreed and ultimately paid the fund back out of the regular trust fund. Maryland DOT was able to build the pier in less than 9 months, meeting Piedmont's needs. The rest is history; BWI attracted the Piedmont hub, built the pier, and is a huge success.

Maryland's setup allows it to react quickly. The two dedicated funds provide stability and allow the department to implement what comes out of the planning process. Maryland DOT has the legal responsibility and authority to undertake multimodal statewide planning, in addition to the fiscal resources to implement the results to the limit of the available funds.

What is the issue in the future? I think that the issue is funding. I think that we are all going to have to find ways to do more with less. We have two major urban areas, Baltimore and Washington, and it won't be long before you can't distinguish between them. It has become imperative that the various modal administrations work together in finding solutions.

Clyde Pyer's group is currently directing a multimodal statewide study of the major commuter corridors in the state. The study includes the administrators from the Railroad Administration, which is responsible for commuter rail, the Mass Transit Administration, and the State Highway Administration. To find the best possible solution in each of those corridors, we must work smart and develop the best and the most cost-effective solution.

That is our story in Maryland. I think that we have an excellent planning process. It works well. I also agree that it takes a lot of luck! Much of the credit goes to that 1971 blue ribbon committee that established Maryland DOT, gave it multimodal responsibilities, a statewide planning process, and the necessary fiscal resources.

LOWELL JACKSON

My comments today are influenced by the work of some peers for whom I have high regard and who have been instrumental in the development of planning in the State of Wisconsin. John Fuller, now at the University of Iowa, served the citizens of Wisconsin and the citizens of the nation in planning in this same arena 10 years ago. Lance Neuman of Cambridge Systematics was heavily involved in some developing and planning activities in Wisconsin even before I arrived on the scene. And there is my peer and mentor, Roger Schrantz, one of the more venerable state administrators. He has survived in the Department of Transportation (DOT), serving at the pleasure of five successive politically appointed cabinet secretaries of both parties. His participation in Wisconsin's planning effort and now in the nation's 2020 activity has put him in a role that I think is going to do credit to us all.

One of the things we were asked to touch on is how planning came to our aid in the past. I became secretary of transportation in Wisconsin in 1979, although I had a career in educational administration. I was the first engineer to be appointed chief executive officer (CEO) in Wisconsin. My appointment had nothing to do with intellectual pursuits at the university. It had nothing to do with being an engineer. It had nothing to do with having a great deal of administrative prominence. It had everything to do with the fact that I managed the campaign of the successful candidate for governor. And as you might imagine, in the process of challenging the status quo during the campaign, we all had very definite ideas about the way the world worked. They were usually wrong, but nonetheless were very attractive to the body politic at the time.

We knew from the campaign particularly because our candidate had substantial support from road builders, that the state had a crisis in transportation. The crisis was brought on by economic malaise, by a decade of what we regarded as environmental movement excesses, and by resource shortages associated with the energy crisis. We knew, like most challengers do, that if we got in there, we could do what really needed to be done in Wisconsin. As our candidate said, God made all the rivers in Wisconsin go north and south but there isn't any particular reason why man ought to make the roads go in the same direction. We need some new roads going east and west. All we need to do is get in there and somehow manage the enterprise better and we will get those roads without having to pay anything more for them.

Now, perhaps you have heard that claim before. Well, I walked into the office January 3, 1979, and the outgoing administration had been gracious enough to give me a thorough orientation for a month. As the final act of that orientation, I was asked to sign a thick document that was laid on my desk. They would then forward it to the appropriate place. I asked what it was. Well, they said, this is Wisconsin's transportation policy plan. I said that perhaps I ought to read it before signing, having just been highly critical of what we thought was Wisconsin's policy in transportation. I opened it to the first page. It started out something like this, "The highway system in Wisconsin being essentially finished and the era of the automobile on the wane . . ." and it went down hill from there.

Well, suffice it to say, I didn't sign that document. As a matter of fact, I put the organization through about a year of redefining it. At that time, however, newly commissioned, appointed or elected CEOs can do one of several things: (a) circle the wagons and say that the guys who went out are rascals and we have got to do something different than they did; (b) circle the wagons in the secretary's office to protect our obviously more truthful approach to government from the people who have been around; or (c) attempt to co-opt the existing activities and fortunately in the process learn something.

I learned a great deal quickly on why a CEO needed to rely on good planning and that good planning existed in Wisconsin. Wisconsin is a state that has tradition, a reputation of innovative government, going back to the days of Robert LaFollette. Wisconsin is a state that has always been regarded as kind of a crucible of experimentation. Social security was invented there. Workman's compensation was invented there and in New York. It is the state that invented unemployment compensation. It is one of the earliest states, along with New York in 1967, to create a DOT, at about the same time as it was done at the federal level.

I found out how necessary it was to adapt institutional capability in my first appearance before a relatively unfriendly legislative committee that made decisions on our new budget. It was a Republican administration faced with a Democratic legislature, the classic confrontational setup. I decided that it was up to me to convince this legislative finance committee that we had to change the direction of transportation. I had to warn them about where we were going. And as so many scoundrels do, I decided to rely on the Bible for guidance to this committee. So, I extracted a quotation from Ezekiel, which seemed to be appropriate, in exhorting them to help take action to reverse the trends.

You remember, it goes like this:

The word of the Lord came unto [Ezekiel], saying, . . . when I bring the sword upon a land, if the people of the land take a man. . . and set him for their watchman: If when he seeth the sword come upon the land, he blow the trumpet, and warn the people; Then whosoever heareth the sound of the trumpet, and taketh not warning; if the sword come, and take him away, his blood shall be upon his own head. . . . But if the watchman see the sword come, and blow not the trumpet, and the people be not warned; if the sword come, and take *any* person from among them, . . . his blood will I require at the watchman's hand.

I figured that this metaphor ought to get their attention.

One of them turned to me very quickly and said, Mr. Secretary, that is the worst case of passing the buck that we have seen in these hearings. And you have come before us and told us that what you want to do is good for the economic health of Wisconsin. Prove the relationship between more highways and the economic health and development of Wisconsin. And so I said, that is easy to prove. Why, everybody knows that relationship. Well, give us an example. All right, Mr. Secretary, prove to us that the improvement of the surface condition of these highways will in fact improve energy conservation. Well, everybody knows that the smoother the highway, the less energy consumed. They didn't buy that.

And on and on and on, with all the arguments about why we ought to change the way we were headed in transportation. Well, they got my attention. Not only did we redo the policy plan over the year, but one of the most important things that we did in planning during the early eighties was to establish a hierarchy of planning that seemed to satisfy all the somewhat disparate interests in a wide application of transportation interests. A state in which railroads were being abandoned perhaps faster than in other states did engender governmental reaction. Wisconsin was a state with a deteriorating highway system and new capacity requirements and no structure to put it in place; a state that, as part of the "rust belt," was losing much of its heavy manufacturing industry to states with cheaper work forces and better and newer assets.

So, the need to incorporate rational planning became obvious. The way we proceeded was to establish a four-level planning process. I won't go into them at great length except to explain how we incorporated them into the establishment of public policy. At the top of the hierarchy is the transportation policy plan. Expect that document not to change very often, although to be commented on periodically. The importance of that policy plan, which I refused to sign when I came in, became evident very quickly. The Senate held up my confirmation because I refused to make it into an administrative rule in the State of Wisconsin.

I wanted to be a little more flexible than the original policy plan. Flexibility in an overall policy plan is important, as long as it serves as a document that lets everyone know your general intentions. We carried that policy plan to the public on many occasions in many hearings. In fact, we held the first statewide public hearing over a statewide television network on that policy plan to attract attention, obtain comments on its specific elements, and get overall public reaction.

The second level of planning is our system plans. We took a good look at the highway part first, to explain as much as we could about the highway system. We looked at what the real meaning of moving people and goods meant; what the interfaces were between the modes that we were representing;

what, over a 10-to-15 year horizon, we could expect. We used public opinion research surveys extensively to determine what alternatives existed with regard to the highway system in what we perceived at that time to be an energy-driven future.

The third level, the one that most states now have, is a program planning level for each of the systems. The idea is to put together, in our case, a 6-year program planning horizon, to be able to incorporate three successive 2-year periods of the legislative past budget, the first 2 years of which were essentially fixed in concrete, and the last 2 put together on the expectation of continued funding at that level.

The final level is the project level, which has dominated planning procedures and in some circles, particularly the Congress of the United States, still dominates it. This is the traditional planning process, which even in an ostensibly multimodal organization has a tendency to pull back from other more multimodal planning to the traditional demands of the highway old boy network.

What makes statewide multimodal planning work? You have heard from Bill Hellman that one requirement is to have a state public policy agency with the responsibility, the authorizing environment, to carry out this planning and to recommend, if not mandate, the way things are going to be done.

In Wisconsin, the authorizing environment is relatively broad. Wisconsin is the only state that has, for instance, everything including motor vehicle regulation and traffic enforcement under the state highway patrol. Wisconsin does not have the same degree of direct ownership of facilities and operations as Maryland. So, it helps to have authority across all these areas.

Institutional respect for the professional practice of the policy-making body sounds easy and comes trippingly off the tongue, but it doesn't exist if the cultural environment of the state favors dispersal of authority rather than concentration. In such states the usefulness of statewide planning is substantially reduced.

Of utmost importance to statewide planning is a close connection between the budgeting process and the planning process. They should be one and the same, not just in the transportation agency itself, but in the legislative and executive agencies that affect the transportation agency's activities. It is absolutely essential to have a dedicated transportation fund to make planning meaningful. The old Golden Rule, he who has the gold makes the rules, certainly applies when you are talking about the ability to move money from one mode to another. There are today some dependent modes of transportation that do depend, at least temporarily, on support from resources generated from other activities.

It helps to have legislation that channels outside money in a regular formalized way through the state to other users of transportation. Wisconsin has had a channeling act for more than 45 years. A dedication to expanding knowledge, whether for its own sake or whether, as in my case, for simple protection from criticism of our goals, is essential. I am interested in Secretary Skinner's and now Tom Larson's and Gene McCormick's responsibility to engage in establishing a national transportation policy. I hope that they will consult good people like John Fuller to explain some of the pitfalls along the way.

There are some substantial intellectual opponents to the concept of a national transportation policy, for the same reasons that there are people who are not very fond of a national

industrial policy because it implies a federal mandate, a federal coercion, a federal selection of winners and losers. That turns out to be almost an intractable problem in some places. I would like to suggest, just for purposes of discussion and remembrance, some rules for developing this policy from a planning perspective. The rules are suggested by another Wisconsin enterprise, the periodic commentary on the state policy plan called the Transportation Policy Agenda, which was formulated in 1985.

Number one, the overriding principle that guides public sector involvement in transportation is to maximize public good by identifying and valuing costs and benefits that are significant to the public, but which the market would otherwise ignore. In other words, public sector involvement is not to interfere or to set aside market mechanisms of supply and demand, but ensure that social and economic costs and benefits like land use impacts, economic development per se, are not only considered affirmatively, but may be considered negatively as well.

Second, and certainly important to the 2020 participants and difficult to achieve as Congress reconsiders national policies, is the importance of matching public responsibility with the appropriate level of government. A failure to do so results in increased cost and reduced quality and scope of service.

Third is the correlation of who benefits and who pays. This is the most important factor in effective public sector involve-

ment in transportation. We interpret that to mean that user fees should remain the preferred method of financing transportation programs, and that they should be structured to ensure that benefits and costs are distributed appropriately.

Although we have danced away from the issue of cost allocation, it will have to be revisited. Smaller constituencies and entire states may have to accept the development of new fuels and new methods of motor power. Not only are heavy combination trucks perhaps paying less than their fair share, but also new cars are paying less than their fair share because of our heavy reliance on fuel taxes.

So I submit that some of these rules, and there could be many more, will have to be considered in coming up with this new plan. I think that we should all give a great deal of assistance to Tom Larson and to Secretary Skinner and to those who are working on it, because not everyone is going to interpret it in the same way.

I see a good deal of challenge in the future. I see many new tools that we didn't have before to help us do planning. Certainly we have all the statistical tools that have been used in the past, as well as new geographic information systems applied to transportation. The early elements of these appear to be mechanisms to not only give us more data in ways that we can use at our level of government, but also to immediately present that data in ways that are meaningful to those who make political decisions on what we do.

State of the Practice: Transportation Planning

NEIL J. PEDERSEN, CARL B. WILLIAMS, SUSAN MORTEL, AND
HENRY PEYREBRUNE

NEIL J. PEDERSEN

I will be discussing long-range, statewide, multimodal transportation planning in Maryland. There are three key words in the title: long-range, statewide and multimodal. I work for the state highway administration, so I come from the perspective of planning director of a modal administration. The approach that I am going to describe, nonetheless, is truly a multimodal and collaborative approach between the various modes.

I want to go quickly over some background although some of it repeats what Bill Hellmann said this morning, but I think it is important to remind you of some of this background in context.

Maryland DOT is truly a multimodal department. We not only have planning responsibility but ownership and operating responsibility for a number of different modes, including our 5,200-mile state highway system, the Baltimore area bus and subway system, the Port of Baltimore, and Baltimore-Washington International Airport. We also heavily support the Washington area transit system in that we pay all the local match on the capital side, as well as 75 percent of the operating subsidy.

We fund our transportation program from a single consolidated transportation program and all of the funding comes from a single transportation trust fund. This permits the revenues to go to the area of highest need and priority and provides a fair amount of flexibility. It is important, however, not to take advantage of that flexibility to the point that we have it taken away from us. We have to be careful in that respect.

Flexibility helps us make smart business decisions, particularly those that must be made in a short time frame. Bill cited the Piedmont expansion decision this morning. Because we do have enterprise modes within the state department of transportation—in particular the airport and the port—it is important to operate them like private businesses and to make decisions like private businesses, particularly from a time-frame standpoint.

We do find ourselves in a competitive situation with Dulles Airport, which offers stiff competition to BWI in terms of expansion. On the water port side we also have competition, between the Port of Norfolk and Baltimore. So, that flexibility has proven to be important to us when it comes to competition.

On the highway side, we have had a long-range planning process in place for a number of years. Called the Highway Needs Inventory Process, it is now law. Our highway needs inventory is our long-range, statewide "Master Plan" of major highway improvements. We used to call it the 20-Year Highway Needs Inventory; it listed all the projects that we expected had to be built within the next 20 years.

We recognized, however, that given funding constraints and other realities, many projects would not be built within the next 20 years. So we now call it the long-range Highway Needs Inventory, recognizing that many of those projects may be more than 20 years in the future.

Some 700 projects are listed in the Highway Needs Inventory. The inventory also addresses significant policy and funding issues. For example, it includes fairly comprehensive technical analyses of funding levels required for pavements and bridges. In fact those analyses have been critical in establishing funding levels for pavements and bridges.

We have had the good fortune of having a legislature that recognized as early as 1982 the importance of putting money into preservation of the system, and they have given us legislation policy guidance that it is to be our number one priority. We have also had the good fortune to have secretaries of transportation who have recognized and taken that priority seriously.

The Highway Needs Inventory under the law has to be updated every 2 years. Those updates are based on a technical process in which we look at service needs, safety needs and structural needs. But it is also tied into the political process.

We work closely with the local jurisdictions in Maryland. We have the good fortune of having a strong county form of government with only 23 counties. So it is a little easier to work with local jurisdictions than in some states, such as Massachusetts, that have a large number of local jurisdictions. We try to have as much consistency as possible between local jurisdiction master plans and our state Highway Needs Inventory. We are also under law obligated to notify the counties of changes and we do that every 2 years as we update it.

The Highway Needs Inventory serves an important function from a planning standpoint, in that we use it for corridor preservation purposes. The vast majority of improvements

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are on the existing system, as opposed to new corridors. When we identify a highway improvement need, we get setbacks from developers on the basis of improvements identified in the Highway Needs Inventory. We also work closely with local jurisdictions to ensure that development does not take place within the needed rights-of-way.

The Highway Needs Inventory is closely linked to the programming process. Through the Highway Needs Inventory process, for example, we are now identifying priorities for our anticipated next big effort at a revenue increase, which we expect will probably be in 1991.

I referred earlier to our consolidated transportation program. It is a 6-year, multimodal, statewide, capital program. Every September and October, we consult with elected officials in all 23 counties on an individual county basis. That consultation is extremely important from our perspective. We get tremendously valuable input into our planning process and it becomes a truly grass-roots planning process as a result. I cannot emphasize enough the importance of that consultation.

We identify strategic issues during the consultation, although a lot of the discussion is project-related. The consultation sessions are also valuable in terms of laying the groundwork for upcoming revenue increases. For example, we expect our next big push to be in 1991, the year after our next election. We are starting to lay the groundwork right now. We started in last fall's tour of the counties by identifying some of those needs; during the next 1989 tour, we expect to be providing additional information, 2 years ahead of that big push in 1991.

The elected officials take that consultation seriously. They know that it is probably their best shot at giving us their input and what they have identified as needs. Also, many other public sector groups recognize the importance of that process as well and provide their input at meetings.

Our consolidated transportation program, the 6-year program, not only identifies projects that are funded for construction, but identifies those projects that are funded for any of the four phases of project development: planning, engineering, right-of-way or construction.

That process is particularly important on the highway side because for a project to even go into the consolidated program for the planning phase, it has to be identified as a priority by the elected officials from the county in which it is located. So, that base level of support is needed before the project planning process can even begin.

The project must also be in the Highway Needs Inventory, which is a technical document, but on which we have consulted with elected officials. That may sound like a political process and to a certain extent it is, but at the same time it is technically based in that it puts tremendous obligation on bureaucrats to develop information for elected officials, who provide policy guidance and then give us back the list of priorities. In fact, with few exceptions, the priorities on that list are close to the priorities identified through the technical process.

I am now going to move from that background into our commuter assistance study (a multimodal effort to identify long-term needs) and expand on many of the concepts that we have developed through the Highway Needs Inventory process, and tie into the Consolidated Transportation Program process. We have identified 24 corridors around the state where we are doing multimodal transportation planning

for surface/passenger transportation. I emphasize that the planning is only for surface and passenger transportation.

We tried to limit the scope so that it is manageable, but we do expect that if this process is successful, it may expand beyond surface/passenger transportation. In particular, it may include freight as well.

The 24 corridors are all around the state. They are focused on our two major metropolitan areas, Washington, D.C., and Baltimore; but it truly is a statewide study, extending into our rapidly growing exurban areas.

Historically, about 75 percent of our capital program has gone into highway improvements; the next largest share is transit, about 10 percent of the program, followed by the port and the airport. One other point I should make is that the transit capital program, up until a few years ago, largely provided the local match for major subway construction both in the Baltimore and the Washington areas.

We had a proposal several years ago to build a 27-mile-long light rail system along an old freight line that ran north/south through the Baltimore metropolitan area. When the proposal was made, legislators from the rest of the state said that it was all fine and good for the four legislative districts that the line ran through, but asked how they would benefit. Then they immediately jumped on the band wagon, saying that light rail was the solution to all of Maryland's transportation problems. They favored a statewide light rail system and came up with proposals that together added up to nearly 200 miles of light rail.

We recognized quickly that many of those proposals did not make sense, but we had not done a study to determine from a multimodal perspective what did make the most sense. We faced the dilemma that planning in most of the corridors had been primarily highway oriented, with relatively little multimodal planning. For the most part, we had not studied the tradeoffs between highways and other modes, although there were a few notable exceptions that did entail multimodal planning.

We also recognized that many corridors had either already been built out, or were slated in our current program to be built out to the maximum extent with highways; but the impact associated with trying to provide additional highway capacity would be too great. Yet we were not sure what made the most sense in terms of a long-term strategy. We had done a lot of work, particularly in the 1960s and early 1970s, identifying needs that are now being funded; but we hadn't looked beyond the year 2000 recently from a multimodal perspective. So, we initiated the commuter assistance study.

We are using a set of evaluation criteria that fall into general categories of engineering feasibility, travel demand, service provided, capital and operating costs, and impact assessment. I think we have between 20 and 25 different evaluation criteria for which we are developing information in all 24 corridors.

It is important to recognize that we have not yet defined a clear process for using that data to define exactly how to accomplish tradeoffs between the modes. We intentionally want to keep that process somewhat fuzzy because it should remain somewhat political if we are to get the support that we need for funding the additional capacity, whatever mode it may be.

We are looking at the full range of improvements including light rail, commuter rail, high-occupancy vehicle (HOV) lanes,

express bus service, and park-and-ride lots, as well as highway capacity improvements. We are looking at the full range of alternatives in almost all corridors in a truly multimodal study.

The study process has several keys. Administrators from each mode are involved, including the State Rail Administration, the Mass Transit Administrator, the State Highway Administrator, and planning directors from each mode. All work together with the secretary and his staff. It is a cooperative study, but one with friendly competition because fundamental decisions coming out of it will affect the amount of money going into each mode.

Another key to the study process is that local jurisdiction staffs and elected officials are heavily involved throughout the study process. We consider it key to the success of the process that the local staffs and, probably even more important, the elected officials get into the process early, so that when we finish they can't sit on the side lines and take pot shots at us. We will also have public involvement later.

The commuter assistance study will be the basis for a multimodal needs inventory along the same lines as the highway needs inventory. It will be the basis for determining what modal projects go into the project planning phase. It will be the basis for programming decisions and putting together a package of projects that will sell the next revenue increase.

Our experience in Maryland in obtaining the passage of the last two revenue increases showed the importance of the list of projects. But almost as important, the list of projects must make sense from a technical standpoint, be based on sound technical planning studies, and have sound technical support.

In fact, if you look at the list of projects funded in our 1982 revenue increase and our 1987 revenue increase, I think you can see that there were no "turkey" projects in those revenue increases. I would like to think that it is because we did a lot of hard work planning and gathering the information that went into selling them.

Finally, AASHTO has a task force that involves two representatives from the standing committee on planning, Kirk Brown from Illinois and Neil Pederson on the issue of corridor preservation. It is an area that we, as planners, should be concerned about; so, we are preserving our options in the future. In fact, one emphasis in our commuter assistance study has been to identify those corridors that need to be preserved, not just for highway improvements, but for transit improvements as well. We are thus preserving our options well into the future, even if we may not be funding them during the next 10 years.

CARL B. WILLIAMS

It is overwhelmingly apparent that transportation policy today must be linked with land use, air quality, economic competitiveness, and related subissues. Yet today's state-level transportation funding and planning process is the same used when the objective was to spend a large single source of revenue on major new highways linking cities.

The mobility problems facing California today cannot be solved by a single solution. Rather, a combination of capital and operating strategies must match the environmental and travel demands of each regional area with the supply of service

that is feasible in those circumstances. What works in urban Los Angeles may not work in rural Eureka. Planning for development of our transportation systems must consider issues of system integration and regional impact, as well as local needs and plans.

Today the challenge is to preserve interregional mobility and improve urban mobility. A web of new local revenue sources has evolved to drive locally initiated solutions. Yet the state (compelled in part by the federal government) is still running a funding and planning system that only crudely responds to problems of urban congestion, minimally addresses issues of rural access, and more often than not gives priority to projects that do not offer the best solution to transportation problems.

In addition, current expenditure prescriptions for federal, state, and local transportation funds constrain the programming and funding of transportation improvements as interdependent elements of a larger transportation network.

These provisions in federal and state law can interfere with funding the highest priority transportation projects because they impose categorical limitations on how funds can be used and what transportation mode they can be spent on, and they require rigid geographic distribution of funds. As a result, each element of the system competes with all others, constituencies become entrenched around their special interest, and the integration of systems that is so essential to the overall functioning of the transportation network, does not occur.

NEED FOR SUBREGION/CORRIDOR APPROACH

Currently, transportation decision making is the responsibility of numerous entities including the state, cities, counties, transit districts, transportation commissions, special transportation authorities, regional transportation planning agencies, air pollution control districts, and land use regulators. Each level of government has something the others need for the success of their own goals. Each agency has a unique focus but shares a common (if not always recognized) interest at the regional or subregional level.

Transportation solutions must originate and be implemented where the problems occur. We need to be working together at the regional and subregional levels to develop, agree upon, and carry out specific solutions. For the best interests of the state, the regions, and the cities and counties, we need corridor/subregional transportation planning to

- Better link land use, air quality, transportation planning and programming, and implementation across jurisdictional boundaries.
- Promote intermodalism and better target limited resources by ensuring that the most cost-effective transportation solutions are identified, given appropriate priority, and funded.
- Begin to integrate state highways, county roads, city streets, and transit facilities into a single coordinated and well-tuned system.
- Promote direct and vigorous participation of all corridor jurisdictions in the planning, programming, and implementation process.

SUBREGION/CORRIDOR APPROACH DEFINED

The subregion/corridor approach is an extension of current comprehensive transportation planning efforts designed to address transportation problems and prioritize and fund their solutions. The subregion/corridor approach addresses transportation problems in both rural and urban systems on a multimodal and multijurisdictional basis.

There are two generally agreed upon types of corridors: rural and urban subregional. Rural corridors are those that can be identified by specific termini (e.g., Sacramento to Redding). Urban subregional corridors are urban area systems that must be examined as a single closed multimodal system even though they may lend themselves to further subdivision or may be part of a larger area system (e.g., The Golden Triangle in Santa Clara County).

Simply put, the subregion/corridor approach brings all the responsible decision makers together to develop an integrated program of improvements (including all modes and strategies), pools funds to pay for the program, and then implements it. To accomplish this, three elements in the planning, programming, and implementation process either need to be included or need to be strengthened:

- A *binding commitment* on the part of each agency to seek common solutions in the corridor study effort, to develop a workable plan of financing, and to follow through in implementing their respective portions of the integrated program.
- An *integrated program* of multimodal improvements to increase capacity and to reduce congestion. This means combining demand management measures, transit improvements, and new capacity on state or local facilities into one subregional network package. Without an integrated and coordinated system of good arterial networks, transit systems, traffic operations centers, and demand management, additional freeway development will be of little benefit in addressing transportation problems.
- A *flexible pool of money* to fund the implementation of plans and to ensure that the funding is applied to the plan's integrated program and its agreed upon priorities. This means changing or removing existing use and decision constraints on transportation funds.

HOW THE PROCESS WORKS

The subregion/corridor approach is a method to address the subregion's problems as a whole. Elected officials and civic leaders must be committed to resolving transportation problems without preference for a specific mode, facility or agency. The operating premise must be that each player benefits as the group succeeds.

Caltrans, regional transportation planning agencies (RTPAs), and local transportation commissions will develop guidelines for conducting corridor studies. These guidelines will include a method for prioritizing among studies; identification of funding; modes to be studied; land use, population, and air quality considerations; and a system for setting priorities among projects within corridors.

The RTPA will be responsible for the overall process of identifying corridors, ensuring public involvement, scheduling studies in the annual overall work plan, and conducting or

commissioning the corridor studies. The state (Caltrans) will be responsible for this process wherever a corridor is not being studied by the RTPA. Upon completion of the studies and following a public hearing, the corridor study is amended into the Regional Transportation Plan (RTP), and included in the Regional and State Transportation Improvement Programs (RTIP and STIP). Corridor plans must be consistent with and incorporated into 11 state, regional, and local plans or a resolution of overriding considerations must be adopted.

The determination of how each program element would be funded would have to take into account existing commitments and other stipulations that could influence funding flexibility. State funds currently programmed for a state highway in STIP could be reprogrammed, for example, for an improvement to a local arterial if the corridor/subregional process determines it to be a more effective transportation solution.

Corridor/Subregional transportation planning will be a major shift in transportation planning and funding. It moves to a more regionalized and localized approach in which urban and rural transportation problems will be addressed on a multimodal and multijurisdictional basis. It focuses authority and responsibility at the regional and local levels and begins with comprehensive, detailed, and integrated corridor studies. Following study adoption, priorities are set for the best transportation solutions from the full range of highway construction, public transportation, traffic management, and other available approaches.

Because the corridor/subregion concept depends on a higher level of cooperation between the state and a variety of local transportation interests, its development and enactment also requires unprecedented coordination. The corridor/subregion process has been shaped by many regional and local entities under state leadership.

Corridor/subregion transportation planning has been presented as a policy option by Caltrans at numerous local and state forums over the past several months. Responses have ranged from negative to enthusiastic. Most concerns expressed have related to protecting existing authority or jurisdiction and are most often addressed to the manner of implementing the concept, not to the concept itself.

STATUS OF ITS IMPLEMENTATION

On June 30, 1989 the California Legislature passed a new transportation program to deliver \$18.5 billion of new revenue over the next 10 years. The new transportation program allows California to use existing revenues to support the state's basic program of maintenance and rehabilitation while using the new revenue to drive new ideas. Those new ideas are

- **Flexible Congestion Relief Program:** Removes the artificial proscriptions on what the new dollars may buy, allowing the decision maker to fund the highest-priority projects based on the quality of the project and its ability to relieve traffic congestion;
- **Congestion Management Plans:** Forces all transportation decision makers in urbanized areas to work together to plan and operate an integrated surface transportation system in order to maximize the dollars they receive;
- **Program Management:** Lengthens the time frame of the STIP to 7 years, eliminates bureaucratic red tape and caps

project development overhead percentages to cut delay and contain costs, ensuring that the new dollars will be converted into transportation improvements; and,

- **Privitization Demonstration:** Provides the private sector an opportunity to invest in the transportation infrastructure through a "Build-Operate-Transfer" arrangement with the state.

One factor that will influence the success of California's new transportation program is creating of the National Transportation Program. The national program will affect California's ability under the new state program to allow maximum flexibility in the use of transportation dollars and to address transportation issues as an integrated system rather than as a group of competing modes, categories, projects and jurisdictions.

SUSAN MORTEL

I would like to talk to you today about the Michigan Department of Transportation's investment planning process and some of the successful strategies that we have used to implement that investment plan, and a little bit about where we are headed.

The Michigan Department of Transportation is facing challenges related to funding just like any other department of transportation. We are trying to make our existing dollars go farther and target our investments to accomplish the greatest return. One of our most important tools is our investment planning process, so I would like to give you an investment plan update.

Our investment planning process is a logical extension of many traditional planning tools such as needs studies and revenue forecasting. In this instance, however, it incorporates investment planning in a long-range step-wise process that we refer to as resource allocation, using the old tools and building on them to form our new tool, our investment plan.

Resource allocation is a process that many states have, but they may not call it resource allocation. We begin with a needs study, which is an inventory of all of the capital needs of the transportation system and then go on to a state transportation plan (STP), which is a policy document (Figure 1). The STP is approved by our state transportation commission and it determines which of the needs are most important and which we are going to target first. In fiscal analysis we estimate how much money we are going to have in the future to apply to those needs. The investment plan begins the implementation phase, dividing revenue into broad program categories over a 10-year period according to the priorities set in the state transportation plan.

We then develop a long-range program, which puts projects into those broad categories, and an annual program, which is simply an annual breakout from the long-range program and sometimes referred to as a construction program.

By investment planning I do not mean investments in stocks and bonds. One of our aeronautics commissioners, when told recently that he was going to be presented with an aeronautics investment plan, thought that aeronautics funds would be invested for the short time between tax collection and application to capital investments. But we are talking about capital investments. We are approaching this as a transportation plan-

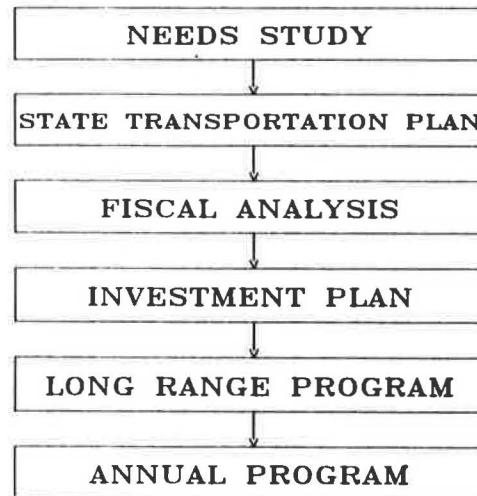


FIGURE 1 Resource allocation process.

ning tool and not specifically as a budget tool. We allocate our available revenue to an investment plan with broad program categories and then work as an organization to produce department programs and investments consistent with that plan. No projects are actually mentioned in our investment plan.

That investment plan is the means of carrying out strategies linked to transportation policy and of providing structure to the department's spending. It requires that we look forward and make some important decisions about priorities and prepare to be held accountable for how funds are going to be spent in the future.

Explicitly stated goals and objectives are thus needed for each mode. Most states have goals, although they are not necessarily explicitly stated. We have to know what the system will look like at some point in the future and have an idea of how much change in the system can be expected for a given investment level.

Our investment plan has had an important stabilizing effect on our program and has helped to keep the program in line with expected revenue. We now have three investment plans in various stages of development and sophistication. We started with highways several years ago and are now nearing completion of the aeronautics plan. We have the most experience with the highway mode, so I will focus on that for a few minutes.

First, let me comment on the role of a needs study in our investment planning process. The needs study is one of our most important ingredients for success because it gives a base line for determining how much of the various categories you will want to buy. The updates of these needs, based on yearly condition information, provide the data needed to measure progress toward goals.

The question "what is a need?" is central to investment planning because the essential must be separated from the non-essential. Evaluating what a need is gave us the basic structure of our investment plan, which we refer to as preserve, improve and expand. That structure forms the underpinnings of our entire investment planning process (Figure 2).

Preserve refers to maintaining existing services and facilities. This definition applies to all modes. For highways, pre-

serve includes all traditional "3R" actions, increasing facility capacity services already in existence. Expand means new roads, new services, new programs, new facilities.

I mentioned earlier that it is necessary to develop clearly stated priorities. Within the preserve, improve, expand structure, we have determined that preservation is our first and most important goal. Our initial investment plan allocated all but about \$400 million over a 10-year period to preservation. Through the needs study, we calculated the cost to preserve the system at a specific level and then set some strategies within the preserve category to carry out our goals.

The preserve part of the investment plan has a discrete set of priorities with specific dollar amounts attached to each of those subcategories (Figure 3). But even within the preserve category, it is essential to have some strategies for accomplishing your goal. Otherwise, you know the destination, but have no map.

-
- 1. PRESERVE**
To maintain the existing system.
- 2. IMPROVE**
To add capacity to the existing state trunkline.
- 3. EXPAND**
To add state highway service.
-

FIGURE 2 Structure of the investment plan.

For example, within the preserve category we specified a subcategory of "repair road surface and base." The dollar amount allocated for the next 10 years is based on our needs study and subsequent updates. But we needed another way to further target preservation money because "repair road surface and base" is a very broad category with a large sum of money assigned.

We refer to a subset of our 9,500-mile trunkline system as the priority commercial network (PCN). It includes about half of the 9,500-mile state trunkline system and includes the entire Interstate System (Figure 4). Our priority commercial network contains all routes essential to our state's economy, including high-volume truck and long-distance travel routes, and the entire Interstate System. It serves all our major population centers.

Through census information and a computer modeling process, we determined where the value of agriculture, forestry, wholesale, manufacturing and tourism were located in the state and which roads were most necessary to serve those economic sectors. We calculated that between 80 and 95 percent of the value of goods and services related to each of those sectors of the economy travel on the PCN, yet this is only half of the state trunkline system.

Developing the PCN was an important part of the overall state preservation strategy (Figure 5). Starting with the modeling process, we set some standards for the PCN and assessed the needs and the condition of the system. By a process of allocating dollars to program categories, we set some mileage targets. Now we have only to select projects consistent with the strategy and make sure that implementation follows.

I would like to tell you more about another part of the investment plan, focusing for a moment on aeronautics. We have underway the development of our first aeronautics

	Millions		Millions
INTERSTATE		NON-INTERSTATE	
Interstate Completion	\$ 158		
PRESERVE		PRESERVE	
Repair Surface/Base	\$ 746	Repair Surface/Base PCN	\$ 430
Bridge Rehabilitation	122	Non-PCN (Good Roads)	279
Bridge Painting	73	Shoulder	30
Safety	24	Bridge Rehabilitation	103
Traffic operations	37	Bridge Painting	62
Roadside Environment	<u>66</u>	Safety	41
		Traffic Operations	168
SUBTOTAL	\$1,068	Roadside Environment	<u>36</u>
		SUBTOTAL	\$1,149
IMPROVE			
Widen	159	IMPROVE/EXPAND	\$ 700
Interchange	<u>24</u>		
SUBTOTAL	\$ 183	NON-INTERSTATE SUBTOTAL	\$1,849
INTERSTATE SUBTOTAL	\$1,409		

FIGURE 3 Highway Investment Plan, 1989–1998; total: \$3,258 million.

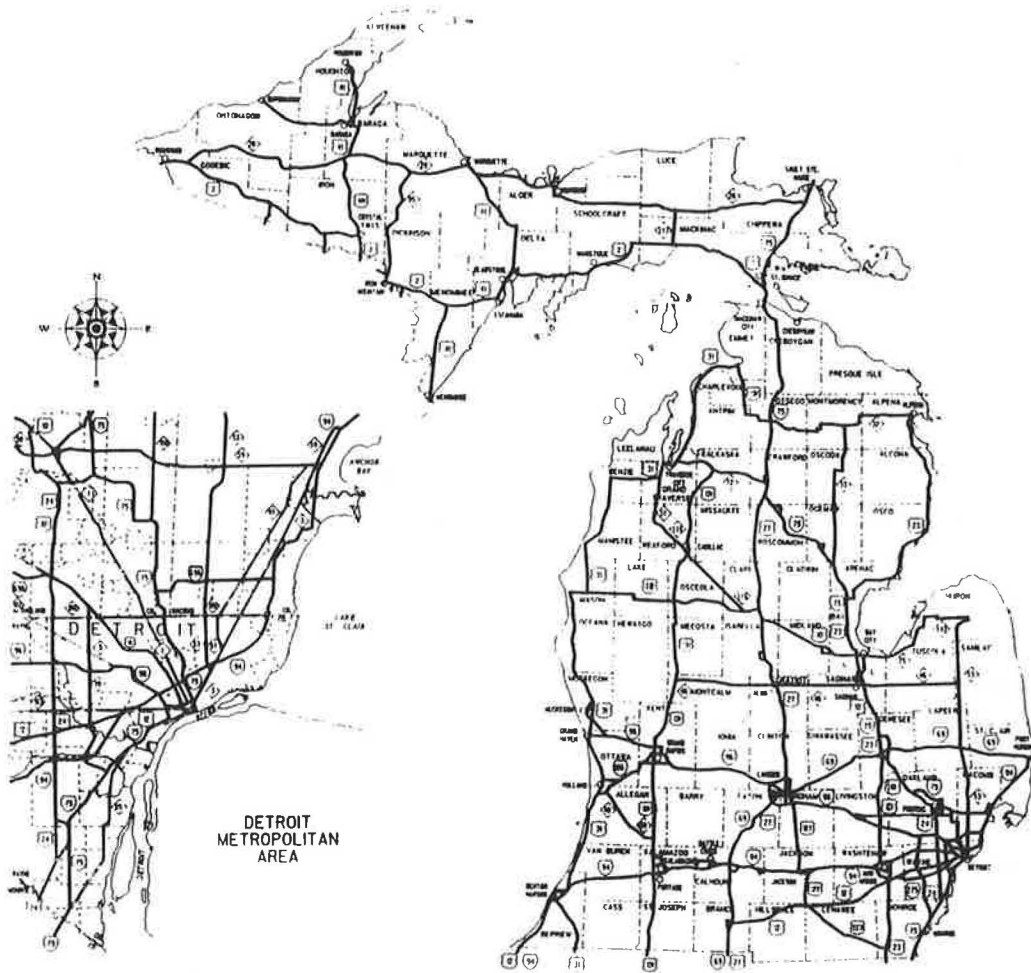


FIGURE 4 Michigan priority commercial network.

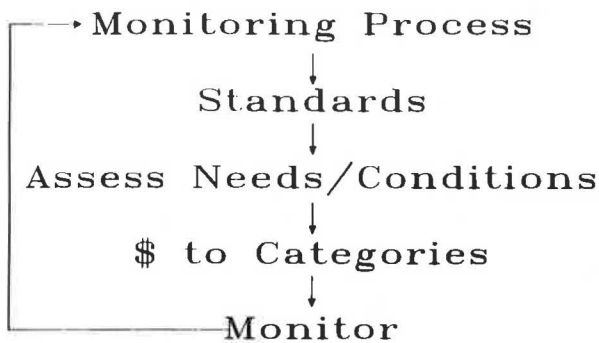


FIGURE 5 PCN strategy.

investment plan. Although our priority system is fairly well developed, in this case we are hampered by a lack of comprehensive condition information for public airports in Michigan. The assessment of total needs is underway, but for the time being we are applying our priority structure to the expected revenue and making some judgments about the goals and the types of work that are most important. We expect about \$390 million to be available in the next 10 years for aeronautics. As in many states, the program depends heavily on federal aid.

There is a shortfall between the revenue and our current needs assessment of about \$546 million (Figure 6). The shortfall probably looks familiar to most people here. So, we have been applying our priorities to this structure, starting with safety (lighting, approach clearing, safety signals on primary runways); and then going on to primary airside (runways and taxiways); and on to secondary airside (less important secondary runways and taxiways); and then to the primary landside issues (terminal buildings, access roads, tie-downs); and finally, the secondary landside (fencing, storage, service roads).

In addition to the facilities aspect and capital investment, we have focused on two service issues. One is the fact that some smaller cities in Michigan are losing business because it is perceived as cheaper to drive to Detroit than to fly to Detroit for an airline connection.

We developed a promotion called "Fly From Nearby," to get people to take another look at the cost of flying out of their local airport instead of driving to Detroit. We are working with local government and the promotion has just started, so, it is a bit early to tell what the outcome will be. So far, we think that the marketing effort is working.

The second service issue is referred to as "Access Michigan." Deregulation hit half of Michigan's airports very hard. They experienced a 50 percent drop in passengers and some never recovered. The result was some severe impacts on eco-

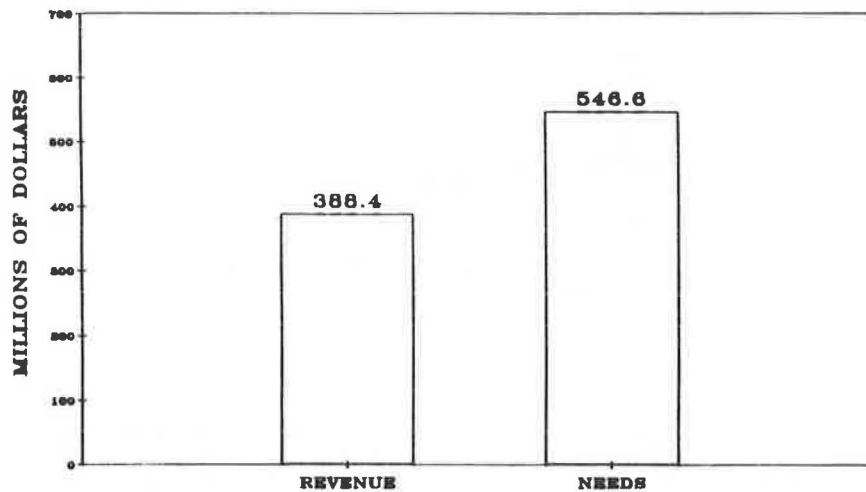


FIGURE 6 Aeronautics Investment Plan revenue/needs comparison, 1989–1998.

conomic growth. The purpose of our Access Michigan program is to induce some airlines to provide upgraded air service by guaranteeing profitability for a limited time on selected routes.

We have been working with local units of government to determine which cities will participate in Access Michigan. Local government is responsible for 50 percent of the cost of a market analysis and feasibility study. It is also responsible for part of the financial guarantee to the airline.

Access Michigan has some very specific goals, the first of which is to improve accessibility; the second, to support private initiatives that create or retain jobs in specific urban areas; and then to encourage the development of facilities that will bring travelers and businesses to Michigan.

One important aspect of Access Michigan is the belief that these air routes can be profitable and all we need do is work closely with the airline companies and with local government to structure the program so that the minimum guarantee is not needed for long.

The program is set up around some specific and strict eligibility factors and we are looking closely at evaluation criteria to select cities. We will also measure impact and effectiveness and estimate that the three cities targeted for service will have routes that are self-supporting by the end of the 3-year period.

The first city chosen for Access Michigan is Traverse City. In this instance we worked with Northwest Airlines to add jet service to the Traverse City Airport to support a growing convention business at the resorts.

The last aspect of investment planning that I want to talk to you about is monitoring. The term monitoring may sound “after the fact” or “passive”. It is not—we approach it in a proactive way. It not only measures progress, but makes sure that progress happens. A successful investment plan must be actually used as the guide for allocating money and for choosing projects. This requires a direct line between the investment plan and the development of long-range and annual programs in which projects are actually selected (Figure 7). With this link, you can monitor the progress of the investment plan over several years. Without this link, you have a plan that is put on the shelf and dusted off a few times if it is necessary to make a good impression.



FIGURE 7 Direct line.

By monitoring I mean the process of evaluating whether your plan is working and whether you are on or off target and whether the organization is, indeed, adhering to its chosen course of action. To do this, you have to be involved in project selection, which may be a new area for some planning organizations.

In Michigan DOT, planning is involved in the process of project selection. I serve on a group called the Project Section Committee and my main function is to help the rest of the group think in terms of broad program categories and goals, making sure that project selection fits within the framework of the investment plan.

In planning, we have learned that organizational dynamics over the last several years, and our path, has been at times anything but direct. But we can compare the results of our first several years under an investment strategy for highways and see progress (Figures 8 and 9).

One of the first measures, of course, is the number of miles improved. Our targets for the number of miles to be improved are 4-year goals. On our Interstate System we targeted 432 miles and met our goal. We had targeted over 1,800 miles for non-Interstate progress, and we exceeded our goal.

In addition to the simple miles improved, we are also seeing a shift in the overall condition of the system. On a scale of 1 to 5, where 1 is the best condition, the overall average system condition in 1985 was about 2.8. Now, after 4 years, we have significant improvements in the average condition of the Interstate System and PCN, with only a minor decrease in the

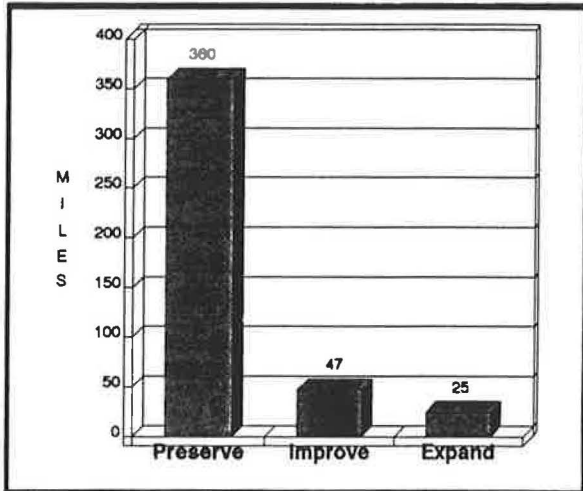


FIGURE 8 Interstate progress: 432 mi, \$732 million; 129 percent of 4-year preservation goal achieved.

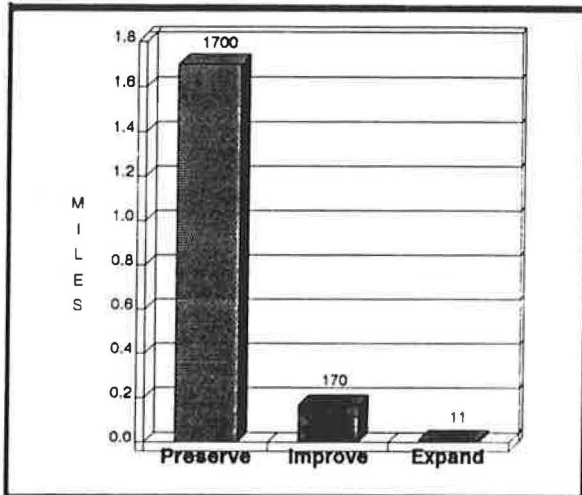


FIGURE 9 Non-Interstate progress: 1,881 mi, \$708 million; 109 percent of 4-year preservation goal achieved.

average condition of the PCN. We are currently analyzing the implications of this news.

Our field engineers, by the way, have expressed considerable concern over the PCN strategy because some resisted the idea that part of the trunkline system was more important than some other part. We have not experienced any complaints, however, from the motoring public with this targeting of resources. As a matter of fact, we have had fewer complaints from truckers about the condition of our Interstate System.

The data in Figures 9-13 show that we have moved a large group of pavements from the poor and very poor categories in our Interstate System all the way to the number one category by targeting funds. We have seen remarkable progress.

Another factor that tells us that the PCN strategy is working is that the cities and counties have approached us and are interested in developing a secondary commercial network that applies to county and city roads.

Other aspects of monitoring are also important. Monitoring enables you to establish a relationship between investment and a deterioration rate, which will be very useful for incorporation into a pavement management system in the future. It also enables you to verify that the department is meeting its commitments. It allows you to document how gas tax revenue is being spent so that when gas tax time comes around, you have the data to verify that it is being well spent, targeted, and accomplishing its goals.

So, monitoring is an important management tool, providing feedback at checkpoints that serve as the basis for revisions and adjustments to the categories. Our investment plan is not rigid and inflexible. We have a process for evaluating and changing and for reevaluating implementation progress regularly.

Organizational self-discipline is needed in order to make the investment plan work because there is constant pressure to add here, to move this into that category and to shuffle things around. Suddenly, you find that your program has grown by millions of dollars.

From here we go on to finish our comprehensive transportation program investment plan and work on increasing the level of sophistication. Our challenge is to integrate and consolidate our investment plans. We will not be able to solve

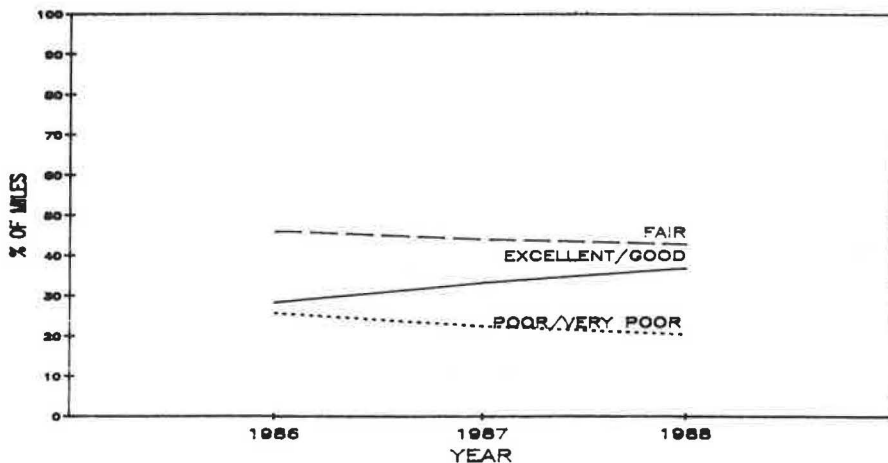


FIGURE 10 Priority commercial network trends statewide.

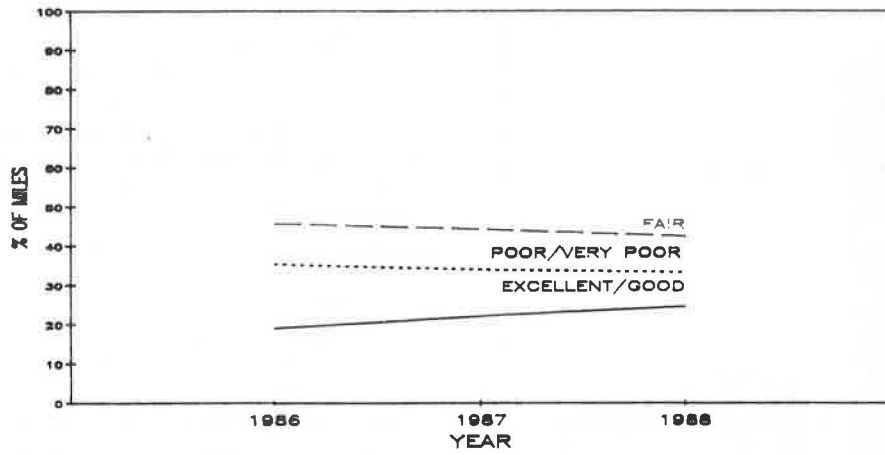


FIGURE 11 Nonpriority commercial network trends statewide.

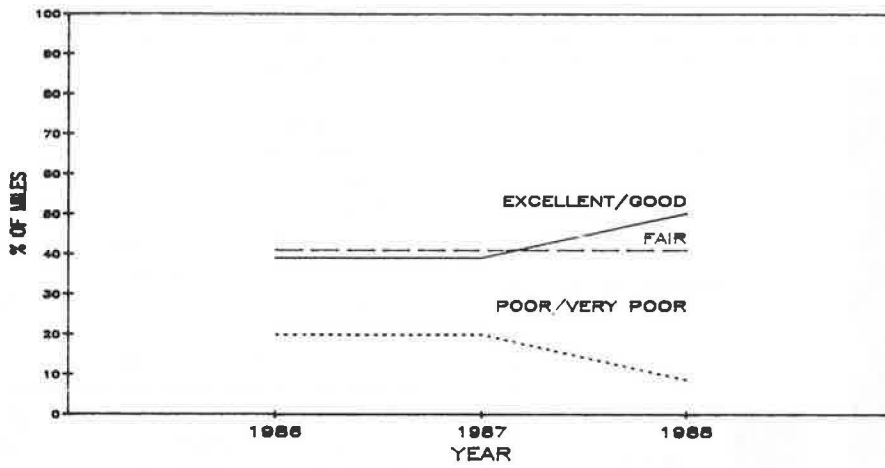


FIGURE 12 Interstate trends statewide.

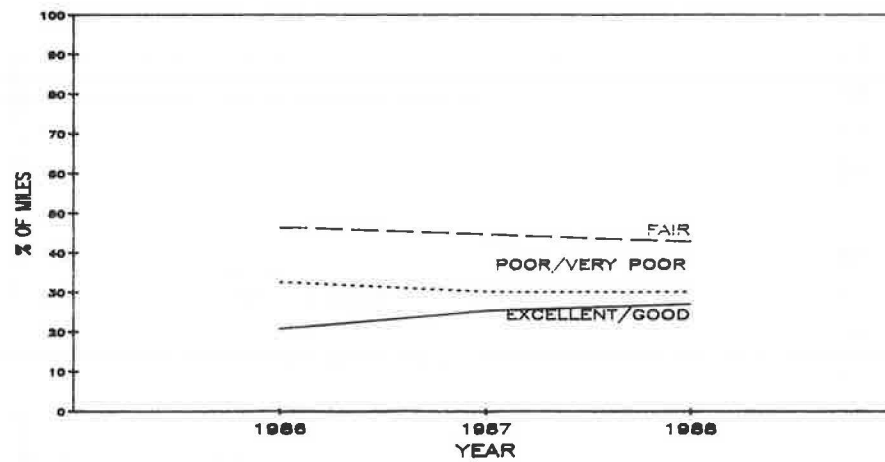


FIGURE 13 Non-Interstate trends statewide.

the transportation problems of tomorrow with any one mode. There is no way that we can widen the Interstate enough to take care of all the travel in particular corridors. We are going to start integrating the investment plan and take a good, long, hard look at how we can use public transportation to remove some of the burden from our Interstate system.

I like the “smart money” concept mentioned earlier because I think we are going to have to be a lot smarter as planners. Not enough money is available to do everything that is needed; so targeting resources makes good sense for the future. I think that we have taken the first important steps.

HENRY PEYREBRUNE

I have been asked to serve on this panel from my role as Chairman of the AASHTO Modal Technical Advisory Committee (MTAC) and in my role in New York State Department of Transportation, which has a vital interest in preserving and enhancing public transportation in the state. I would like to review my impressions of the 2020 efforts and then try to relate these to statewide multimodal planning with some illustrations drawn from New York experiences.

I have participated in the development of and reviewed various reports coming out of the 2020 process and several conclusions jump out at me:

1. All efforts have been basically modally oriented. Why? We do not have the tools, process or organizational structure to plan on a multimodal basis.

2. The data base to make multimodal tradeoffs is almost totally lacking. Highways has a good data base, and HPMS was very helpful in conducting analyses of alternative funding scenarios. Many of you have heard of our problems in developing a transit data base. Illinois was successful in this effort, but the data were lacking here. Something as critical as a bridge data file for HPMS analyses did not exist and has yet to come on line. For other modes, the situation is even worse.

3. Data that were available suggest the following conclusions important to the scope of this conference:

- A. Not enough money will be available to do all the things that people want done in 2020.
- B. The needs estimates for 2020 are dramatically understated because they are in constant 1986 dollars and do not recognize the real effect of annual cost increases attributable to inflation. In New York we have been using an annual inflation rate of 6 percent for capital programs. Over a 10-year period, a 1986 constant dollar figure is low by 78 percent.
- C. The cost of maintaining our infrastructure highways and transit, when factored by inflation, significantly exceeds current revenues on any revenue scheme being discussed currently.
- D. If maintaining the infrastructure has the first call on limited resources, little money will be left for adding new capacity. This is especially true for the Northeastern states.

4. AASHTO’s transit analysis shows that we are entering another period of disinvestment in our basic transit system,

repeating the mistakes of the 1950s and 1960s. If transit systems are to maintain their current absolute ridership, funding for transit must significantly increase. If transit is to maintain the same percentage of the total trip market (some 3 percent) or 20 percent of top 20 area work trips, transit ridership would double and the funding requirements further increase.

5. More highway funding is not necessarily the solution. Tests run under the 2020 process showed that between 11,000 and 25,000 lane miles of capacity improvements are needed at locations where such additions are considered to be infeasible. Highway service performance measures show a general decline even under the high-funding scenarios.

6. Based on present trends, 102,000 miles of new urban highways will be needed by 2020. If only 20 percent of these cannot be built (because of right-of-way and financial constraints) and the demand were shifted to transit, ridership would double.

7. The key solution bounced around is to increase “mobility,” which is usually interpreted to mean maximize person carrying capacity vs. vehicle capacity, or put another way, get more fannies into empty seats. Yet 2020 did not (could not) measure this potential although it is seen as the solution—more on this later.

SOLUTIONS FOR BETTER STATEWIDE PLANNING

In reviewing the 2020 process, I would like to discuss several implications for multimodal statewide planning with some New York illustrations.

Goal-Driven Scenario Planning and Programming

The 2020 process did not use the traditional “oh my God” needs estimates, but rather used a series of goal-based scenarios that say if you want to meet this goal, it will cost you X dollars. If you want a higher goal it will cost you extra X dollars. Running the analysis backwards, if you do not invest in the system, you can expect this condition and level of service. This analysis was very powerful in 2020 and leads to one of the major conclusions: you can pay me now (in program dollars) or pay me later (in increased travel costs).

We have used this type of process extensively in New York for both statewide resource planning—to establish revenue estimates for scaling future funding needs—and for developing our 5-year capital program.

The process involves several key items:

1. An up-to-date continuous inventory of conditions that can be readily translated into goals, e.g., no more than 10 percent of pavement surfaces rated poor.
2. A model (analogous to HPMS) that takes into consideration
 - Continued deterioration,
 - Impact of programmed fixes on deterioration,
 - Impact of different program mixes, and
 - Impact of inflation.

We used this approach successfully on a statewide basis to (a) scale the need for future funding; (b) convince the gov-

error, legislature and public on the need; and (c) develop support and pass a 4-year \$3 billion Bond Issue that essentially doubles highway program.

We also used the process for the past 2 years to develop and update our 5-year capital program. It allowed us to focus resources on our bridge infrastructure problem, for example, and as a result our latest goal-oriented program shows a significant improvement predicted in overall bridge condition.

Goal-Oriented Capital Programming

This method manages a capital program by establishing goals, setting clear objectives and measuring program performance in attaining these goals on objectives. It is the extension of goal-oriented management to developing and managing a capital program.

The first step in the process is to set realistic measurable goals for the 5-year capital program using condition surveys and computer models tempered with old-fashioned judgment.

The second step is to measure the performance of alternative 5-year capital programs against goals using quantifiable performance measures such as percentage of lane miles in poor condition, number of bridges requiring structural repair, and highway locations where accidents can be reduced by cost-effective capital projects.

The intent is to use highway and bridge inventories and computer models to assess the current and future implications of alternative program strategies. These mechanisms allow us to measure progress toward goals and to explain the implications of program changes to our public stockholders—the legislature and people of New York.

The advantage of having this kind of process in place became apparent in dealing with last fall's \$3 billion Action Bond Program. An initial Capital Program was developed in conjunction with the department's regional directors. (Later Metropolitan Planning Organizations (MPOs) were involved in the approval process.) Then the capital program was presented in the New York State Legislature. Adapting the capital program to selected changes desired by the legislature was helped immensely by the goal-oriented management process and the program evaluation mechanisms that were available. This was accomplished in such a manner that a very effective and realistic capital program resulted. The department won. The legislature won. And, more important, the public will benefit from a program of important capital projects that reflect deliberate negotiations—but with program results evaluated and interpreted using the goal-oriented management process.

This process has been instrumental in keeping the legislature focused on the needs of the department. It has also been useful in helping remove some of the subjectivity from the selection process. There are fewer tradeoffs and the consequences of having a project that may not meet the goals are clearly understood.

Return to 1960 Planning Techniques

The process is technically sound, well developed and sophisticated—it estimates, forecasts and models travel behavior. The process is also politically sound—MPOs are well accepted

and serve to integrate technical decisions into a complex political environment. The expressway is no longer the ultimate answer because in many areas we have reached the practical limits of new construction. These limits include lack of funds, political constraints, and limited rights-of-way.

The key word now is "mobility." Emphasizing mobility is the key to solving all our problems, but nobody has a real definition of what that means, no ability to measure or project if the argument has any substance and no way to know if the traveling public will respond. The strange thing is that I believe that mobility programs are the answer even though I do not know why—probably because it is the only answer possible when you look at all the other alternatives studied by the 2020 process.

We know the manifestations of mobility. It involves unused seat capacity in single-occupant cars, it involves measuring capacity in terms of people moved rather than vehicles moved, it involves filling empty transit seats in off-peak hours. It involves coordinating the various special-service transit systems to reduce duplication and save scarce resources. It involves coordinating schedules and fare policies of various transit providers on a regional or statewide basis. It involves coordinating toll policies with parking policies and transit pricing strategies.

Role of Growth

Most people believe that the largest growth is occurring in the South and West. There is some truth to this but both New York State and the New York City region are also experiencing some extraordinary growth. The growth in vehicle-miles traveled has been at about 3 percent a year statewide and will probably continue at this rate.

The absolute growth is startling. NYMTIC data show that more than a million new commuters have been added since 1977. Because absolute numbers of people travel, not percentages, this presents a significant challenge in New York.

The New York metropolitan region has experienced a 50 percent growth in travel. Transit ridership there is already 84 percent in peak hours to Manhattan CBD, where an HOV lane already carries more than 30,000 persons per hour. Existing rights-of-way there are constrained and significant infrastructure programs lacking.

The dominant journey to work has become the trip between suburbs (60 percent of the total for the region). This trend further exacerbates congestion problems owing to gaps in the highway and transit systems linking suburban job sites and suburban housing.

New York City truck operating costs are double the national average, according to AASHTO. Increased congestion is expected to even further reduce the efficiency of truck-borne goods movement. Current resources to fund needed transportation improvements from federal, state and local governments will be insufficient to keep the region economically competitive.

The negative effect of increased traffic on the economy is beginning to be felt even in the suburbs. Long Island's share of new jobs is projected to fall from 19.8 percent in 1987 to 10.7 percent in 2005 because of land access constraints, according to RPA.

In short, forecasts of growth in regional population and employment, along with other underlying causes of increased transportation demand, cannot be easily reconciled with the limits of the already overtaxed regional network. Thinking in terms of mobility of people and goods is the only possible solution. Enough new highway capacity to handle the problem is simply not an option.

SUMMARY

Mobility is the key. In New York we think the key is to institutionalize mobility thinking into all processes in agency and metro areas. One means to accomplish this is to develop more planning techniques. In addition we need to better integrate the various modal groups within DOT, within urban areas, within the MPO structure.

Better measurements and goals must be established for our program managers. Instead of measuring capacity as number of land miles of Level of Service X, for example, measure capacity projects in terms of number of hours or minutes of congestion relieved per dollars spent: for example, a capacity project in the north country to relieve 15–30 minutes of congestion may be worth X dollars, whereas on the Long Island Expressway, which operates at Level of Service E for X hours, the max project may still have 1, 2, or 3 peak hours at Level of Service E or F, but the remaining hours with less congestion are worth Y dollars.

On the highway side, we are trying to look at each congested corridor slated for improvement and review the corridor for potential or improved person travel. Examples include the Long Island 4th lane, a highway which was originally a commuter run to New York City but is now more intra-island. Another example is the Cross-Westchester expressway, where we have decided instead of a \$40 million rehabilitation to do a 20-mile-long HOV for basically suburb-to-suburb travel.

On the transit side, we held our own 2020 conference and came up with some conclusions similar to the 2020 results. The discussion centered around the role of transit operations in dealing with mobility issues. Some felt that they should become full-service agencies dealing with carpools, vanpools, and HOV, and that anything with more than one person per vehicle was transit. Other operators felt that transit agencies should continue to do what they do best, move large quantities of people rapidly to work and back and that getting too extended would sink the whole thing.

Clearly there is an institutional void in our metro areas. On the state side, it is even more difficult to institutionalize mobility thinking. Agencies usually concentrate their plans and energies on the facilities they own and manage because that is where the political liability rests. For example, if a state bridge falls, there is no question who is politically liable. Because state agencies generally do not run transit systems, there is a tendency to step back from mobility-type problems. State agencies have to take the leadership role and recognize that concerns of mobility affect their own facilities as well as those of other institutions. We need to break down these institutional barriers if we want to make any progress.

Consumers and Users

SANDRA ECHOLS HAYES, CAL PIPAL, DELAINE EASTIN, AND
KIRK P. BROWN

SANDRA ECHOLS HAYES

In the downstate New York metropolitan region it is both the very best of times and the very worst of times. In mid-April, the Bi-State Transportation Forum—a forum composed of the chief transportation officers of New York State DOT, New Jersey DOT, New York City DOT, New Jersey Transit Corporation, the Metropolitan Transit Authority, and the Port Authority of New York and New Jersey—jointly released a regional assessment document developed by Metropolitan Planning Organizations (MPOs) in New York and New Jersey.

Now when the six transportation executives of metropolitan New York and New Jersey bring together their collective resources and concerns for meeting the future mobility challenge of the region, it is the very best of times.

However, when that assessment finding indicates that “the assessment shows that chronic congestion has become the common denominator for virtually the entire region during peak commuting and weekend travel hours,” it is the very worst of times.

This focuses the critical need for statewide multimodal transportation planning in the New York region. To the extent that the MPO, the collective body of local governments, is the consumer/user of statewide transportation planning, it is appropriate to ask how effective is statewide planning in the New York Metropolitan region.

I will limit my comments to two of the elements of statewide transportation planning, two elements in which locals participate and in which the region can benefit: (a) assessing and forecasting the short- and long-term transportation environment, needs and resources, and (b) participating in the metropolitan planning process.

In this region, and perhaps in other regions within the state, there is a changed environment. Even as the current highway and transportation systems were being put in place, the trends on which they were premised were changing. By 1980, a noticeable loss was registered in the region’s population, and even with equivalent growth in the mid-1980s, the population has not reached its 1970 level.

Within the region, economic activities have increasingly spread to the suburbs to the point that intrasuburban trips

have become the dominant pattern for the suburban commuting network. The highway and transit infrastructure is now a mismatch for the dispersed intrasuburban travel patterns.

From 1970 to 1981, there was a 40 percent increase in vehicle miles of travel (VMT) in the region, and by 2050 a 50 percent increase in VMT is projected. The New York metropolitan region is a region at risk and the state transportation planning process has assumed the leadership role in meeting this critical mobility challenge.

Statewide multimodal transportation, to be most effective for users, must present a perspective that is regional, intermodal and multijurisdictional and it should include:

1. Articulating the strategic issues to the policymakers and the voters;
2. Taking the lead on data collection and management, a prime requisite to proactive planning;
3. Expanding the transportation partnership to include private stakeholders; and
4. Addressing the capacity needs for both highway and transit.

STRATEGIC ISSUES

Proactive planning can be a useful first step in the process. The notion of developing strategic transportation issues in cooperation with other stakeholders in the region has already proved beneficial as the region moves toward a shared understanding of the mobility crisis in the New York region.

The Bi-State Forum jointly convened a regional mobility conference hosted by the Port Authority of New York and New Jersey. They invited public and private sector participants. The findings of that conference can be the first step in articulating the strategic issues to the policy makers in the downstate region.

DATA COLLECTION AND MANAGEMENT

The data collection, storage and analysis element is a mandatory part of the regional planning process. It has been a major effort of statewide planning in New York since the early 1960s and the state is a key player in this area.

The New York region has a heavy overlay of separate public entities and jurisdictions, some autonomous while others are executive departments of government. This contributes to a fragmented regional data collection and management system. The state assumed the lead in convening the regional trans-

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portation system data in the region as a whole. The regional assessment document I mentioned earlier was that beginning.

PUBLIC/PRIVATE PARTNERSHIP

The transportation system in the region has historically reconciled the imbalance between jobs and housing availability. A system operating beyond capacity such as it is in our region, however, has a much tougher time satisfying that need and, thus, puts the economy of the region at risk.

To maintain the region's transportation system in a state of good repair, not only must the existing partners find ways to increase their investment levels, the partnership must be expanded to include private providers, developers, employers and new and creative funding methods.

Major capital investments in the transportation system around the globe are impressive: In Tokyo, Hong Kong, Paris, and London multimillion dollar projects are being implemented with a massive infusion of private funds. State planning has taken the lead in expanding this public/private link to begin the dialogue on resources versus needs in the metropolitan region.

The whole issue of financing transportation should be securely linked to the issue of what transportation service should be provided in the region and what quality of the service should be there.

EXPANSION

Significant expansion of the highway system can be ruled out in most locations in the New York metropolitan region. Capacity needs, both highway and transit to move people and goods, continue to pose the problem of congestion and immobility. Three issues related to capacity needs in the region are (a) the high cost of mobility, both in terms of time lost in moving people and goods, as well as the cost of maintaining and building the system; (b) access to the Manhattan central business district; and, (c) intersuburban commuting.

The state planning process must move to the forefront in capacity building through improving and managing the existing highway and public transit systems.

In summary, statewide multimodal transportation planning must serve as the catalyst for the new mobility perspective in New York. The car-versus-transit, city-versus-suburb debate must end. New commitments among jurisdictions to harmonize transportation planning and operations, a new level of intermodal integration and a new sense of balance between expanded capacity and continuing maintenance and renewal should be on the statewide multimodal transportation planning agenda.

CAL PIPAL

I am going to speak to you both as a member of the business community and as a private citizen. From a business perspective, it is important to discuss the people issue, the employee issue and the goods issue.

In looking at transportation, the first concern is transportation quality. Transportation quality means getting people and goods to destinations safely, and I put safety above every-

thing else. It does no good to deliver products if they are damaged when they get there. Safety certainly is important. In addition, these goods must be delivered within consistently predictable times. If we tell the customer that delivery will occur the day after tomorrow, then it must arrive the day after tomorrow. The delivery times must also be considered reasonable by the customer. Maybe we can get it there in 4 days, but 4 days is not reasonable; the customer may consider 2 days or 1 day or 8 hours reasonable. We have to live by the customer requirements and cost must be affordable.

Another issue of great importance to a business is employee transportation. We have more lost time because of accidents that occur on the trip to and from work than because of accidents during the working hours. Industry and business have a responsibility, along with government, to deal with this problem. Rush hours are terrible, but industry can do something to help. We traditionally have had people come to work at 8:00 a.m. and leave at 5:00 p.m. We really do not need to do that. We can stagger working hours better than we have. I will give you an example in 3M's case. Our St. Paul headquarters with some 10,000 people is located next to Interstate 94. For years everyone came to work 7:45 a.m. and left at 4:30 p.m. There were only two exits from the freeway then and they were continually jammed. The parking lots were jammed. Someone thought of staggering work hours. The office employees, half the population, could come in at 7:30 a.m.; the laboratory employees, the other half, could come in at 8:00 a.m. This simple approach solved our congestion problem.

I will now cover one item relating to the "people" issue, that of senior citizens. Society owes these citizens good mobility because for the most part they have made major contributions to society. And they are becoming a larger segment of the population. People are living longer, driving longer, enjoying good, healthy lives and able to contribute longer. The "baby-boom" era is over. I think we have to look at making it easier and safer for senior citizens to drive. Certainly, this helps maintain their quality of life.

I know that I do not react quite as well as I did 30 years ago in emergency situations. My vision probably is not quite as good as it used to be. I do not even like to drive at night because my night vision is poor. We need to look at the aging driver in our planning efforts and prepare for a different world.

Representative Eastin mentioned that we need to think globally and act locally. I very much subscribe to that point view. Global logistics is the competitive battleground of the nineties and if we in the United States are to be successful, we must be concerned about global competition. The requirements for competing effectively include having good products and services. That is a given. In addition, we must have the right price. If we price ourselves out of the market, we will go out of business. Beyond that we have transportation requirements. We have to have reliable delivery and timely delivery. And we must have flexibility, because our customers requirements are changing very quickly.

"Just-in-time" delivery is a good example of our changing world. More and more companies are using it. More and more customers are demanding it. It means more frequent shipments, and more use of transportation deliveries. We have customers telling us that delivery must be made in a certain time slot or they will not accept delivery. Appointment deliveries are becoming more common.

As I look to the future, I see some significant challenges. Europe will become a common economic bloc in 1992. Europe is going to be one market with 300 million people, just like the United States. I recently saw a cartoon showing a big truck at a customs station and a driver talking to the customs agent. The driver had a small package in his hand; this was the cargo. The paperwork was in the rear. This is going to change. With the Common Market there will be no paperwork. Crossing boundaries will be the same as crossing state boundaries here in the United States. This is a dramatically changing situation.

We also have a changing situation in the North American market. The tariff barriers between the United States and Canada will be coming down. We cannot look at the U.S. market as separate from the Canadian market. In 3M's case, we have had them separate all these years. Now we are saying, "Vancouver British has been supplied out of our Toronto warehouse. Why not use Los Angeles which is only half the distance to Vancouver?" We were going to build a warehouse in the northeastern United States, but now we have a big warehouse in Toronto. Maybe we do not need another warehouse.

Another global factor that will affect us locally is the emergence of the Pacific Rim countries. I am not talking about Japan or Australia, but rather the Taiwans, the Koreas, the Singapores, the Hong Kongs, the Malaysias, the Thailand, and the Philippines. Look at the gross national product. It is growing faster there than it is in any other part of the world. My company has traditionally supplied these countries out of St. Paul. The St. Paul office sends orders to the plants and they are consolidated in St. Paul and shipped by rail to the West Coast and then to our Far East subsidiaries.

A \$4 million subsidiary like Taiwan 8 years ago was acceptable, but that \$4 million has grown to \$40 million today and growth is continuing at that rate. We can no longer conduct business like we used to. We are going to build a warehouse on the West Coast that will supply our Far East subsidiaries. Instead of waiting 3 months, they will only wait 2 months. Beyond this, we have to look at building a distribution center somewhere in the Pacific area, maybe in Taiwan or Singapore. Then we can reduce our delivery time to 1 month because this timeliness is absolutely critical to our survival.

So, these are the changes that are coming. All of us need to recognize these changes and their consequences.

Let me end with a listing of "wants." One of them is to relieve congestion. That may be impossible, but I travel around the country and I see freeways at rush hour that are giant parking lots. Congestion will seriously constrain our ability to compete. Another "want" is uniformity among states. It is frustrating when trucks are legal in one state but illegal in the next; or legal on an Interstate highway and illegal when you turn off. We must strive for better uniformity, particularly if we are going to be globally competitive.

Transportation planners have to be the visionaries. We cannot afford to say that it is working now, so let us be comfortable. Things are going to change. Two things are required for encouraging change—courage and effort. Peter Drucker has said that innovators do not create change, they exploit it. He went on to say that the best way to predict the future is to create it. I think that this group is in a position as much as any group to create the future. We in industry and business have been remiss in not helping you. I would like to suggest

a transportation partnership between business and the private sector, private citizens and people in government. Such a partnership, I think, is absolutely necessary.

I would like to close by reciting something I read not long ago. "Don't walk in front of me, I may not follow. Don't walk behind me, I may not lead. Just walk beside me and be my friend." I think that people in government and in private industry and private citizens have to walk side by side as we create the future in transportation.

DELAINE EASTIN

This conference has given me hope. I find myself recently thinking about that great philosopher Woody Allen, who said that we have reached a crossroads. One path leads to destruction and the other to despair and he hoped that we would have the wisdom to choose wisely. I first came to the California State Legislature from corporate planning and asked myself what I could do to prepare for this job. I was on the transportation committee, so I asked if I could see the long-range plan for transportation in California. You know the one, the long-range plan for transportation, *the long-range plan*. I found that, in fact, California had stopped doing long-range planning in transportation several years before. Although we had a laundry list of projects that we call the State Transportation Improvement Program (STIP), it was in fact a list of projects that we were intending to build, nothing more than a laundry list of highway projects. The state was not doing long-range transportation planning and it had also stopped funding transportation.

Under the previous administration, California dropped from being one of the leaders in transportation, a position it held for a great many years. In fact, we used to have a jingle in California: "So, sing my friends, be blithe, be gay or weep my friends with sorrow. What California is today, the rest will be tomorrow." If I thought that were true in transportation, I would suggest that we all join hands and pray for the future of our country, because under the last governor we dropped to 49th of the 50 states in our per capita investment in transportation. It is hard to do worse than 49th out of 50, but under the present governor, we dropped to 50th. In fact, we are 51st, if you include Washington, D.C. as a state.

So, not only does California fail to have a long-range plan, California also did not have an investment base worthy of its problems. To put this in context, we are spending on roads in California the same amount in constant dollars as in 1948 when I was 1 year old. During that time, our state population has increased by almost 500 percent. The number of vehicles and vehicle miles driven has expanded dramatically. Especially horrifying is the dramatic growth per day in California.

The growth per year in California is the equivalent of a new Boston every year. So, California, which is adding 600,000 people every single year, has failed to plan and failed to invest and is really in deep yogurt at this point.

I also discovered when I got to the legislature a remarkable inability to appreciate the difference between expense and investment. I think that this is to some extent, a problem in our nation as a whole today and I fear for the republic when I look at our failure to plan for several aspects of the infrastructure of the United States.

Recall that in the immediate postwar period we were pretty puffed up with ourselves. We had 26 straight trade years of surplus, 26 straight years as the number one trading nation in the world, and we felt pretty darn good. When you look at the asterisk next to the 26-0 season, however, you discover that, as Tom Peters said, all wins were by forfeit. We were the only game in town.

In a real sense, the 1970s was the first time that California entered a global economy with global competition. California and the United States are competing in a world economy quite different from that of the immediate postwar era. So, if we fail to invest in our infrastructure, not just in our roads but in all aspects of transportation including airports, sewers, bridges, water delivery systems, and even education, America will surely be competitively disadvantaged as we move into the next century.

One of the things that is striking to me is the failure, at least in California, and I believe to some extent in your states and certainly at national level, to differentiate between expense and investment.

Just for a second, let me point out to you that every major company—and I know that this is true at 3M, which is one of the finest companies in America—has a 20-year plan. Now not every member of the company may have seen the 20-year plan. Some of it is privileged information. Most are familiar with the 5-year business plan, but in the top drawer of the chairperson's desk of every major company in America, if I am not mistaken, is a 20-year plan for investment.

In the State of California, we require every city and every county to have a 20-year plan. We just don't do it ourselves.

Last year, I carried a bill, Assembly Bill 2927, requiring the State of California to do long-range planning for transportation. We received wonderful support from the Business Roundtable, California Chamber of Commerce, California Manufacturers' Association, the California Transit Association, and the California State Auto Association. In his veto message, our governor said that it was impractical and unnecessary to do long-range planning for transportation. Interestingly, however, that same week he formed a strategic planning group at Caltrans.

So, I am hoping to be able to tell you at some time in the future that although we lost the battle, we won the war. I also have to tell you that I believe that Franklin Roosevelt was very shrewd, when having listened to a group of people who were lobbying him on an issue that he cared very much about, said to them, "I agree with everything you have said. Now, go out there and put some pressure on me to do something."

I think it is imperative that the business community in America begin to put pressure on each of the 50 states and on the national and local governments, to look at this issue in a clearer fashion. Yes, we ought to hold down expenses in this country. You bet your life. And we could do a better job at it. But even as we hold down expenses, and every major corporation does that, we have to know when it is time to invest, and I am here to tell you that I think that it is time to invest in America again.

Now, if you do that, you really ought to do it with the kind of vision and foresight that our ancestors had. I have to tell you that I think this country's history is absolutely stupendous. If you think about how hard it must have been for people in the 1820s to figure out how to build the Erie Canal, in the

1800s, to build the Transcontinental Railroad, how hard it was at the turn of the century to build the Panama Canal after the French had failed, how difficult it was to build the Golden Gate Bridge and the Bay Bridge at the height of the worst depression in the history of this country, when you think about how hard it must have been to build the freeways that we built in the immediate postwar period and how we built the BARTs and the Metros and expanded systems during the sixties, you ought to really ask yourself what in the world happened. How have we lost this sense of purpose and sense of vision of our ancestors?

And how did we get so out of touch with the people whom we serve? In the end, the same is true of excellent government that is true of excellent companies. We have to be customer focused. We ought to be running the transportation system in this country as if we were customer focused. If you understand that—which happens to be one of Tom Peter's primary rules for excellence in corporations—then you will begin to understand why multimodal transportation planning is absolutely essential.

The environmentalist community has a great slogan, one that we should all pay close attention to: "Think Globally, Act Locally." I am here to tell you that I do not believe it likely that the solution for the future transportation policy in the United States will come out of the federal government.

The process in Washington has become so convoluted, in part because of the deficit and in part because of the very size, scope, and scale of the country. As a result it is hard to imagine the kind of system that you would build to serve the rural regions of Iowa, the urban regions of New York, and the suburban areas that are growing so rapidly. Increasingly, the commute in my area is no longer from the suburbs to the city, but too often it is from the suburbs to the suburbs.

You have families that pick a place to live so that they can split the difference on their commutes because the husband goes west and the wife goes north, or the husband goes east and the wife goes south. You find areas in which the commute is so stretched out that you have to begin to be customer focused. In the San Francisco Bay area, a region that is as interrelated as any I can think of in the country, there are 24 transit agencies and they hardly talk to each other. There is no common universal ticket, and no systematic attempt to coordinate the schedules between those various transit agencies. It is as if you had 24 little fiefdoms and no one ever traveled between counties.

The only exception—probably the best exception—is the BART system, which carries a quarter of a million passengers a day and proves that if a system is clean, convenient and timely, people of all classes will ride it. The BART system is full. You could practically use pushers to get people in during commuting hours, despite the fact that it does not go to some of the most important work centers in the Bay area. If there is more than one transit agency, they should communicate with each other. The bottom line should always be not, how do we get the greater glory of any one agency, but how do we get the consumer, that customer, that transit rider, from Point A to Point B.

We also have to begin to rethink exactly how we develop the transportation system of the future. In our California we love our cars. We are joined at the hip. We have cellular telephones and stereos and we spend half our time thinking how we can enhance our cars even further. At the same time,

California is experiencing a series of devastating problems. Not only is every citizen in California spending more than \$120 extra per year on vehicle maintenance, but California is having terrible air quality problems. In Los Angeles, Draconian measures being discussed. In fact, the air basin authority, the South Coast Air Quality Management District, is talking about banning such things as charcoal fire starters because the air quality of the district is so deteriorated.

Sacramento is also one of the top 10 worst air quality basins in the entire country and we also have serious air quality problems in other regions of the state. And so we find ourselves in a situation with lengthening commutes, growing out of an imbalance between jobs and housing. That will be one of the great challenges not only in our area, but in this city and in other cities.

Land values are so high in many of our cities that we are pushing people further and further out into the countryside so that they can own a piece of the rock and have their own home. We have people commuting two and a half hours each way. They are living in the Central Valley of California, in Tracy or Stockton or Merced and literally driving 80, 90, or a 100 miles into work.

My husband works in downtown San Francisco. His secretary has a home in Sacramento. The distances are nearly a hundred miles. So, the truth of the matter is that California, in addition to not being focused on interrelating its transit system, has forced many people to live further out because of land values. At the same time, however, we are not building roads to those areas. So congestion is spreading into many areas outside the San Francisco Bay, outside the Los Angeles and Orange County areas. I know that the same thing is happening in Boston; I heard reference to it on the news the other day.

We thus find ourselves in a position where we either have to start thinking about what to do to put jobs and housing back into balance or our problems are going to get worse. In addition, I would suggest that we need some new models. We talked about this a little in our breakout group this morning. I think that we need some new models for evaluating the cost of transit versus the cost of highways. You will recall that during the energy crisis in this country we created an avoided-cost model of energy. We said that there was a value to the United States of America not to import foreign oil.

Is there not a value to this country in protecting and maintaining the vast stretches of land that could be lost to new highways? In California, where extraordinary housing prices exist, the cost of building a freeway approaches the cost of building a rail system, even without an avoided cost.

The Century Freeway in Los Angeles costs a hundred million dollars a mile to build. That is a freeway. It costs that much because you had to buy people's homes in order to put that freeway in. When you start buying up California real estate at a quarter million dollars a house, you begin to run into some high costs. The Los Angeles Air Basin won't let you continue to build Century Freeways over the long term, even if you wanted to write a check for the amount.

We are building a new freeway in California that will cost \$41 million a mile, Highway 85 in Santa Clara County. At those prices, you begin to approach some of the costs of light rail construction in Santa Clara, which run on the average between \$30 and \$70 million a mile. Again the highway figures do not include the long-term cost of taking all that land off

the tax rolls and the long-term cost of air quality problems that you generate by having more people in their cars.

So, California has a lot of work to do. As bad as things are in California today, estimates are that the 500,000 hours of commuter delay that occurred in 1985 will grow to 3½ million hours of congestion and delay for commuters in the year 2010.

Put somewhat differently, the \$620 million or so cost to business in California in 1986 associated with traffic congestion is estimated to grow to \$2.3 billion in the year 2005.

So when you see people in traffic jams in the San Francisco Bay area or in the Los Angeles or Riverside or Orange County area, you are not just seeing inconvenience. You are seeing goods late to market and you are seeing customers late to make their purchases. You are seeing workers late to their jobs.

The economic development of the United States, and nothing less, is at stake in the infrastructure planning and the investments of the next 20 years. I fear for this country's future when I think about that. The thing that makes me hopeful, however, is the people that I see thinking globally and acting locally.

If we are to be competitive, it will be because local jurisdictions have decided to take matters in their own hands, as have some counties with half-cent sales tax measures in California. In fact, counties representing approximately a third of the population of California have passed half-cent sales taxes to support transportation improvements. That is extraordinary and it has come about because of the willingness of the public and private sector to join in trying to resolve the problems of a given local area.

Think globally, act locally. It is time to improve our local planning. I carried legislation that said that regional transportation plans in the San Francisco Bay area had to reflect the individual county transportation plans and that county plans had to reflect city planning. It is hard to believe, but they were not required to match prior to the passage of this bill.

We have to improve communication among all levels of government. I remember having a political science professor who said that if you want to think of American politics, don't be tricked into the habit of thinking of it as a layer cake. It is a marble cake. We are all swirled up together.

If we could begin to strengthen the planning process at the local level and at the regional level and ultimately at the state level, I think that it will put pressure on the national government to begin to understand what we must do to ensure the economic development of our country.

We have a lot of work to do and it requires us to go beyond reacting to tomorrow's pothole or tomorrow's immediate problem, but to anticipate what the long-range developments of this country will and should be. That means thinking about transcontinental rail service rather than just pouring a little more concrete. It means thinking about the next stage of communications and telecommunications. In the end, there is no such thing as a free lunch. We had better make ourselves a lot leaner and meaner, make our departments of transportation a lot more efficient, and ensure that they are delivering much faster.

California's Department of Transportation is working on that, but only after we discovered that it currently takes us 8 years to deliver the 5-year STIP in California. We need to make the average taxpayer willing to invest in us because

we give them a decent return on their investment. If we define this as an investment and communicate effectively and get the business community to work with the public sector to see transportation planning and delivery as an investment in the future of this country, we will have a chance in the twenty-first century. Remember that the twentieth century was the American century. The twenty-first century will be the global century. California is not competing against Texas or Michigan or New York. California is competing along with those states. Our competitors are the European Common Market. Our competitors are Japan and Taiwan and Korea. I do not think that they are going to drop a bomb on our heads; through economic competition they can just as effectively reduce our ability to grow in a way that we have come to expect and in a way we would want for our children and grandchildren.

I am proud to be an American. I like the sense that we have been entrepreneurs, but we need to dig down and rekindle that sense of adventure and begin to have vision again. After all, what is vision but planning, foresight and more planning. If we do that, we will find that just as our problems are bipartisan problems, we can come up with bipartisan solutions. In my state it was governors from both parties who failed to do the job. So, this is not a partisan problem. This is an American problem and together we can do some exciting things.

KIRK P. BROWN

Let me present a different perspective than the previous speakers. I will give you my perspective, or bias if you will, as a trial lawyer. In my role as a member of the Colorado Highway Commission, I look on planning documents as a kind of Exhibit A in planning and promoting a construction program, promoting revenue-raising programs with the state legislature and with Congress, and meeting with the public at large. I see the legislators and the governor as a jury judging whether the documented needs justify the expense.

So, if we look at planning documents as Exhibit A, how we can improve or adjust them so that we can sell that jury, so that we can come back with that award of a revenue increase?

The Colorado Highway Commission is somewhat unique, I think, in that the legislature gave the 11-member commission decision-making authority on maintenance programs and operational decisions. We are perceived as a joint budget or finance committee with respect to oversight. In addition, we serve as a kind of board of directors, controlling the development, contents, and implementation of the plan. The commission sets construction priorities in Colorado and the legislature sets the level of funding. A trust fund is shared with local governments.

Because of the diversity (urban, rural, geographic, and ethnic) of Colorado, it is very difficult to come up with a statewide plan. I see myself as a broker for the Highway Department in trying to convince the public, the media, and the legislature that a statewide plan exists. I also see myself as providing feedback from local governments and from the public at large on how it is working. So, I deliver the baby both ways in this process.

Colorado experienced tremendous growth in the seventies, as well as ravaging inflation that wiped out our ability to meet

our infrastructure needs. In addition, as our former government said, we are seeing the Balkanization of the transportation system. Special authorities have been formed because statewide revenues cannot do everything, such as provide for transit, HOV lanes, and highways. Developers are joining with other constituent groups to develop these authorities for transit and highways. One of the authorities is constructing a beltway around Denver.

We are all talking in this conference about a scarce resource allocation program. The documents of the past, the Exhibit A's of the past, were not geared to surviving with that kind of program.

Well, how do we live with it? One of the key tools is communication. How do we make our planning documents communicate to that jury out there? In the 1980s, Colorado had a traditional planning document that identified maintenance needs, safety needs, capacity needs, bridge needs, and service to the state. It was called the Colorado Forecast of the Year 2001 Highway System and it worked quite well. In fact, we got a 6-cent fuel tax increase using this document. It set forth the surface condition of the state, the objectives we wanted to meet, and the cost. It had foldout maps (some with capacities), levels of service needs, costs, and geometrics. It listed bridges and bridge rehabilitation needs, and told which were structurally deficient or functionally outmoded. It also described rest areas, noise walls, grade separations, and interchanges. We worked closely with local governments in a joint planning effort and relied heavily on local advice and input in selecting priorities.

The problem with the plan, however, was that it was a wish list. Accordingly, it made no commitment to a construction program. We have, as many of you do, a 5-year program. But this long-range planning document did not commit to a long-range construction program. We can argue about the merits of having or not having such a commitment. One of the reasons for no commitment of course, is that Colorado has a very unstable revenue stream. One year we get 6 cents, adding \$110 million to the trust fund. The next year \$58 million is cut. This year, the 6-cent tax is sunset and the governor is threatening to go into a special session and hold the legislature all summer until the 6-cent fuel tax is extended, but that could result in a \$110-million loss a year. It is obviously very difficult to make long-term commitments with such instability.

Another problem with the plan was that it did not clearly identify how our transportation forecasts met state needs. In other words, how did they relate to economic development, to air quality improvements, to land use plans, to development patterns, and to the strategic state objectives set by the legislature and governor?

We suffer from the same problem as you do. We suffer from taxpayer revolts. We suffer from the "read my lips" mentality of no new taxes. We suffer from "I want, but I won't pay." We suffer the inability to perceive the long-term investment needs that have to be made, but that lack the glamor of some other projects. We suffer from competition for funds with the educational system, the prison system, and other areas. What is needed in future planning documents, therefore, is an increased sensitivity to justifying the system. That justification, moreover, must be able to defend itself from the scrutiny of the public and the legislators. It also needs to say how the system is relevant to our objective.

In some areas, the plan must be designed with greater relevancy and accountability. We need to look at highways as more than just ADT, vehicle miles traveled, and surface condition. We need to look at how users travel on them, why they travel on them, and what the benefits are. If you can measure your road system on the basis of how it is used, or in terms of the air quality strategies that you need to adopt or the environmental strategies that you seek, then a cooperative attitude begins to develop among all the groups involved.

Highways should be viewed as corridors, as more than just a means of carrying traffic. We should view them as "utilidors," which are corridors for transporting water or telecommunication systems, such as fiber optics. If you can make multiple use of the corridors, you might get contributions to right-of-way cost.

Colorado designates certain routes as hazardous material routes. This policy has created a whole new constituency for particular highways because constituent groups interested in safety improvements on that road emerge. Such constituency groups could be the nucleus for a statewide transportation constituency.

Special generator access roads are, of course, critical and should be a factor in any kind of core system. Economic development should be a factor as well. Colorado has enter-

prise zones, for example, which have special taxing exemptions to encourage companies to locate in them.

The planning document of the future should also include a performance budget or an efficiency plan that shows how the department will operate more efficiently and how it will be more accountable to the public at large. If the public gives us \$250 million a year in new taxes, which our governor wants, can we spend it? How fast can we spend it? How efficiently would we spend it? These are the kinds of questions that must be answered by the planning documents of the 1990s.

The plan should also contain financing strategies. Financing strategies for roads may differ depending on the particular road. If it is a new road, you might look at tax increment financing. If it is an improvement in an existing corridor without much growth, you might have a different strategy. If we are going to present a vision of the future and allow the leadership of our states to go forth and broker the planning document and the highway program, we must include the tools that are being asked for. At a minimum, these tools include justification for the present system and for future plans, relevance to the objectives and needs of the state, and relevance to the public and the legislators. Providing these components will provide that vision that we all seek.

Future Directions and Emerging Issues

KEVIN HEANUE, GEORGE T. LATHROP, AND JIM CHARLIER

KEVIN HEANUE

I have been asked to cover three topics: the emerging issues conference convened by FHWA last fall, our in-house futures efforts, and planning research needs.

EMERGING ISSUES CONFERENCE

Some 14 states and 20 Metropolitan Planning Organizations (MPOs) were represented at the emerging issues conference. One of the lead questions was, Are today's transportation planning policies adequate? The conclusion reached was that existing policy is generally satisfactory. The states were more satisfied than the MPOs, but the states did recommend more flexibility in the administering process in areas with under 200,000 population.

The MPOs sought a more active role, expressing a desire to be given more assignments by the states and the "feds". They wanted to be more proactive and less responsive. They wanted to include long-range planning in their work programs, characterizing existing MPO planning as too reactive to project proposals coming from state and local sources.

Another emerging issue concerned planning resources. Those states completing their Interstate System are experiencing a serious shortage of HPR funds and a pattern of staff cutbacks. As a result, they have a limited ability to take on additional work.

Even more serious was the problem of noncompetitive state and MPO salaries, staff turnover and great difficulties in hiring either experienced or entry level staff. Hiring staff, getting them up to speed, and having them hired away was described as a particular problem of the smaller MPOs, which generally only have one or two trained planners. Employee retention was described as a critical problem in administering transportation planning at all levels.

Corridor preservation and access control came in for extensive discussion. Neil Pedersen described the work of the AASHTO task force. The discussion centered on making NEPA work in support of long-range planning rather than constantly being dictated to by the EIS process. The practice of waiting a long time after plan development to initiate project imple-

mentation has to be ended. A desire to experiment with corridor preservation under police powers was expressed. States must begin using authority that local governments are exercising in corridor preservation and access control. The group expressed a need to experiment with different approaches to the NEPA process.

Another major topic area was data management at the state and MPO level. Microcomputers are causing a revolution in transportation planning. There are now computerized systems for weigh-in-motion, automated counting and classification, geographic information systems, pavement management, bridge management, safety or accident record keeping and maintenance management. Many organizations initially have five or more parallel automated systems in different organizational units. Increasingly states are bringing together within the planning unit a single automated data base, with a single geographic control system.

A related discussion covered the rescaling of planning tools so that they will address topics like pavement management and bridge management. The difficulty is in determining how to plan for rehabilitation within the same framework of planning for major capital investments.

An interesting discussion took place on environmental issues. Both the states and MPOs expressed a desire for greater planning involvement. There was a dichotomy between those states where the EIS and project development unit was an element of planning and those where it was not. Those states with different organizational units involved in the project development process expressed the need to close the gap.

Air quality was another subject of discussion and of frustration, particularly on the part of those states and MPOs with air quality problems. The Los Angeles and Denver areas were represented at the conference. The conclusion reached was that legislation must resolve the issue and most of us cannot productively get involved until the Congress sorts out the ground rules.

A discussion on coordination targeted the feds. Representatives of states and MPOs expressed frustration at the apparent lack of coordination between the Environmental Protection Agency (EPA) and DOT and within DOT between the FHWA and UMTA. I accept this criticism. Improving coordination with EPA is going to take legislation. At one time, FHWA and UMTA worked very closely together. We have definitely drifted apart but we are committed to coordinating appropriate elements of our programs.

A wide-ranging discussion took place on research. Topics included: travel behavior, transportation and economic development, truck forecasting, analytical tools for traffic opera-

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tions, and in general, microcomputer application tools for transportation planning. That list went on, but those noted rose to the top.

Other issues cited, not as research, but as emerging issues were (a) the institutional questions still prevalent in some states, including the MPO role in programming, and (b) performance planning (Bruce McDowell of ACIR gave a forceful argument for performance-based planning, arguing that "what gets measured gets done," and hitting a very responsive chord among participants).

The role of long-range planning and urban and suburban congestion were additional major topics that I do not have time to go into.

FHWA FUTURES EFFORT

Let me shift gears now and talk about the FHWA Future's work. Les Hoel gave an excellent overview not only of our work but of the other key participants in the 2020 process. I am going to try to emphasize a few points from my own perspective.

First, there is no doubt that the trend is toward a much lower rate of travel growth, driven by a much lower rate of population growth. Population is projected to increase at a rate of well under 1 percent as we move toward 2020. FHWA projects VMT to grow within the range of 2 to 3 percent. Within FHWA we had advocates of the 2 percent level, a level suggested by serious analysis of demographics. Others favored 3 percent, which is supported by current traffic volume trends of 3½ to 4 percent month after month. We were dealing with a 1984 to 1985 base and now 5 years into the forecast period, growth is not slowing. I am reminded of the old adage that it is almost impossible to overestimate future travel. Our models yield a growth rate of 2.4 percent, which also happens to equal the independently estimated aggregate state HPMS growth rate. This 2.4 percent average hides wide variation among different parts of the country. Some the farm and plains states have no growth, and some booming urban areas have growth of 6 to 8 percent annually.

Let us now consider congestion. A high percentage of the Interstate links in our major metropolitan areas are congested. Half of all congestion is not recurring but is incident based. We heard yesterday of smart cars, smart highway and then smart money. I think we need smart "incident managers" to do something about the half of congestion that is nonrecurring. The idea of a federal role in the incident management problem is particularly intriguing.

In our futures work we also looked at the benefit/cost relationship. We added a benefit/cost algorithm to the end of the HPMS system and looked at investment levels 10 percent below the present levels and then 10, 20 and 30 percent above the current levels. The results showed positive benefit/cost ratios at all investment levels over all functional classes. This finding is another way of demonstrating the seriousness of the transportation problem.

In general, the benefit/cost ratios were higher in urban areas than in rural. Other principal arterials (non-Interstate principal arterials) were better investments than further improvements to the Interstate system, which just demonstrates that it is very costly to widen Interstates to gain additional capacity.

I want to now turn to investment requirements. First let me say that the 2020 process, in my judgment, places too much emphasis on dollars and not enough on defining the problem. Henry Peyrebrune said yesterday that we have all underestimated needs. I support that statement. Estimates by FHWA show that to maintain existing conditions with a 2 percent growth rate in VMT, we should be investing \$25.9 billion a year. At the other end of the range is the \$39.4 billion estimate to meet full *constrained* needs at a 3 percent growth rate in VMT. This is the estimate you get when you do not widen an Interstate that lacks available right-of-way, but rather cost out all other arterial and collector needs. So, the range of needs is \$25.9 billion to \$39.4 billion. These estimates do not include local system investment. Today we are spending \$31 billion in capital at all levels including what is spent on local systems. Even though the numbers do not take into account the "local system" difference, I conclude that today's investment levels are at the very low end of the scale to maintain current system performance. The HPMS supports this conclusion, showing that we are making progress in pavement condition and losing ground on capacity. The composite index is about flat.

The HPMS monitors the existing highway system. It does not directly consider new facilities on new locations. You always have to adjust for new facilities that represent additional needs.

With respect to the post-Interstate program, I argue that our immediate problem is not dollars, but concepts. Everyone seems to be buying into the general idea of a system of national interest and a block grant; but beyond those broad concepts, we have a long way to go. There is no consensus on the federal role.

I perceive a real problem in how to reflect multistate corridors in the new program. The FHWA is working on 15 congressionally mandated studies of corridors, including Shreveport to Kansas City and St. Louis to St. Paul. Maryland and Virginia are considering eastern and western bypasses of Washington, D.C. How do we integrate these future system needs into our thinking?

We also have the problem of low-growth states versus high-growth states, urban versus rural and a whole host of equity issues to be addressed. Beyond that is the flexibility issue. The local participants in the 2020 process want to talk highway/transit funding flexibility even on the system of national significance, which FHWA staff has not been thinking about.

Tom Larson was quoted yesterday. The quote was that a successful launching of a new program requires three things: "vision, a positive authorizing environment and organizational capacity." Where do we stand? The vision is not going to come from a dollar level, but from concepts. As I listened to the discussions yesterday, I noted that the states with successful gas tax increases are selling solutions, not problems. And thinking back, the 1982 nickel was sold on the solution. We had potholes and it was quite clear most of that nickel was going to go to repair our infrastructure, and that translates into a solution.

Now let us consider the dominance of urban congestion in terms of our post-Interstate needs. You cannot merely ask for dollars to solve urban congestion. Once we are asked the next question, what are we going to do with the dollars, we are confronted by the fact that we do not yet have a good set of answers. I am hearing a lot of talk about flexibility. System

performance expectations and proposed solutions vary around the country, depending on what part of the country and what size urban area you are dealing with. It is difficult to translate flexibility into a vision!

Organizational capacity breaks down into federal, state, and local. I do not think anyone is arguing for a more extensive federal role. The real tradeoffs are between state and local. Yesterday at one of our breakout sessions, a local participant said that he could see all this coming down to the feds and the locals striking a deal, and the states not being able to get their perception. I am not suggesting that the feds and the locals have any common agenda.

This afternoon, we will be talking in much more detail about the system of national significance and where it stands. So, I am not going to comment further now.

I would like to close by touching on the topic of planning research. The whole infrastructure debate in the country fostered much needed research in materials and pavements. The SHRP program was initiated with significant funding. Planning topics in the NCHRP program have not been popular in recent years. Two to three years ago, the Group 1 Council of TRB, which covers Economics, Finance and Administration, began an initiative to highlight the need for planning-oriented research. Progress is being made and, yet, today we hear calls for smart cars, and smart highways research. There is an enormous head of steam behind it. I would argue that we are not going to solve the problems of urban transportation "in the car" or "on the highway," that is, within the right-of-way fences. There are much broader issues involving land use, investment priorities, density and shape of urban areas. We have gone for almost 15 years without looking at these topics, while our urbanized areas have restructured themselves. High-density suburban clusters, coupled with continuing sprawl, have changed the nature of travel. This phenomenon was documented in the 1980 census. It is continuing at a more rapid pace. I am not arguing against smart car and smart highway research but rather for a broader program.

Because the states essentially determine NCHRP priorities, we should all work together to get planning topics into that NCRP system and put planning back where it was in the late sixties and seventies, when some 60 percent of the NCHRP program supported planning or—some people don't like the term—"soft-side research."

GEORGE T. LATHROP

I will begin with my perception of statewide multimodal planning and then speak to my concept of an appropriate role for statewide multimodal transportation planning in the next decade, what it can be as well as what I think it should be.

For argument's sake, begin with the notion that planning is basically rational resource allocation. That probably is more true at the statewide level than at others. There is allocation between construction and maintenance, among modes, and certainly across geography. Basically, much of planning is determining how to spend money in the immediate future and, in many instances, in the longer term.

Does statewide planning exist? Has statewide planning really ever existed? Is there rational allocation of a pot of money? I can argue both sides of the question.

I would argue yes, particularly if planning is defined as something short of actual decision making, because planners have had a significant effect on the decision-making process related to allocation and on allocation itself.

On the other hand, a very strong argument says no, there has been no statewide planning, or very little. I say that because, to a large extent our actions are prescribed by federal programs, state programs, legislative mandates, political considerations, and categorical dedications of funds. It is hard for us to say that planning is truly allocation of resources because, in many instances, the resources already are allocated for us.

What exactly are planners trying to do? Objective or rational planning was mentioned by a previous speaker. The economists would view it in terms of public welfare and optimizing. We want to be rational; we want to be good stewards of the public funds. We are interested in equity. We are interested in new economic development. All these objectives, to some extent, are abridged categorical allocations.

Planners at the statewide multimodal level, to answer my previous question, advise. Much of the decision making, in the end, is political or programmatic or both. Your job, as statewide planners, is to advise the legislature and the executive what to do in transportation and how to allocate those resources. Reality, however, tells us that they are not about to let us actually make the decisions. Of course, my specific job, with an allegiance to a local government and local elected officials, is essentially exactly the same.

Now, I will tell you what I think you ought to do. This is the advice I think you ought to give. We have used the terms multicounty, regional and substate to refer to an urban area. For my purpose, urban is cities and their commutersheds and nonurban is everything else.

The history of federal and state programs is largely non-urban. That is not news, but having entered this field in the mid-sixties when urban transportation planning was just beginning (at least in the formal sense under federal programs), I am continually struck by the history of the federal highway program and the state programs that arose in response to it. In essence, there was a complete lack of focus on urban concerns before the mid-sixties. The Federal Aid Interstate and Federal Aid Primary (FAP) systems, even in the sixties and seventies, were not intentionally urban. They were urban only because they penetrated urban areas to make connections. There was a belated addition of some urban spurs to the Interstate System, but it still was primarily a rural or nonurban system.

The other federal agency that has dealt directly with local transportation concerns, the Urban Mass Transportation Administration, came out of HUD, and has a history of direct dealing with cities; highway programs have never had such a history. My concern is that, although we don't know where the federal programs are going, it seems clear to me that something must be done for urban areas.

I am cautious about generalizing from my experience in North Carolina. Many of you know the peculiarities of North Carolina's relationship with local governments, as far as roads are concerned. But even given those peculiarities, it is safe to generalize that something must be done to help the urban areas in states, cities, and the communities that surround or are near them, the counties and the other towns and cities within the urban areas.

I see three general categories of groups who might provide that help: the federal government, the states and the locals themselves. My reaction is that if the feds and state government cannot (or will not) do it, that leaves it up to us at the local government level.

If the local governments are going to have the responsibility, then they must have the authority and the tools. The authority and the tools in too many instances are withheld by the states in what appears to many local governments to be an almost unholy alliance to deny local governments an opportunity to do something for themselves.

I do not know how to change this, there are hints that something may be emerging. This afternoon at the SCOPE meeting we will hear about a system of highways of national significance. That sounds to me like, in one sense, a federal divestment of responsibility and, in another, a reasonable and rational thing to do, to focus on something besides the huge and unwieldy FAP and FAUS systems, but something more than the Federal Aid Interstate System. It sounds like a good idea.

In North Carolina, there is a move to establish something called the intrastate system. I have heard references here, from other states, of corridors of strategic significance or strategic highways within the state or similar phrases, but what it sounds like (and what it is in North Carolina) is a definition of a system of roads, transportation corridors in some cases, at the state level that apparently is roughly parallel to the definition at the national level, of the system of national significance.

I regard what is about to happen in North Carolina as a partial divestment of responsibility. The intrastate system, like the Interstate System, is urban only to the extent that connections are made in urban areas. There is money for urban beltways, but not for urban arterials. Many state responsibilities in the urban areas are neglected, and if the cities do not get some help, there will be real problems, the end of some friendships and some political difficulties.

Looking at this more optimistically, I see that a better definition of the functional system may emerge, perhaps defined by responsibility, but nonetheless cataloging or categorizing highways according to their functional role. With a federal clarification of the functional system, we can hope for some clarification and specification of responsibility, and perhaps with it some authority.

My suggestion to you is to advise your legislators and executives to address urban transportation. We continue to evolve into an urban nation; the transportation problems are there, and you can lead elected officials to the inevitable political hay that will be made there.

A bit of perspective on statewide planning and, from the local government point of view, an appeal for a definition of role is critically important. Planners have complained for years that their plans do not get carried out, but planners never have been in the business of making decisions. They are in the business of giving advice. We need to give good advice and we have a real challenge as to what advice to give at the state level.

I have offered *you* some advice that I would like you to give to your legislators and your executives about giving a hand to the local governments. A less polite way to put it is the old cliché—if you can't lead, get the hell out of the way.

That pretty well summarizes what I think is the representative attitude of local governments.

JIM CHARLIER

I thought I would preface my remarks with a few observations about Florida. You know the saying, "Where you stand depends on where you sit." Florida is a state with a strong commitment to planning. In other words, the state is managed through a comprehensive planning process that integrates planning at the state and local levels.

Florida is an urban state—nearly 80 percent of our population lives in our urban areas. It is also a high-growth state. Each year our population grows by over 300 thousand—an amount equal to a good-sized city like Tampa.

Rather than try to present a national perspective, I will approach the subject of transportation planning from a sun-belt perspective. What I say may sound familiar to those of you from other fast-growing urban states, and may offer a glimpse of the future to the rest. I will describe growth trends in Florida and briefly outline the major transportation trends. I will review Florida's growth management legislation, touch on political trends, and finally identify some of the major transportation planning issues facing us today and in the next few years.

Florida is often referred to as being on the cutting edge—we have begun to use the phrase "The Bleeding Edge." Our population has been growing at an annual rate of 3.1 percent so far this decade. Some 12.4 million people live in Florida today—this in a state that had fewer than 3 million people in 1950. Our net growth rate works out to about 900 people per day, primarily the result of in-migration exceeding out-migration. We believe that people will continue to come as long as the sunshine holds and the tanker captains leave our beaches alone. Conservative population projections indicate that 20 million people will live in Florida by the year 2020. Our automobile fleet is growing by over 250,000 cars per year. This is roughly equivalent to a string of cars 1,000 miles long coming across the Florida line each year, bumper-to-bumper.

The predominant pattern of growth in Florida has been suburban sprawl. Our growth has occurred not so much at the urban fringe as in rural areas near, but not necessarily adjacent to, our urban centers. Florida growth patterns reflect the national trend toward suburban office parks, urban villages, distinct major activity centers. These trends are driven by the fact that major land parcels for development are more easily assembled outside existing developed areas.

Another important factor is that employers are beginning to follow the population out to the suburbs. We are beginning to see office complexes spring up in places like Kendall, a large unincorporated subdivision west of Miami. Congestion and travel times are obviously important factors in locating building sites. As companies "shop for highway capacity" the effect can be to spread a thin veneer of development over the landscape. Of course, all of this is very much in line with what is happening in many other states.

Between 1980 and 1988, the population of our incorporated areas increased by 20 percent. At the same time, the population outside incorporated areas increased by 36 percent; some areas doubled or tripled during that 8-year period. In

1980, 80 percent of our population lived in urban areas; the figure was down to 78 percent 8 years later.

Fortunately, our central cities have remained strong. We have not seen too much of the inner city decay that has plagued midwestern and northeastern cities for so long. Our CBDs are not growing, however, and this has obvious implications for public transit, something I will come back to later.

Overall population densities are low in Florida. The statewide average is 222 persons per square mile. Our most dense urban county (Pinellas) has 3,000 persons per square mile. Data from the 1980 census show a mean census tract density of 4,781 persons per square mile in Ft. Lauderdale, compared with 3,704 in the Tampa Bay area, and 7,027 in Miami.

Florida reflects national trends in commuting patterns as well. Each year, 4 out of 5 new jobs created in Florida are in the suburbs. More than half of our commuting trips today are from suburb to suburb. Travel patterns are becoming more bidirectional. Peak hour directional splits of at least 45/55 are now the norm on most major routes, with the exception of some coastal access routes.

Florida's economy is healthy. Income levels are rising and job formation continues. Fortunately, our economy is also becoming increasingly diversified, which should help to shield it somewhat from short-term national fluctuations.

Interestingly, our greatest problem may be a shortage of qualified labor in certain sectors (service and manufacturing) and at certain locations, an obvious clue to future transportation needs. Almost 10 percent of nonfarm employment in Florida is in the construction sector. In some of our counties, 25 percent of personal income comes from this sector, which may help explain why we approach growth management issues with such caution.

I want to take a minute to describe our major transportation trends. The highway construction picture is changing rapidly. We may already have built much of our arterial highway system. Florida needs to spend \$200 million per year for routine maintenance of the state highway system. We need to resurface about 1,500 miles per year at a cost of \$100 million per year or more. We should spend at least \$75 million each year replacing and repairing existing bridges. As a result, the state is now building fewer than 100 lane miles of new highway capacity per year, and in some years much fewer. Yet demand on state highways is growing at a rate of 400 to 500 lane miles per year.

Florida's Interstate System is just now being completed. We do, however, have significant sections operating at or near capacity. For example, we need to spend \$1.5 billion on I-10 and I-95 along the east coast and on rural sections of I-75 between Orlando and Georgia, to say nothing of substantial capacity needs in Miami and Ft. Lauderdale.

We anticipate about \$100 to \$150 million per year in IR Interstate funds, including discretionary funds. This will be enough to keep up with Interstate resurfacing needs and to replace bridges as needed. However, Florida may need to look to state and local funding sources for a substantial part of its Interstate needs.

The primary funding mechanism for funding new alignment highway construction in the next few years will be the Florida turnpike. Florida has embarked on a major expansion of its turnpike system. The basic concept is to use the existing 320-mile system as a financial institution. In many urban areas we have potential tollroads that are only marginally bond feasi-

ble. That is, they cannot go to the bond market on the strength of anticipated toll revenues alone.

Nonetheless, the existing turnpike system today generates over \$100 million per year in revenues. And the bonds are paid off; there is no outstanding bonded indebtedness. Florida plans to use this revenue stream to leverage expansion of the turnpike into a statewide system of toll highways. Projects must meet rigid economic feasibility requirements. They must cover at least 50 percent of their own construction costs, and they must break even (covering debt service and operating and maintenance costs) within 15 years. We anticipate being able to build over 125 centerline miles of new expressways over the next 10 years through this leveraging of toll projects.

The program must be approved by the legislature this session, however, and it is encountering rough going. The legislators find it difficult to authorize a program that appears to take toll revenues collected from their constituents and spend the money building roads in another part of the state. Although this program would eventually benefit all parts of Florida, it can appear unappealing to certain parts of the state in the short term.

Most of you have read about Florida's high-speed rail project, so I will not go into great detail. It is an exciting program, however, and I should at least mention it. It is official state policy in Florida to have in place a high-speed rail system from Tampa to Orlando to Miami by 1995. In fact, that goal is written in statute. It is also state policy that no public funds will go into development of the system. The high speed rail commission is currently involved in a lengthy process of evaluating proposals submitted by consortiums made up of transportation firms, financial institutions, and development firms.

It is important to understand that the project could not stand on its own without public funding as a purely transportation project. It is the land development aspect, the exclusive rights to development at the stations, that will make the project go. Even so, we are watching to see if it will be possible for someone to put together a proposal that will work and meet the guidelines of the authorizing statute.

Florida is also taking the lead on developing magnetic levitation (Maglev) transportation in this country. This past year the state embarked on developing a magnetic levitation rail demonstration project in the Orlando area. The most likely route would link the Orlando Airport with the Disney complex. The Disney complex (Disneyworld, Epcot center, and the new MGM studios) have more than 25 million visitors each year. And the Orlando Airport handled 16.5 million passengers last year.

The project has given rise to a interesting debate locally. Those working with the project appear to feel that a direct link between the airport and Disney complex with no intermediate stops is the best configuration. After all, it is a distance of only 17 miles, which is barely enough to attain the speeds required to demonstrate the technology, much less make intermediate stops.

If the project succeeds, travel agents would offer a single combined air/rail rate to take you and your family from Sandusky or Des Moines along with your baggage directly to the hotel at Disney. Other tourist attractions and hotels in the Orlando area obviously are concerned about the exclusivity of such a proposal.

Downtown Orlando, to say nothing of developers in the northwest suburbs, has been interested in using some kind of

guideway transit system to enable the city to grow and stay vital in the face of increasing highway congestion. The coming of the Maglev is an enormous opportunity, but also presents difficult transportation planning issues.

As is true in most other states, Florida's public transit systems still carry a relatively small part of our daily travel. The state's systems carry a total of 140 million passengers each year. Our transit systems are carrying less than 5 percent of peak hour trips in every urban area except Dade County, where metrorail carries about 7 percent of peak hour trips. Of course, Florida is the home of metrorail, which a former president referred to as "metrofail." The fixed guideway transit issue is important in Florida and I will return to it in a minute. We also see a significant change in the role of public transit in Florida in the next decade, which I will treat later.

Florida's airports have been undergoing a phenomenal boom in recent years, owing partly to the weakness of the U.S. dollar, which is encouraging international tourism and keeping American tourists in Florida where they belong. Over 50 million people are passing through our airports each year.

Emplanements at Orlando increased 11 percent in 1988 alone. On the lower east coast, the central east coast, and in Jacksonville, serious consideration must soon be given to developing new airports to relieve congestion. Even so, capacity at airports may not be nearly the constraint that airspace congestion and ground access are.

As I said earlier, Florida is a state with a strong commitment to planning. The state's growth management statutes and rules are among the most far reaching and controversial attempts to control growth in the nation. The state's 1985 statutes established state goals and policies and put in place a comprehensive planning process that includes state land, water, and transportation plans. Also mandated were local government comprehensive plans. More than 450 local governments are preparing and submitting their local comprehensive plans over a 3-year period.

The primary issue now revolves around the concurrency concept. The term comes from a phrase in the 1985 legislation:

It is the intent of the legislature that public facilities and services needed to support development shall be available concurrent with the impacts of such development.

This phrase has given rise to the "M" word, moratorium. In other words, local governments that cannot assure that facilities will be available concurrent with growth might have to place moratoriums on further building permits.

As local plans have come in, the major issue has been state highways. Essentially, the issue shapes up like this: Are we going to (a) build additional transportation, (b) slow or halt growth, or (c) redefine the problem? This issue has been complicated by the fact that the governor and others are not at all convinced that the transportation planning process has led to either the right list of projects or an accurate assessment of needs.

Growth management is on the agenda again this session. Topics include urban sprawl, transportation, and a proposal to mandate urban service areas. It is interesting that the original 1985 act identified as a goal avoiding undue concentrations in our urban areas. Now we are considering language that would encourage greater urban concentration as a means of preserving natural resources, maintaining the viability of

our existing urbanized areas, and achieving "efficient development patterns."

I suppose that the conclusion to draw from this is that although Florida is a leader in efforts to plan for and manage growth, there is still considerable debate over what the end result should be.

It might be helpful to review some political trends that affect the transportation planning process in Florida. First, we must recognize that although the public is concerned about roads and transportation, these may not be the foremost public issue or need. Florida faces grave problems in the areas of crime and education. Moreover, Florida has not escaped the "read-my-lips-trend." Of course, this may not be too effective with some of our school children. They have enough trouble reading printed matter and have not yet progressed to reading the lips of elected leaders. The governor has made it clear that he will not only oppose, but will veto, any new taxes passed by the legislature, including taxes and user fees for transportation.

It is interesting to look back to just over 1 year ago. The governor and secretary of the Florida Department of Transportation flew around the state together to announce a new strategic transportation plan. This plan identified strategies targeted at solutions to what were then perceived as the problems facing Florida. The Department of Transportation was perceived as an inefficient bureaucracy that could not build at a rate that would meet the state's needs. The strategic plan identified reforms designed to achieve T/2—cutting in half the time required in the productive capacity of the department.

The strategic plan also listed 20 years worth of proposed transportation projects. Cost estimates were developed for the first 10 years of projects. The price tag came to \$40 billion, compared with anticipated revenues from all sources over that 10-year period of \$15 billion. In other words, the plan showed a shortfall of \$25 billion.

The strategic plan immediately caused considerable stir. The press reported on it widely and the Florida Transportation Commission issued an analysis of potential funding sources to close the gap. One of the commission's recommendations was that the state should issue fuel tax revenue bonds to buy rights-of-way for future highway construction. The legislature agreed and placed this on the ballot. On November 8, 1988, Florida's voters approved Amendment 4 to the Constitution authorizing the state to sell revenue bonds for right-of-way acquisition for state highways.

Yet as I stand here today, the strategic transportation plan is a dim memory. The governor has completely withdrawn his support for the plan, apparently owing primarily to his stand on taxes. Something has happened, however, that will have far-reaching implications in Florida.

There is more than a little doubt in the governor's mind about the validity of projects in the strategic plan. What would they do to our urban development patterns and to our neighborhoods? Would they encourage further urban sprawl? Are they the result of a good transportation planning process? Are MPO long-range needs plans little more than wish lists intended to compete for funding?

As much as anything, this attitude reflects a realization on the part of Florida's elected leaders that infrastructure investments—especially transportation investments—affect urban growth patterns. The professionals in our business have known that for years, but now it is on the political agenda in the capital.

Florida will develop a new strategic transportation plan, but it will have to thread the needle on some unresolved questions. With a 3 percent annual population growth rate and 4 percent to 5 percent annual growth in highway traffic; with 25 percent of our state highways already congested (55 percent in urban areas); with a population of "nimby's" who don't want "lulu's;" with a fragile and precious environment that we must protect; and with a public that will not support elected leaders who advocate increased public spending; just what should transportation planners be planning?

This leads me at last to a discussion of what I see as the transportation planning issues Florida will be wrestling with over the next 5 to 10 years.

It is interesting to note that in Florida, there is little concern with or discussion of movement of goods. We are concerned with movement of people. This may have to do with where we are on the growth curve. Peak periods on most urban highways in Florida are still relatively short. The percent of ADT occurring in the design hour (30th highest) ranges from about 7 percent to 8 percent in Dade County, up to as much as 20 percent in some of our smaller coastal communities. In other words, capacity still exists for truck movements in the off-peak periods.

The state is still young. It is growing rapidly and will continue to grow for many years. The opportunity still exists to shape our cities and our transportation system consciously and deliberately.

All good planners start by identifying goals and objectives. Let us say that the objectives we are working with would include the following:

- ensuring continued personal mobility and quality of life for Florida's residents
- ensuring continued economic vitality and development
- preserving our natural resources and fragile environment

In highway planning we need to reexamine how we measure capacity. Florida is a national leader in taking the 1985 highway capacity manual and the level-of-service concept beyond design to planning applications. We are using level of service to measure and report on the operating condition of our state highways and to provide standards for meeting the concurrency requirement I described earlier.

It is interesting, and this may surprise you, that our level-of-service standards, which are basically set at C in rural areas, D in urban areas, and E or lower in special circumstances, are criticized as being too high and as a restriction on growth.

Access management has become a major capacity issue in Florida. We simply cannot afford to buy out the access rights along our state highways. Yet the access permit is generally the last step in the development process. Florida passed significant new legislation last year that establishes a 3-year process for classifying state highways according to access criteria. An important part of that new process will be linking access permitting with local growth management through local agreements and in some cases a delegation of state authority.

Closely related to the overall access issue is interchange location and justification. This is no longer simply a question of design and safety. I am sure you know that in rapidly developing areas like most of Florida, funding for new interchanges is not the problem. Land owners and developers will fund the interchanges and be pleased to do it.

The issue, rather, is what is the purpose of the limited access highway? Is it to move local traffic or to provide for intercity, interregional mobility? And the issue concerns secondary development. The development pressures that follow the opening of a new interchange can easily overwhelm any local land planning process, even in Florida.

I believe that in the future, transportation planners need to look to opportunities to bring forward projects that have both transportation and environmental objectives. I do not mean mitigating the impacts of the project; I mean projects whose central purpose is a specific environmental objective. For example, Florida developed its I-75 project through the Everglades along Alligator Alley in a manner that will restore the sheet flow characteristics of the huge southern end of the Florida peninsula.

Future opportunities exist in Florida to use transportation improvements and funding to establish land bridges between the remaining contiguous areas of natural habitat for such large mammals as the black bear or other species.

As right-of-way costs continue to increase, as they will in the face of development pressure, we must find better ways to identify corridors. Acquisition is part of this, but only part. Certainly, we need to rethink whether federal funding provisions originally put in place to ensure proper planning and decision making actually have that effect in rapidly growing urban areas. We are working with FHWA on this, and have had excellent support and assistance from the division office in Florida and from Washington on developing a programmatic environmental planning process to help us preserve and acquire rights-of-way earlier.

Finally, highway planning at the state level may require a reassessment of the role of state government. In Florida, it is an appropriate role for the state to invest in the capacity needed to move people between cities and regions of the state and between Florida and other states. It probably cannot be the role of the state to be the primary investor in the capacity needed to move people from shopping center to shopping center. Ultimately, we may need to look at scaling back the state role to a more focused system of highways of state and regional significance.

Of particular importance to Florida in coming years will be the role of the public transit in shaping our urban areas. We believe, for many reasons, that achieving greater commercial and employment densities will be vital to Florida's future. My personal opinion is that we will not be able to do much about overall residential densities. The public will not support that kind of public policy. Public transit will not reduce congestion in Florida. However, it is the key to continued growth in our existing urban areas. Florida is focusing considerable public attention on the public transit issue now.

The Florida Transportation Commission has published a detailed look at the state's role in public transit. The governor's task force on urban growth patterns, in its interim report completed before the legislative session, identifies public transit as a key part of the state's strategy to contain suburban sprawl and meet personal mobility needs. Finally, new legislation, which appears headed for passage this session, will completely restructure the state's public transit assistance programs.

The most difficult public transit issue may be fixed guideways. We know that they are an essential part of our future, and projects are under development or consideration in Jacksonville, Tampa, St. Petersburg, Orlando, and Ft. Lauderdale.

dale. Of course, metrorail in Miami is our largest operational system. We also know that fixed guideway projects can be spectacularly unsuccessful. The per-trip operating cost on metrorail is \$12. Dade County spends over \$100 million in local tax revenues each year to operate its transit system, including metrorail.

How do you develop successful fixed guideway systems? Simple. Get control of public and private parking supplies (regionally). Keep politics out of location decision making. Do not build too much too soon. Use realistic cost and ridership projections. Put in place a dedicated source of local revenue for operations. Get control of development so that you can concentrate commercial development in a small number of activity centers, especially CBDs, associated with stations. Bring about greater residential densities in the system corridors. Sounds easy, right?

Another important transportation planning issue in Florida is our local government planning process and structure. We are working with a complicated local government structure. Counties, cities, county-wide planning agencies, MPOs, regional planning councils, local public transit providers, local expressway authorities, local airport authorities, and port authorities are all conducting transportation planning activities.

Consider airports and airport access. Metrorail does not go to the Miami International Airport. Another major international airport in Florida does not allow the local public transit vehicles onto its property. Airports in Florida are essentially successful profit centers. Taxi cabs and shuttle operators pay access fees. Rental car companies lease space. Automobile drivers pay parking fees. All of these are significant sources of revenue to the airport.

Or consider seaports, airports and ground access between the two. I saw an estimate recently of the number of people who are coming through the Ft. Lauderdale Airport each year bound for cruise ships a few miles away at Port Everglades. It works out to thousands daily. Are they all going to want to rent cars or take shuttles? I think not.

Another example is parking authorities and public transit. I know of three functions of municipal government that earn excess revenues: airports, utilities, and parking authorities. It may actually be easier to influence private parking supply in some of our cities than it is to influence public parking supply.

Of course, there is much discussion of regional organizations. Florida has had little success with this so far, however. Florida statutes authorize metropolitan transportation authorities, but none have been approved. The statutes also provide for regional transportation authorities, but only one has been created and it operates on less than a regional scale.

One thing is clear in Florida. We need to reexamine the role of our MPOs locally. We have top-notch, highly professional MPOs in Florida capable of sophisticated transportation planning. However, they are doing little in the way of public transit planning, and are under siege from the other local planning activities underway and are having increasing difficulty fulfilling their essential role in the process.

I wanted to touch on transportation systems management and transportation demand management, both of which are critical to our future success. I am running out of time, however, so I will close with one last observation. One of the special joys of public works is that everything you do is controversial; you read about yourself every morning in the newspapers. We have often wondered how the nation's media would handle the story if they learned that the world was going to come to a sudden end tomorrow—irrevocably, unalterably. We think that the headline in the *New York Times* might read:

World to End Tomorrow—Market Response Mixed as Investors Wait To See Reaction In Tokyo.

Finally, our own Tampa Tribune would run this headline:

World To End Tomorrow—State Lawmakers Cite Florida DOT for Unexplained Delay.

Future of Transportation Technology

DAVID K. WILLIS AND DOUGLASS B. LEE

DAVID K. WILLIS

My talk this morning is about "intelligent vehicle/highway systems technologies." These are microprocessing communications technologies that provide information to drivers or give drivers additional control over their vehicles. The technologies can be divided into three categories: technologies that are strictly on board the vehicle; technologies that are strictly external to the vehicle, but provide useful information to drivers; and a combination of the two.

In the popular press and in meetings of TRB and similar organizations, there has been a sudden explosion of interest in these technologies as a potential means to make more efficient use of current and future roads. It seems to me that the interest has been generated from three perspectives:

1. The technologies hold some promise to help reduce highway congestion.
2. Some of the safety-related technologies, such as radar braking and lateral longitudinal controls for vehicles, may improve highway safety.
3. Real productivity gains may result from these technologies, particularly for commercial vehicle operators.

For state transportation planners, the potential of these technologies for reducing traffic congestion should be of greatest interest, so I will concentrate on that application. Congestion is obviously not a new problem. We had it back in the twenties, in the fifties and we have it today. What has changed, I think, over the last 50 years is our perception of our ability to deal with congestion.

Some data on Alexandria, Virginia, illustrating typical suburban congestion in the Washington, D.C. area, does a good job of explaining why we have not built our way out of congestion. We can look at three trends from 1970 through 1987, the latest data I have for all these points: changes in vehicle registrations, changes in vehicle miles traveled (VMT), and changes in real-dollar (inflation-adjusted) expenditures on roads.

The data show a 70 percent increase in both VMT and registrations but only a 6 percent increase in real dollar expenditures on roads. Not surprisingly, a failure to spend enough to keep up with changes in demand results in increased traffic congestion. Data for 1983 and 1985 from FHWA showing vehicle hours of delay on freeways indicate a 57 percent

increase in just two years; preliminary data out for 1987 make the picture look even worse.

What about the future? I have looked ahead to the year 2005, 16 years ahead, and forecasted growth in VMT of about 3 percent a year, which is just about what FHWA is forecasting. I have used a slightly lower growth rate for vehicle registrations. The real question, though, is expenditures on the roads.

According to FHWA, if we fail to make substantial new investments in road capacity, congestion figures will worsen. This can be seen in data that forecasts 2005 figures on the basis of the 1983 and 1985 points I mentioned earlier. Now, some people may think that the FHWA numbers are unduly pessimistic and that we will indeed begin to spend more money on roads and thus avoid these levels of intolerable congestion. Maybe so, but congestion is clearly already a public concern. It has been popularized in the news media, and is getting increasing attention from public policy makers.

The problem for us as planners is what to do about it. My own sense tells me that the public will not learn to live with levels of congestion anywhere near those being forecast for 2000 and beyond, which suggests that we are going to have to figure out how to manage the congestion problem. We will certainly add some additional road capacity, but the expenditure trends I showed you before suggest that we will not add nearly enough.

Consequently, I foresee increasing movement toward restricting the use of roads. We have already seen a proposal for a ban on truck travel on Los Angeles city streets during peak periods, for example. As congestion gets worse, more of these kinds of initiatives will emerge. Another way to deal with the congestion problem is to make more efficient use of our road systems. Efficiency gains can be made through conventional methods such as car pooling, van pooling, and HOV lanes.

It is the technologies that I mentioned earlier, however, that hold real promise for dealing with the congestion problem by making more efficient use of roads. The first category that I mentioned was driver information. Drivers need to know how to get where they want to go. Before road maps became widely available about 1914, chambers of commerce and other organizations erected signs along the road directing people how to get from here to there. One such sign put up by the Auto Club of Southern California showed the route to California. You had to pull off to the side of the road, look at the billboard, and figure out how to get where you were going.

We have obviously come a long way since then. Improvements in microprocessing and communications technology now allow us to provide drivers information that we could not even dream of just 10 years ago.

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In the area of electronic route planning, considerable work is currently being done in Europe using tele-text and video-text. Tele-text is a television-based means of providing textual information. Video-text relies on computer terminals. The sort of traffic information you can get through this kind of system includes a route finder system currently available in the United Kingdom. It enables you to call up a series of screens on a television set that give information on traffic conditions. You can also get detailed instructions on how to get from here to there, if you have an inexpensive printer that hooks up to a digital television or a computer terminal. You can literally print out driving instructions, for example, instructions on how to go from the Transportation and Road Research Laboratory outside London to Hyde Park Corner.

Here in the United States experimental work is underway on the use of tele-text to provide information. The California Department of Transportation (Caltrans), in particular, is working with a company called Tele-Text Communications in San Jose to develop a television-based system, using tele-text, to provide close to real-time information on traffic conditions.

You can also get textual information, some graphics, and, finally, simplified map displays illustrating the exact location of freeway problems and information about expected delays. Although the system is not yet operational, it is the sort of relatively inexpensive technology to consider as you look ahead to the future.

In addition to helping motorists before they start a trip, such a system could also be used to provide information while they are driving down the road. For example, we know that many owner/operators in the trucking business have televisions in their trucks. Obviously, it is not safe for a single driver to watch television while going down the road, but one of two drivers in a team can be looking at the television to get traffic information as they are rolling down the road.

Another way to provide drivers with better information is through radio broadcasting. I think most of you are aware of Highway Advisory Radio. It is a low power A.M. broadcast of recorded messages about traffic conditions that has been fairly widely used here for a long time. It is not a very sophisticated system.

The Europeans have gone much beyond using F.M.-based technology, and they have some sophisticated traffic broadcasting systems already in operation. The ARI system in West Germany, for example, gives drivers periodic updates on traffic conditions. As better sensors are installed in the road, it is getting closer and closer to providing real-time information on traffic conditions.

I am sure you have all seen Highway Advisory Radio signs around airports and other places. This is probably the latest state of the technology in Europe, where it is called Radio Data System (RDS). It is a digital radio broadcasting system, in effect the radio equivalent of tele-text, which uses a digital signal to provide a stream of information that can be displayed in written form or synthesized voice on the radio.

Because RDS radio broadcasts conform to a European standard, a speech chip used in RDS radios will allow a German driver in the United Kingdom to get traffic information in German because he has a German speech synthesizer in his radio. It is a very sophisticated system, and is already being tested and implemented in Europe.

The next step in driver information technologies is what is being called routing advice systems. These are systems which

employ routing algorithms on board the vehicle. The driver uses a key pad to address the computer system, giving a destination, and the system gives instructions on how to get there.

The ROGUE system is another experimental approach being developed in the United States and it is representative of our technologies. ROGUE does not use detailed map displays. Instead, it has a simplified graphics display combined with audio prompts that give the driver information on where to turn. These systems can employ synthesized speech as well.

Finally, a variety of navigation technologies is being explored. The earliest one that I am aware of is called the South Pointing Chariot that was used by the Chinese military. The figure on the chariot always points south, so you can use the device to navigate because you always know where south is.

Here in the United States, there has been interest in on-board vehicle navigation technologies for a long time. One patent dates from 1907, another system from the 1930s. The latter is my favorite, combining a shade and guide map all in one. I do not think that anybody ever actually manufactured it, but it is not a bad idea.

We have come a long way since those early patents in terms of technological improvements. We already have available in the marketplace self-contained, on-board vehicle dead reckoning navigation systems. The best example of these is the ETAK Navigator. It is a U.S. product that initially became available in 1985 and is manufactured by a small company in California called Etak. It uses an electronic map display to navigate. General Motors developed the system as licensee for the Etak technology in the United States. With this early version of the system, the driver inserts a cassette tape into the system. The tape, which is just like a regular audio cassette tape, stores a map database. It has a dead reckoning navigation system with a flux gate compass on board the vehicle, so the vehicle knows where it is in terms of latitude and longitude. That location is indicated by the triangular cursor on the electronic map display.

The driver then tells the system where to go. The destination can be a specific street address with number and street; the intersection of two streets; or simply a street name (If the street is in several different communities, the system will ask you which community you want.)

Once a destination has been identified it shows up on the map display as a blinking star. You then simply drive toward the blinking star, and as you drive, the map constantly reorients itself. It is a straight-up display, so that every time the vehicle turns the corner the map automatically reorients itself around the cursor. You decide which route you are going to take to get to your destination. The system does not tell you how to get there; it simply provides a changing display and you pick the route to drive.

I find it to be a very useful technology. Some people say that it is dangerous to be looking at one of these things, but the alternative is balancing a map—if you do not know where you are going, you are balancing a street map on the steering wheel while trying to drive. That is just as bad or probably worse than looking at one of these displays.

One experimental General Motors display uses color to highlight major arterials. Another uses black and white—the Bosch-Blaupunkt version of ETAK navigator, which has been licensed is now being manufactured in Germany by Bosch. It will be available in Germany starting next month and in the rest of Europe late in the year. Bosch has improved on

the original Etak design by replacing the cassette drive for the map database with a CD-ROM, the little compact disk that can be used for music as well as for storing information.

To deal effectively with traffic congestion, drivers need navigation capabilities like routing advice systems or navigation systems, plus real-time information about traffic conditions. So, you combine the ability to navigate with information about what is happening on the road system ahead of you.

The Japanese have done a lot of work in this area; I think that their AMTICS Program is a model for how to approach this whole issue. AMTICS is an acronym for Advanced Mobile Traffic Information and Communications System. I think that the Japanese have approached this subject correctly from an organizational standpoint. They brought industry together with government to address the problem, and they did it quickly.

The project started in 1987. It was aided by the fact that, at least in Tokyo, an extensive and fairly sophisticated traffic monitoring system had already been installed. A police traffic control center collects and then broadcasts real-time information about traffic conditions. AMTICS goes the next step to integrate this traffic information with on-board vehicle navigation. A pilot test was conducted in April 1988, and the system worked very well. Consequently, the Japanese are talking about commercial applications next year.

The AMTICS system has an Etak-type electronic map display unit and uses a CD-ROM for storing information, as in the Bosch version of the ETAK Navigator. It broadcasts to the vehicle, in real time, information about traffic conditions. The other nice thing about the CD-ROM is that not only can it store map data, but it can also be used to store other information as well—tourist information, “electronic yellow pages” with locations of restaurants and hotels, etc.

A General Motors mock-up shows how one of these systems would look with the full-blown AMTICS type system. It will have the electronic map display. Overlaid on the map display in different colors will be indicators of congestion points ahead. The system also has an electronic yellow pages feature; the driver uses the icons at the bottom of the screen to call up information about hotels and restaurants, gas stations, etc.

As I said earlier, AMTICS can be a model for us here in the United States to provide this kind of information to drivers. We are beginning to move in that direction. A small scale experiment will be beginning in California next year. Called the Pathfinder project, it is a cooperative effort among Caltrans, General Motors, and the FHWA. It is not a large experiment in terms of dollars but it will be doing, in effect, what AMTICS does: give drivers electronic maps; broadcast to the vehicles, in real time, information about traffic conditions; and then see what the drivers do.

That is the critical question. Do drivers really use this information? The Pathfinder experiment will, it is hoped, indicate whether drivers do act on the information.

Obviously, much can also be done with traffic control systems. I think most of you probably know more about this subject than I do, so I will move quickly through this section, except for an item at the end.

The original traffic light was erected in Detroit in 1914. At the time it was installed it worked all by itself, because there were no other traffic lights with which to coordinate. Unfortunately, over half the signalized intersections in the United States still work the same way. There is absolutely no coord-

ination of traffic lights, no synchronization at all with adjacent traffic lights, all of which are doing their own thing and contributing to traffic congestion as a result.

So, we can do a lot in terms of timing of lights. We have known how to do fixed-time synchronization with mechanical systems since the 1920s. Increasingly, these systems are becoming computer controlled and they can be taught to adapt over time. The systems can learn about changes in traffic patterns and adjust light timing accordingly. We can also go to real-time control of traffic lights, like the ACOOT system in the United Kingdom, where traffic light timing changes in real time in response to traffic congestion.

As I mentioned at the beginning of this presentation, corridor controls and HOV lanes are also useful traffic management tools. Ideally, however, corridor control technologies and traffic signal technologies should be an integrated package.

The Smart Corridor Project beginning in California next year will try to do just that. The Smart Corridor is an area in Los Angeles. The Santa Monica Freeway runs down the center of that corridor, between Santa Monica and downtown Los Angeles. In addition to the Santa Monica Freeway, a number of large arterial streets run almost parallel to the corridor. Currently, these streets do not carry much traffic. The idea is to use that excess capacity when there is a problem on the freeway. For example, if a truck has blocked the freeway, motorists should be diverted off the freeway and onto one of these parallel arterials. So you use variable message signs and radio broadcasts to alert drivers to a problem ahead. The drivers then detour off the freeway. The driver who has an ETAK Navigator can look at the Navigator to figure out how to get over to Adams or Venice Boulevard or another street. The traffic light timing on those streets would then be changed to produce a longer green light, which increases vehicle through-put. People would be diverted around the problem and then back onto the freeway.

Finally, we have vehicle control technology. Electronic vehicle identification technologies should be of real interest to you because of their increasing use for a variety of purposes, toll collection being one. Radio frequency transponder technology can now be used to collect tolls from vehicles as they roll through toll plazas, without any need to stop. The technology being tested on the San Diego-Coronado Bridge in California works at speeds up to 35 miles an hour. The vehicle is identified, charged a toll against a debit account or a credit card, and then simply rolls right through. Some attention is also being given to this technology in the East, particularly in the New York metropolitan area.

Electronic vehicle identification technologies can also be used to monitor heavy vehicles. The best example of this application is the Heavy Vehicle Electronic License Plate (HELP) project. The HELP project will use automatic vehicle identification technologies—radio frequency transponders—to identify vehicles, to check their permits, to collect fees on the toll, and to weigh in motion. The HELP Project will be ready for a demonstration phase next year, when the technologies will be tested along Interstate 5 from Washington through California and eastward across Interstate 10. The HELP technology is of interest to the trucking industry as well as to regulators because it promises to reduce delays at toll plazas, weigh stations and ports of entries, thereby offering real productivity gains for the trucking industry.

Finally, automatic vehicle identification can be used for road pricing. Such a system was tested in Hong Kong in the mid-1980s. Technologically, it worked fine. The technology is very reliable, and it is not very expensive. Politically, however, there was strong opposition to road pricing, so it was never actually implemented. As congestion gets worse and worse, however, road pricing becomes a more attractive alternative. For example, until the Dutch government fell last month, its transport minister was seriously interested in road pricing, using transponder technology, to deal with traffic congestion in the Netherlands.

Electronic vehicle location technologies are of serious interest to us in the trucking industry. They have some applications for public service vehicles as well, but from a productivity point of view, the trucking industry is really beginning to use these technologies to track vehicles and to communicate with drivers. There is a variety of ways to do it. Some systems combine LORAN C radio navigation technology to locate the vehicle with two-way communications, generally mobile radio, to keep in touch with the vehicle.

The LORAN C location systems have a dispatcher's work stations. The dispatcher views an electronic map display and uses a control console to poll vehicles on the road. The electronic map display shows vehicles as yellow rectangles and the dispatcher can see, in real time, exactly where the vehicles are going. These kinds of systems are being used by taxi services, police departments, and trucking firms. They have some congestion reduction potential as well because if the driver is stuck in traffic, the dispatcher can suggest alternative routes.

The same sort of location and communication can be accomplished using satellite technologies. There are pure satellite systems and there are approaches that combine satellites with LORAN C. The over-the-road trucking industry is very interested in satellite-based systems. One type of equipment used for satellite tracking is the QUALCOMM system. The QUALCOMM is currently the industry leader in satellite tracking and communications for the trucking industry. A device on its right antenna is used to communicate between the vehicle and the satellite. The driver communicates not by voice but by using a keyboard. The system includes the proverbial "black box" and an electronic map display. The map displays are not as detailed as they are with the systems used for local pickup and delivery operations, but most dispatchers do not need to know exactly where their over-the-road trucks are. They need to know generally where they are. The map might display the progress of a vehicle down Interstate 5 in California, or track a variety of trucks in many different locations on a national scale.

In the truck load sector of the trucking business these technologies are becoming very useful for matching available empty trucks with loads that are coming up. Some tremendous productivity gains are to be had with this technology in the trucking business. The same sort of thing can be done using an Etak-type system with communications.

Vehicle control technologies are basically of two types: technologies to aid the driver, and technologies to actually replace the driver. There is a lot of work going on in Europe on radar braking, automatic headway controls, machine vision—all technologies to give the driver an edge in adverse circumstances.

A radar braking van is being experimented with by a company in San Diego, California. I took a ride in such a van,

demonstrated at the University of Michigan last fall by the man who developed the system.

The radar braking system first gives the driver an audio prompt that says "look out, look out." If the driver does not respond quickly enough, the vehicle brakes automatically. It was quite an experience to ride in this van because the driver tried to hit telephone poles and other vehicles. It was a scary experience, but it worked.

Technology not only aids drivers, it can get drivers out of the picture altogether. Technology can be used to either automate the roads or automate the vehicle. The Europeans, again, are very interested in automating the roads, taking control of the vehicle away from the driver through an automated road system. So is a group in California, through the PATH Program. The Europeans though, are investing large amounts of money in this. The Europolis Project, which is currently underway, is a \$150 million dollar effort to develop automated roads. It may well be 2050, however, before these technologies really become feasible.

I think that a better approach to automating the driving task is automating the vehicle. The one nice thing about automated vehicles as opposed to automated roads is that automated vehicles can be operated on the existing road infrastructure.

Automated vehicles are being experimented with here in the United States by Martin-Marietta, through the Autonomous Land Vehicle (ALV) Program. This is a project being done for the Defense Advanced Research Projects Agency, DARPA. So, it has military applications, but it could conceivably have civilian applications sometime after the year 2000 as well.

The interesting thing about the ALV project is its rapid progress. The effort began in 1984, and the first demonstration of the vehicle was in 1985. At that time the vehicle could go down a straight paved road at 3 kilometers an hour. It could not steer around obstacles, nor detect obstacles. By 1987 however, the vehicle could travel at 20 kilometers an hour. It could go down a winding road. It could detect obstacles if it knew they were something that it should not hit based on its vision. It could go to the destination specified, stop, turn around and come back. That is significant progress in just a few years.

The obvious question is how rapidly this progress will continue. If the capabilities of this vehicle continue to grow at the rate they have, it is conceivable that these kinds of vehicles could be roadworthy sometime after 2000.

The point of all this, then has been to emphasize that there are some promising new technologies available that may be able to help us deal with traffic congestion. They will not solve the problem by themselves. We are going to have to create some additional road capacity. We are going to have to do some other things as well. But these technologies can buy us some time in some cases, and they can help make more efficient use of the road system if they are wisely implemented.

The DOT Appropriations Bill instructed DOT to do a report on intelligent vehicle highway systems, to review what is happening in Europe and Japan and then suggest possible approaches for a national IVHS program here in the United States.

The report, "Discussion Paper on Intelligent Vehicle Highway Systems (IVHS)," was released recently and is available for comment. It is a good summary of IVHS developments

to date and raises some important questions about the desirability of a national program to deal with these kinds of technologies. I encourage you to get the report if you are interested in the subject and to comment to DOT on it.

DOUGLASS B. LEE

The scope of technology considered here encompasses applications of computers (often microchips), in conjunction with other engineering and management innovations, to improve highway operations. Technology that might be used in construction, in construction management, or in the planning process (e.g., traffic flow models) is not covered. The purpose is to assess how the various technologies may affect the future production and consumption of highway services.

Table 1 divides these innovations into two major categories, those primarily of a mechanical nature (propulsion and guidance) and those primarily of an operations nature (commu-

nications and identification). In many of these applications, the function (e.g., toll collection) has been carried out for a long time, but technological evolution has changed the performance characteristics of available alternatives.

When discussing new technology, it is always tempting to describe the components of the hardware and software and explain how they work. Although such descriptions are helpful and ultimately necessary for implementation, they are distracting from a planning perspective. Thus the table does not say much about the components or particulars of the technology, and gives only a general indication of what function it performs. In many instances several technologies can be used to produce comparable results.

INDIVIDUAL TECHNOLOGIES

Reviewing the technologies one by one, or by groupings of similar technologies, offers some clues as to which ones might

TABLE 1 HIGHWAY AND RELATED TECHNOLOGY

Function	Method/Subfunction	Prospects	Installation	Remarks/Application
Mechanical				
Engines	Fuel efficiency	H	V	Pollution reduction
	Emissions control & reporting	H	V	Variable regional standards
Propulsion	Alternative fuels	H	B	Enforcement
	Electric vehicles	M	V	Pollution, energy savings
	Magnetic levitation	X	V	Pollution, energy savings
	Electric highways	X	B	Perhaps long term
Guidance	Lane following	X	B	Very long term
	Collision avoidance	X	V	Closer vehicle spacing
	Night vision	X	V	Incident prevention
Speed	Speed controls	X	V	Accident reduction
		X	V	Enforcement, flow control, incident prevention
High speed ground	High speed rail			
Vehicle size	Limited performance vehicle	X	B	Perhaps long term
		X	B	More lanes per pavement width
Operations				
Traffic flow	Ramp flow control	M	H	Traffic flow improvement
	Signal coordination	M	H	Traffic flow improvement
	Vehicle sensors	M	H	Detectors with system response
	Signal preemption			
	Incident detection	M	B	Priority vehicles
Communication	Incident response	M	H	Maintain capacity
	Cellular phone	H	H	Communications & coordination
	Aid in distress	M	V	Avoid congestion, central control
	Transit security	M	V	Respond to accidents, threats
	Dispatching/coordination	M	V	Increased traffic performance
Navigation	Dead reckoning	H	B	Just-in-time delivery
	Route display	M	V	Reduce wasted travel
	Route guidance	M	V	Reduce wasted travel
Location	Voice communication	X	B	Real-time feedback
	Cordon or checkpoint	M	V	Fleet management
	Coordinate location	M	B	Traffic flow, pricing
Truck weight	Weight charges	H	V	Traffic, fleet mgmt., pricing
	Weight enforcement	H	B	WIM, by road and axle strength
Toll collection	Credit card	H	H	Instrument roads & bridges
	Electronic pass	M	H	Time savings, billings
	Debit (fare) card	H	B	Permit or area license
	Vehicle identification	H	B	Tolling on the move
Pavement management	Condition sensors	H	B	Followup billing/debiting
		M	H	Report pavement status
Parking management	Cash control	M	B	Reduce lost receipts
	Security	M	B	Reduce stolen vehicles

NOTE: Prospect symbols are: M = marginal impact on traffic or congestion, H = high priority for application, X = currently expensive relative to benefits. Installation symbols are: V = installed in vehicles only, H = installed in highways and other fixed facilities, B = installation involves both guideway and vehicles. WIM = weight in motion.

make potentially significant contributions to improving highway travel. Each technology or function is rated, in the table, as to whether the expected payoffs are high (H), marginal (M), or distant (X). "High" means that the technology is ready, and that the impacts would be large on such problems as congestion and pollution. "Marginal" means that the technology is currently feasible, but that the anticipated impacts appear relatively small on the performance measures of interest. "Distant" means that the technology requires long-term development, and that the impacts may be modest relative to the cost of applying the technology. This rating is derived entirely from the author's judgment, which undoubtedly differs from the conclusions of other observers.

Mechanical Innovations

The significance of innovations that affect only the vehicle, as distinct from those involving both vehicle and highway, is that vehicle manufacturers can market the features without waiting for highways to implement anything. Hence the apparent popularity of such items as heads-up displays, computerized maps with route guidance, and research on collision avoidance systems. Some of these "smart car" features may be attractive to drivers, but they are not likely to do much to reduce congestion or increase vehicle occupancy.

Alternative fuels are getting a lot of exposure as a means for combating air pollution, but the impacts are likely to range from marginal to the substitution of new pollutants. Reduction of air pollution from highway traffic depends mostly on how much fuel is burned and to some extent on how it is burned. Devices that can monitor both factors, adjust operating parameters, and report when queried on the amounts emitted, could be especially useful in creating pricing incentives to improve fuel efficiency and reduce emissions. Without such incentives, fuel changes and combustion technology will probably have only marginal impact.

Long-term mechanical innovations involving both highways and vehicles (such as electronically powered and guided highways) would seem to be among the least promising. These technologies in effect pack vehicles together more densely and shift the pollution to a different source, doing little else; arrayed against these modest impacts are costs that are difficult to estimate, mostly because of their enormous magnitude. Many of these innovations, such as smaller (limited performance) vehicles and automated steering, require sweeping changes to and major replacement of the existing system before benefits result. Electrically powered vehicles might fill a useful niche, but it is a small one at current highway scales and vehicle speeds.

Operations Innovations

With the possible exception of incident response, most traffic engineering measures involving the technology generate small increases in highway capacity without creating incentives to use the available capacity any more efficiently. Some have the primary effect of rearranging congestion. None, for example, shift trips to off-peak periods or increase vehicle occupancy (even HOV lanes, not listed here as "technology," have only modest-to-negligible impacts on occupancy). To the extent

that traffic improvements can prevent operating regimes in the "backward bending" portion of the traffic flow curve, they certainly make sense, but they will not relieve vehicle congestion overall.

Several categories of operations innovations, such as communications and tracking, can be implemented on vehicles alone, and seem to be on the verge of widespread adoption on specialized vehicle fleets. Another innovation that is spilling into highway use from applications in other sectors is automated toll collection, which promises to make user charging—no matter how complex—essentially costless to operate. Manually operated toll booths that require vehicles to stop are unnecessary relics, given the technology now available. The innovations have enormous potential for immediate payoff and are sufficiently developed to be risk-free.

COMBINATIONS OF COMPLEMENTARY TECHNOLOGIES

Not covered in the table are combinations of technology applications that are mutually reinforcing, creating a synthesis at a higher level of application than any single item. A few of the most prominent of these synergistic clusters of innovations are described below.

Centralized Control of Goods Movement

By combining automatic vehicle location (AVL) using satellite navigation, on-board satellite communications and computerized tracking and inventory management systems, the control of freight delivery is entering a new phase. The whereabouts of truck fleets will be tracked much more precisely, and electronically identified cargo—such as in containers—will be followed through internodal transfers in real time. Thus the implementation of just-in-time delivery and precise inventory management will be greatly facilitated.

These developments are taking place primarily in the private sector and the military, and do not require the instrumentation of highways in order to be successful. On the one hand, however, these developments provide opportunities for improved highway management; on the other hand, current highway management imposes limitations (for example in congestion and pavement quality) on the performance of the private sector innovations.

Truck Weight Enforcement and Pavement Conservation

With private fleet owners already in the process of instrumenting their trucks for tracking purposes, a parallel effort on the part of highway managers is especially advantageous. Requiring trucks to carry electronic tags for automatic vehicle identification (AVI), combined with roadside interrogators and weigh-in-motion sensors, allows for the monitoring of heavy vehicle traffic to a level that was previously inconceivable. This information can be used for enforcement of vehicle gross weight restrictions, bridge weight restrictions, and driver time-on-the-road restrictions.

Perhaps even more important, heavy vehicles can be charged user fees based directly on the axle loadings *and* the strength of the roads they are riding on. Rates can be set to create strong incentives for heavily loaded trucks to stay on roads strong enough to carry the weight without undue stress on the pavement, and to use more axles when the benefits justify the costs. Such precision in road use fees can now be implemented at relatively modest cost.

Toll Collection and Congestion Management

Automated collection of tolls from passenger vehicles is probably the functional area with the highest potential impact. It is likely to yield large benefits in financing urban and intercity highways, in reducing congestion and increasing vehicle occupancy, and in guiding investment into those facilities for which users demonstrate a clear willingness to pay. Many technologies are now available for this purpose, and they are cheap enough that standardization is not a prerequisite for imple-

mentation. We can experiment with a variety of systems, in a variety of contexts, and see which ones work best.

At present, only a few examples of automated toll collection exist beyond exact change machines, and no U.S. highways are priced according to peak versus off peak. Several expressways planned or under construction, however, will use fully automated toll collection, and it is likely that more will follow. The AVI is not necessary for tolling-in-motion, but it provides advantages that will prove essential in the long run. The ease with which the technology can now be applied creates the opportunity for high levels of local autonomy and innovation in the solution of financing and congestion problems.

Other functional areas where new technology will have major impact have not been mentioned, such as traffic signal coordination and overall flow management. The opportunities for improved utilization of existing facilities are so rich that even the most creative current thinking cannot begin to enumerate them all. It is urgent, however, that transportation planners begin testing and using these technologies as soon as possible.

Where Will We Get the Transportation Engineers and Planners of Tomorrow?

LESTER A. HOEL, FRANCIS B. FRANCOIS, AND GEORGE R. LLOYD

LESTER A. HOEL

New transportation professionals will have to work in a changing world with new technology. This new environment will place increasing demands on the education and training that they receive. New transportation professionals must, in effect, emerge with new skills.

Two reports provide an excellent starting point for those interested in this topic. One is a summary of a conference held in Williamsburg about 4 years ago dealing with transportation education and training: *Meeting the Challenge*. This conference examined education and training needs of transportation professionals in the future, recognizing that we had a crisis in research funding and in the number of students that were entering the transportation field. The report recommended the type of education that the transportation professional in the twenty-first century needs.

The other is TRB Special Report 207, *Transportation Professionals: Future Needs and Opportunities*. This study was also completed about 4 years ago and dealt with the impending personnel crisis expected from the loss of professionals who would be retiring in the late 1980s and early 1990s. Incidentally, AASHTO participated very heavily in that report and provided the database. The professional study needs examined the current and projected supply of new graduates, particularly in civil engineering, as that source has continued to supply the bulk of professionals for the highway transportation field.

The study confirmed that a generational shift will occur in the highway transportation field during the next decade and that a third of the professional work force would be retiring. The study included a state-by-state analysis and showed that some states were worse off than the average and would face severe personnel shortages in the next 10 years.

The good news was that these changes need not necessarily create a severe crisis if agencies planned ahead. Because the losses would be at the upper levels, they would create room at the top for people within the organizations.

The study found no current shortage of civil engineering graduates at the entry level. It did predict that if present trends of declining enrollments and a lower share of engineering graduates continued, a problem would exist within 3 to 5 years as the number of new jobs became greater than the states' historical share of recent graduates. That is exactly what has happened.

The report also noted enhanced opportunity in the highway transportation field for young people, but observed that it will be necessary to get the message out to those young people because other exciting fields such as computer science, aerospace, and electrical engineering have demonstrated needs and higher starting salaries.

The study examined and suggested several ways that agencies could cope with the coming turnover in professional ranks. These include developing improvement programs such as job rotation and managerial training to prepare younger employees for more senior positions.

The study also suggested that agencies periodically review their recruitment procedures and policies to ensure they are competitive. Students who are graduating and can choose to work for your agency or work some other organization will be looking at what your organization has to offer. They certainly will consider salary, but they will be interested in other considerations as well: work conditions, employee benefits, and opportunities for growth and development.

The TRB professional needs study also recommended using computers to increase productivity, and recommended employing consultants to handle specialized and peak loads. Today many state DOTs are using consultants and have incorporated computers into the workplace. The study suggested reassigning job responsibilities, modifying job entry requirements and making greater use of technicians, where appropriate; in other words, utilizing personnel in more effective ways.

In light of these studies, how is the problem being perceived today and what are we doing about it? One measure of the problem is its attention in the media, and by professional organizations. Within the last 6 months, *Engineering News Record* has devoted two articles to this subject. One dealt with the loss of senior highway personnel and focused primarily on the CEO problem and turnover at that level. The second focused on the entry-level problem with an article entitled, "Construction Moves to Groom Talent That Will Propel It into the 21st Century."

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Just recently, *The Washington Post* had an article on this problem. I am sure many of you have seen it. Two of the people at the head table (Mike Meyer and Frank Francois) were quoted in that article. The title of the article was "Government Highway Engineers: A Vanishing Breed."

At the organizational level, AASHTO has completed a study of professional needs which we will hear about later, and ITE has recently published a report called "Attracting Students to a Professional Career in Transportation Engineering."

I would like to review some of the problems and strategies that have been identified in these articles and reports. All recognize the shrinking labor pool, that there are fewer young people to recruit. In addition, they foresee a further decline in enrollments in engineering, and greater attraction to non-construction disciplines by engineering students, where there is a perception of job security and higher wages.

Mentors and role models for women and minorities are lacking. If everyone else is going to other fields, they are not likely to be any different. A failure to motivate students at an early age to pursue math and science and the lack of involvement by industry and government to support education and training is also cited. A lack of certain skills, particularly in design, hazardous waste management and other areas; an unwillingness to transfer to high-cost locations; and reduced image of public service are further impediments. Engineers simply do not see the career ladder leading to the top as they used to.

Other problems include perceived lack in quality and fewer role models in engineering schools owing to the increased number of foreign nationals who are teaching. We are also seeing an increased number of foreign nationals who are studying. A survey of U.S. engineering schools with transportation programs today would show that half of all the students at the graduate level (Masters or Ph.D.) have a first degree from another country.

Now, what are we doing about it? We are certainly boosting efforts to nurture and recruit young professionals, developing new approaches to keep employees in place and happy, and increasing our presence on campus with more aggressive recruiting. Our field has fewer recruiters than other disciplines and our students are aware of this. They look at the private sector recruiter and ask where the jobs are.

Students need more personal contact with the people in the field. Attending career days, visiting minority schools, linking senior people with new recruits, mentor programs, going after underutilized sectors of the engineering profession, hiring people who have taken early retirement, and paying higher salaries are all important strategies.

Money, however, still is a principal factor. Adding other financial incentives may be necessary, along with accommodating the new phenomenon of the two career family with day care and other modifications in the work environment so that two career families can manage. Providing sabbatical leaves away from the job, tracking high-performance employees, giving recognition, and assuring continuing training of the better people are also means of attracting personnel.

We must also become involved in developing the engineering curriculum, promoting 5-year programs that include business and communication skills. Direct involvement in the high schools is needed, as is development of professional soci-

ety media materials, to let young people know the excitement and the challenges of this profession.

To summarize, I believe the next decades will be challenging ones in transportation. Our new professionals must have broad-based skills, particularly analytical skills, communication skills, skills in dealing with computers and a perception of where we have been, how we got there, where we are going. Then they must understand the world around them because the 1990s will be the global decade.

Our transportation organizations must create an attractive environment to ensure that employees remain current through continued education and job rotation, but they must also provide adequate compensation. Educators and practitioners must convince young people of the challenges in this field and begin to attract high quality young people to the profession.

This message was first delivered in the TRB transportation professional needs study of 1985 and it is being echoed by various sectors of the industry today. We have thoroughly described and documented the problem. What is needed now is to get busy. Employers, universities, faculty, professional organizations and associations, the federal, state and local government, all of us, must work as a team to solve the problem.

FRANCIS B. FRANCOIS

Let me tell you a little about what is happening inside AASHTO, and then make a few observations.

Many debates are indeed taking place on the issue of training transportation professionals, and recruiting and retaining them over time. Les has covered this topic well. Perhaps I can add to the discussion by reviewing some of statistics on civil engineering students that I think are particularly interesting.

The trend over the past 12 years has not been very encouraging. In 1976, the total of all engineering degrees awarded in this nation was 37,970. By 1981 the total was nearly 63,000 engineering degrees, of which some 10,000 were in civil engineering; in 1987, only 8,000 of the 75,000 engineering degrees, were in civil engineering. We actually lost ground.

So, it is quite clear that we are not attracting the people into the engineering field that we should be. As Les has outlined, a number of groups are looking at this issue, including the National Society for Professional Engineers and ASCE. It was one of the topics at ASCE's conference on 21st Century Highways held recently in San Francisco. Also reviewing the problem are ITE, TRB and others, including AASHTO.

Obviously, many factors are involved. Within AASHTO, we decided last year to look at what is happening in the states and gather information from our member departments. Last July we surveyed all our member departments and in December published the results in a report that summarizes the responses from 41 states, Puerto Rico, and one Canadian Province. Some states, therefore, are not included, which means the results are somewhat understated. All our member departments should now have a copy of the report, which is entitled *Transportation Professionals: Recruitment and Retention*.

The report analyzes a number of areas at the state level, including salaries, recruitment problems, etc.; our results gen-

erally conformed to the conclusions outlined in the previous paper in this proceedings.

Our survey found that some departments currently have no recruitment problem, while others do. Of 41 departments responding, just about half said that they have no current problem. About half of those, however, expected to have a problem in 5 years. The greatest area of variance in terms of recruitment is in general civil engineering, but vacancies also exist in the specialties. We specifically tried to identify the number of vacancies existing at the time of the survey. Vacancies, of course, can change month by month, but at the time of the survey period, approximately July through September of 1988, about 390 vacant civil engineering general slots existed. Vacancies for construction engineers were next at 118, followed by design engineers, 91; traffic and maintenance engineers, 70; right-of-way engineers, 69; materials engineers, 52; and bridges and structures engineers, 50.

So, most of the specialties had shortages, but the greatest problem remains simply getting enough new people into the transportation field. Some states went into great detail on their recruitment activities. Carl Williams from California reported in our survey, for example, that his department had hired approximately 1,100 engineers nationwide since September 1987, making civil engineering very much a growth industry in that state.

Florida reported that all districts were having problems recruiting registered professional engineers. The State of Washington said that "the pool of traffic engineering specialists is diminishing inverse to our increasing needs."

We also looked at salary levels because this is one of the big issues. The survey asked for starting salaries for a B.S. degree and starting salaries for an M.S. degree, for both civil engineering generalists and specialists in areas where the states say they have problems. One intriguing result is that salaries are essentially flat across the board: civil engineering generalists, bridge and structures persons, and other specialists all receive the same entry-level salary. There is no differential, moreover, at least in the first year, in the salary level for a B.S. and an M.S. degree. So, there is little incentive to go to school an extra year if it merits no additional pay. I am sure that at least some people who look at this situation have this attitude. After a few years, however, things improve. The ranges for starting salaries are quite wide. Of those states reporting, the low for a starting civil engineer was in Indiana, \$16,749. The high was in Alaska, \$28,326. In Puerto Rico, the starting salary was \$13,044.

After 2 years, things improve generally everywhere. The lowest state salary for civil engineers after two years of employment was in North Dakota, \$19,565; in Alaska, at the other extreme, it was \$33,648 plus all the oil you can eat, I think. The average reported salary after 2 years had gone to \$28,807. So a person can up fairly quickly, but even so, the overall scale is quite low.

Asked whether starting salary is a problem for civil engineers, only 12 states said "yes." Now, either they do not know they have a problem or they do not have one. I am not sure which. In any case, many states perceived no real need for help on the starting salary issue.

The survey found that computer specialists with B.S. degrees are generally paid higher salaries than civil engineers in some nine states, and lower in other states. The highest salary reported for this category was in New Hampshire, \$30,751; Alaska

reported \$30,216. The lowest starting salary for a planner was in West Virginia, \$13,872; the highest was in Massachusetts, \$30,737. Landscape specialists received \$16,380 in Arkansas, compared with \$32,215 in Massachusetts.

The largest number of "yes" responses was to the question of whether it is hard to recruit planners. Seven states and Puerto Rico said that they cannot get planners at the salaries they are paying.

We need to remember that these job descriptions obviously vary from state to state, as do salary levels. Also, the data are for one point in time, 1988, and salary structures can change.

We also looked at recruitment practices. What is it that the states are doing, and what techniques do they use? Les Hoel reviewed some of them in the previous paper. Summer employment is one practice used by many states. About 31 states use it in some form, bringing in students during the summer with the hope that they will return and stay. On the other hand, few member departments go out into the high schools and talk about engineering. Twenty-eight respondents did not, but some are now looking at it. About 30 states actively work with college students other than at recruitment time.

Another interesting program used by 11 departments is to operate an arm of the state highway agency within the civil engineering school, where students can do real work on the state highway network.

Student mentor programs, which groups like the National Society of Professional Engineers and others view as extremely important, are almost nonexistent. Only five states say that they do much in this area.

Some 13 states now use predevelopment career programs, and others are looking at them. In these programs, the departments deliberately go out and recruit students, get them involved on more or less a contract basis while they are in engineering school, and then stay with them so that they ultimately come into the agency and develop a career.

We asked if the department does anything about career development after it employs engineers. Twenty eight states reported that they have formal programs that tend to move new recruits through the positions within the agencies. We asked for details on these programs, such as whether the program offers tuition reimbursement for postgraduate college courses. Some 28 said "yes," to this question and 9 said "no." We also asked whether the program routes the employee through all or several offices of the department in an organized manner. Almost all of the programs do. Some 22 of the states responded that the employee is allowed a choice in assignment after completing the program.

We also asked for quite a bit of information from the states on their current practices on the use of educational materials, outreach materials, etc., and what kind of things they thought might be taken up nationally by AASHTO and others to help matters.

What has happened since the survey? Well, two or three things. One of those is that we sent copies of the survey report to all the nation's civil engineering school for their comments. We received 30 or 35 responses, some very general and some in great detail, commenting on the various subjects in the report. This year, AASHTO made this one of its emphasis areas. President Pitts nominated it as such and our Policy Committee endorsed it. We have since been working quite a

bit in this area. One of the first things we did, as AASHTO often does, is to create a task force on transportation professionals' development and recruitment. It is chaired by Hal Kassoff, director of the State Highway Administration in Maryland, which is recognized as one of the agencies that has done a better job nationwide in bringing people in, training them, and keeping them with the agency.

This task force held its first meeting about 2 weeks ago, and has proposed a three-stage effort to improve the overall quality and supply of transportation professionals. The implementation of that three-stage program will be before AASHTO in the coming months.

We hope to complete the first stage of that program, the one that is felt to be most urgent, by this fall. It is a guide on the recruiting and retention of graduate civil engineers by state transportation agencies. The task force has already produced an outline for this guide. Let me just run through it briefly.

One chapter of the guide will deal with the formulation of a departmental recruitment and retention strategy, and it will discuss a number of strategies that might be employed by the agency.

Chapter 2 will be devoted to developing and promoting career opportunities at state transportation agencies; it will renew career development programs, scholarship programs, rotational programs, and other things we spoke of earlier.

Chapter 3 will discuss how to cultivate university contacts, drawing on the information we got from the engineering schools, and those practices that the states have found to work. A manual discussing how best to go about this proposal is producing attractive and effective marketing materials. The task force emphasizes Les Hoel's point that our departments of transportation are not present very often on college campuses, and that when we do appear we often do so poorly.

We think that by drawing on the ideas that have worked for our agencies and laying them out for other people, we can accomplish a great deal. Looking at recruitment tactics, we can improve our approach. The response we get in talking to the engineering schools about this area is that for the most part state DOTs are often pure amateurs when it comes to competing against large engineering firms and private industry, that we just do not approach it in a logical way. We can do more with student employment, for example.

As I said, we hope that this effort will result in a draft guideline sometime this fall, one that we can take in front of the AASHTO Executive Committee and that ultimately will give us a handbook that can go to each department's phase of the task force program.

On top of that list is entry-level recruitment and training. It is intended that Project 20-24, the advising panel, which is under the chairmanship of Charles Miller of the Arizona Department of Transportation, will begin to focus more on this area also. Thus, both our task force and Project 20-24 are looking at some of the same issues, and there is a merging of ideas.

One very interesting topic that came up at the task force is that we have all been looking at what college professors, the people in the DOTs, and adults in the general public think about the engineer shortage. Yet no one, to our knowledge, has bothered to ask the students what they think. There is simply no research on this. So, one of the things we are proposing to do is to reach down to the junior high level and do some polling, bring some focus groups together, and see

what is on the minds of those students that we are not attracting. We want to talk to them, let them tell us what is bothering them, so that we can respond to it.

So, to summarize the review of Les's comments, problems do indeed exist: The turnover problem is real. The recruitment problem is real, and the problem of not enough people to recruit is real.

The graduate student situation in science and engineering is very unhealthy. It is true that about half of all engineering graduate students are foreign students currently. This is not because they are displacing U.S. students. If that half was not there, most of our graduate schools would close for lack of students.

Whatever the reason, we have a real shortage of graduate students in engineering. Part of the problem is the student financing methods, especially loans. When a student has already acquired a \$40 to \$50 thousand debt after 4 years of engineering school, how much more education and time can he or she take before starting to earn and paying it back?

I do not know all the answers, but clearly more research grants is one way. AASHTO is working currently on the research agenda for the future, and this issue is something that needs to be included.

Many changes are coming. We have talked about many of them here, including air quality issues. What happens if we change fuels? What happens if liquid fuels as we know them vanish, as some say may happen at the turn of the century or beyond? The Los Angeles air quality plan, coupled with new sources of electricity and superconductivity, should make the electro-vehicle operational. Then what do we do with our current fuel-based user taxes? We will need a new approach to funding. New members, moreover, will present new engineering issues.

Intelligent vehicle and highway systems, computers, and many more developments say that the engineering curriculum must change. ASCE, under a project that Harold Michael of Purdue University has been working on, has tried to identify what the civil engineer of tomorrow is going to look like. He or she will look very different from today, reflecting many of the things that Les was saying earlier.

Typically, tomorrow's civil engineer will have much more of a world view than we have had; a world view on transportation issues from our standpoint. I heard the other day, for example, about a leading West Coast shipping company that uses the Port of New York but has no ships actually going into New York Harbor. Rather, it brings goods from the Pacific Basin and ships them by land across the United States to New York Harbor. From there the goods are shipped by other companies to Europe, and vice-versa. This is the type of new development in transportation with which we have to deal in this country, new ideas on why and how we move freight.

Tomorrow's civil engineer will also deal more with quality of life issues. Tomorrow's civil engineers will be more managers of resources than they have been in the past, and technicians will be employed to do much of what we see now as civil engineering. Tomorrow's civil engineer and transportation professionals, above all, will need to be communicators.

So, we clearly have a lot to do. AASHTO is trying to work with some of the problems. Many things must be done if we are going to get and keep the kinds of transportation professional people we need.

GEORGE R. LLOYD

Both preceding speakers have articulated the problems associated with the current shortage of engineers very well. They have both summarized the approaches to the problem that we in the engineering community are taking, and I will not dwell on that further. Instead, I would like to look briefly at some of the activities of the private sector, and discuss the probable effectiveness of some of these activities.

These same shortage issues are being articulated in the popular press in somewhat different terms than we in the technical community have used. Just in the last week, I read an article in the *New York Times*; one in the *Boston Globe*; a Mobil Corporation editorial in the *New York Times*; and several *Engineering News Record* articles. They were all reporting the results of a National Science Foundation study showing that there would be 96,000 too few engineering baccalaureate degrees by the year 1990 and some 700,000 too few bachelors in engineering and science by the year 2010.

Many explanations have been given for these data. As a community, we understand the raw numerical shortage of individuals. I would like to look at how we are currently attracting people to the engineering disciplines, whether transportation engineering or other related technical fields.

AASHTO has certainly addressed the issue here today. The NSPE, ITE, SAME and other professional organizations have also perceived the seriousness of the problem, and articulated solutions. The private sector is also addressing the problem. On a corporate level, we are involved in Headstart Programs, JUMP programs, and others that attract students at the high school level into an engineering work environment. The hope is that some of these individuals will be impressed with what they see, and continue their education in the technical disciplines.

Within the corporation, we support fellowship programs designed to improve internal technical skills and also attract entry-level people with the offer of chances to improve skills. Other firms are using similar programs to make employment as a working engineer more attractive.

I think at this time it is worthwhile to take a look at what we are doing, a back-check if you will. We have sent a loud message that a numerical shortage of skills exists. We have postulated some solutions. We have articulated programs to implement these solutions. We are spending money and other resources to solve this perceived problem.

All these things are happening at the macro level. I would like to look at the micro level, to see how our message is coming across. To look at how some of our programs are being implemented, and see if the results from the other end of the pipeline will be as we had hoped.

I recently read an article containing remarks delivered at a conference by Bob Gibson, president of the National Society of Professional Engineers. He states that

Our experience dictates that new hires must be technically competent, but they must also be behavioral scientists and they must be pragmatic managers all rolled into one package. The current crop of engineering school graduates does NOT meet these standards.

Later on at the same conference, General Henry Hatch, former U.S. Army chief of engineers, stated that

American-schooled engineers have difficulty communicating with their foreign peers. They possess an insufficient knowledge of the internationally accepted metric system. They have a poor understanding of foreign cultures, and they often have differing professional expectations in such areas as ethics and the pace of work. Possibly, the worst of it is engineering arrogance among U.S. practitioners, who mistakenly believe that the American way is the only way. There are other solutions.

What I am getting at is that we have calculated some numerical shortage, and we have come up with ways to address that numerical shortage. We have perceived some lack of needed skills, and come up with programs intended to get around the problem. I think, though, that we should now look at the quality side of the equation, in addition to the quantity side, and be sure that the things that we are doing are, in fact, having the effect that we intended. In particular, I would like to discuss some of the current trends in my own practice.

My practice has relied heavily on automation of the design process. At a typical magazine stand, you can find about 25 periodicals devoted to that subject. The process is called CAD, CADD, CAE, CAM, CAD/CAM and a host of other alphabet soup acronyms. All the publications go on at great length about "automating the design process." But what exactly does that mean?

The meaning we find at the engineer's level is not quite what we were all led to believe a few short years ago. Yes, I believe that computers are getting us a better constructed product. That is so because we are more exhaustively analyzing alternatives in the construction process, and we are analyzing them in greater depth.

We are getting a constructed product that is more cost effective, that is not going to be functionally obsolete as quickly, and that is more durable in the construction form. At the designer level, however, at the practicing engineer's level, we require MORE manpower and we require better manpower, smarter manpower, to ensure that the information that the computer generates for us is realistically used and is understood and fed into the construction process.

Expecting that computer-generated improvements in productivity will reduce the need for skilled engineers and technicians is not realistic. The classic labor saving from automation does not cross over into the design professions. Automation is resulting in a more efficient deployment of capital, but we are not saving engineering labor. Quite the opposite, we need more and smarter engineers to take advantage of this tool. Perhaps in addressing the sheer numerical shortage of engineers we should also be focusing on the quality of the education each engineer receives.

It has become faddish to analyze this problem by looking deeply into our national psychology and wringing our hands at how the Japanese educational system, or the Taiwanese work ethic, or something else is leading to our downfall. We see articles stating that our educational system is a flop; our industrial base is antiquated; Americans are lazy and on and on.

I would like to present some of my own observations on this subject, and see if they are not similar to yours. I would like to examine whether the problems are as deep as they seem, or perhaps the interpretation of our needs has not been well articulated.

I have a daughter who is in kindergarten. Computers are very popular in kindergarten. I also happen to have computers

around my house. I walked into my home office one day to see what was causing the loud banging noise. What I discovered was that my kindergartner was banging the \$200 mouse up against the side of the \$6,900 display to take out her frustration. When she saw me, she angrily told me that "the computer crashed, again!"

What she meant was that she could not get the CAD software to work. Her diagnosis was cute, but technically incorrect. The little tyke handed the computer a bunch of garbage and the computer balked at processing it, but the computer had not crashed at all.

I thought that it was rather clever of her, though, to come up with that technological term for her problem, at least until I discovered the source. A few weeks later I was in her school for open school week. School officials proudly drag you through the "computer center." It was quite a sight. There was every brand of computer, with all the screens colorfully lit with some educational software or other. All except for one screen, which was blank, except for that familiar little blinking "C:>" prompt.

When asked about the errant screen, the teacher said, "Oh, yeah, that darn machine is always busted. Mr. Somebody is the only one who knows how to fix it when it crashes, and he is not here tonight."

Well, that was where my daughter learned to say that the computer "crashed." The real problem was that the teacher did not know a DOS prompt when she saw one, or how to start an executable program, or even how to find one to start.

In fact, the teacher was a little frightened of all those machines. And the teacher is supposed to be the one imparting information about computers to kindergartners. What I learned was, for me, very revealing. I had gladly paid school taxes all these years. I have been guest speaker at all of the schools over the years, and I have talked to students to see what they were doing and why, but I never bothered to find out what the grade school teacher knew about the subject. No one had bothered to tell the teacher what a DOS prompt was or how a PC works.

This is not a gross problem, nor a macro problem. It is a micro level problem. Our message is not being translated properly at the local level, but it is probably something we could all help to solve in our local school districts.

I also happen to have two daughters who are of college age. In fact, they are past college, and both have completed higher education. They are both math majors, and have both done graduate work. They are very bright and they have some of the same characteristics as some of the recent hires at the office. The college grads from engineering schools are very good at technical subjects. They are very bright. They can solve problems far more efficiently than I could at a similar stage, and the colleges are to be commended for their ability to impart technical skills.

What they cannot do is write a report, or speak or write coherent English. I can trust them to solve engineering problems. I cannot trust them to explain that solution to someone else. I can turn them loose with a computer, and they will solve a problem. I cannot turn them loose with a client, unless I am standing there with a muzzle for them. They will not communicate their ideas, they will not listen and hear the ideas of others. They are talkers, but not listeners. They are not really communicating.

I then thought over my daughters' college experience, to see if I could fathom a reason for the communication skills

going so badly awry. In their freshman year, I remember being very impressed with the curriculum. They had history, science, literature, language, and of course, math. By their sophomore year, it was philosophy, economics, Western civilization, and math and more math. By the time they got to graduate school, what they were taking was Easypass 1.1 and Easypass 2.1, and then math, math, math, math, and math. It is not surprising, then, that the students who came out the other end thought that Wagner was a colorless alcoholic beverage, or that Edgar Allen Poe was a Wall Street LBO firm, nor that they cannot hold a meaningful conversation or write a literate report.

The students will learn, of course, in time to sort out those things that are important beyond the mere technical subjects. But perhaps the college curricula, and particularly the ordering of the college curricula, is worth looking at, to see if our message about the kinds of people we need is being properly translated. Maybe the arts and humanities ought to be taught last, so when they have their grounding in technical subjects, they are then forced to grapple with the harder subjects, and see the relevance of what they are doing in the context of history.

We send messages in the work place, also. We are sending messages to these new hires, and my kids for one are reading the messages loud and clear. The overt message is that "we need more engineers." One look at their career path, however, will show that they do not believe us, and that they are avoiding the traditional engineering disciplines. Instead, they are becoming managers or analysts, and handling other resources. And it does not take a very long conversation with them to discover why. My daughters may not yet have learned to appreciate great literature, but they can crunch all of the information out of the *Wall Street Journal* in about 15 minutes. They are no dummies when it comes to their pocketbooks.

Look at what we are doing in the engineering community, in the state highway and transportation departments, the users of all of that engineering talent that we keep saying we need. What we see are things like salary caps and freezes on reimbursement. When the State agency can no longer hire talented employees, they give work to the consultants, but then they impose on them the same salary caps.

Entry-level people are no dummies. No one ever told Ivan Boesky that he was going to have his salary capped. He might have other problems, but he never had that one. The message is loud and clear. It becomes even more barbed when the corporate marketer, lawyer or accountant is excused from the salary cap, but not the engineer.

The message to the prospective engineer is that the starting salary may be acceptable, but there is a limit as to how far you can go. Your starting salary may be good, but your ending salary is already known, and that may not be so good.

We also impose overhead limits on engineering design firms. Do an audit, and take a look at what gets squeezed out of the engineering overhead budget. Invariably, it is the technical development items. The technical conferences, the seminars, the training sessions. Inhouse research and development is a thing of the past in the engineering community.

The overt message about the shortage of engineers is being heard, as evidenced by the attention in the popular press. But the covert message, the real message, to the prospective engineer, is also being heard loud and clear. At the practitioner's level, we are still saying "don't bother—no money here." I

do not believe that that is the message that we are intending to send.

In summary, I ask that you look at the message that you are sending to prospective engineers. See if it is the right message. Be more demanding in your standards for professionals, rather than less demanding. But look in personally on the results of those demands. Look at the way your mes-

sage is being interpreted and communicated in your workplace. And look at your community and your schools as well. Be sure that the message getting through from kindergarten to graduate school is the one you thought you sent. And be sure that the messenger is prepared to interpret your message properly.