

MANAGING CHANGE

TRB's Field Visit Program 1994-1995

Each year Transportation Research Board staff members visit every state highway and transportation department, many universities, transit and other modal agencies, and industry. The objectives of the field visit program are (a) to learn of problems facing the visited organization and to pass on information pertinent to the solution of these problems based on research or the experiences of other states, industry, or educational institutions; (b) to learn of research activities in progress or contemplated and inform the visited organization of similar research being carried out elsewhere, thus preventing duplication of efforts; and (c) to identify new methods and procedures that might have application elsewhere.

These annual visits provide the opportunity to collect and share transportation research information through personal interactions between TRB staff and the individuals they visit. Although other forms of information transfer exist—such as publications and electronic services—the visit program offers the unique advantage of one-on-one discussions to fully explore areas of mutual interest. Personal visits can also identify innovative or experimental work that will not be published for wide dissemination, but nevertheless is worth bringing to the attention of others.

Another benefit of the program is the opportunity to describe TRB's range of services to new people in the transportation agencies that support TRB. The visits also serve to identify potential candidates for TRB standing committees, panels for the National Cooperative Highway Research Program and the Transit Cooperative Research Program, and special project committees.

One word describes the past year: *uncertainty*.

THE YEAR AT A GLANCE

One word describes the past year: uncertainty. Speculation was widespread in the transportation community as practitioners tried to predict the potential impacts of changes to funding levels and programs that could be made in the next round of federal legislation, and the more immediate implications of unreleased funds in existing programs. Uncertainty also existed over the prospects for the National Highway System and the National Transportation System, the future of the National Railroad Passenger Corporation (Amtrak), and the outlook for the Federal Aviation Administration's air traffic control functions. In addition, the relationship of environmental and societal goals to basic system improvements is being reexamined,

responsibility and funding are being shifted from federal to state and local agencies, the U.S. Department of Transportation may be reorganized, government is being downsized, and formerly public functions are being privatized. Many questions remain at the end of the year, and upcoming decisions about the matters just described will undoubtedly result in far-reaching changes in the transportation community and the society it serves.

Two areas are particularly noteworthy: intermodal transportation and management systems. Both the public and private sectors continue to be extremely interested in intermodal transportation. Some offer the observation that the United States is implementing intermodalism while the term is still being defined. Once considered a buzz word, intermodalism is quickly becoming the central connecting feature of transportation programs and services in this country. A section on intermodalism has been added to this year's field visit report.

ISTEA-mandated management systems for pavements, bridges, safety, congestion, public transportation, and intermodal transportation occupied center stage this year. On the one hand state agencies are developing ways to integrate these systems to build on and complement each other, particularly to allow data bases to be shared. On the other hand some states are questioning the requirement and need for such systems, especially at the county and city levels in the rural parts of the country. Questions about the data-intensiveness of the systems are also being raised. However, the overall sense appears to be that the development and use of management systems—tailored to a particular state's needs—will help the states carry out their programs more effectively and efficiently.

The future of transportation research funding and direction is a major concern. The Clinton administration has been conducting a review of federal research and development programs to ensure that funds are applied to the most important national goals. Transportation, a major element of this review, is being addressed by an interagency committee of the President's National Science and Technology Council. TRB conducted a national forum in March 1995 to provide input from all sectors of the transportation community to the committee's work, and from all indications the federal agencies are sensitive to the nation's overall R&D needs and plan to work with all concerned parties to move ahead with the development of federal R&D programs. The federal review could result in significant changes in the types of research sponsored by the federal



New Amtrak station in Oakland, California, provides intermodal connections.
KING

government. The proposed reorganization of U.S. DOT could also have dramatic effects on federally funded research.

State-funded research is also subject to significant changes. The funding level and restrictions on the use of state planning and research funds (SP&R), provided to the states as part of the federal-aid program, could change dramatically. Funds that are now designated as SP&R may not be so designated in the future, and each state may have more flexibility in setting priorities for undertaking research versus allocating funds to other programs.

Both federal and state agencies view R&D as an essential component of progress, productivity, and competitiveness, which is somewhat reassuring. There appears to be broad support for a viable national research program to address issues ranging from potholes to advanced technologies. However, priorities and opinions change, especially when funding levels are reduced, so the future is indeed uncertain.

PLANNING

ISTEA still plays a major role in shaping and restructuring planning at the state and metropolitan levels. For example, the ISTEA management systems (for pavements, bridges, safety, traffic congestion, public transportation, and intermodal transportation) pose continuing problems for many state departments of transportation because of increased data needs, analysis requirements, and implementation costs. Requirements for management systems in rural states are being questioned.

On the other hand, many successful programs under ISTEA are being implemented by states and metropolitan organizations. An example is the \$6 billion Congestion Mitigation and Air Quality Improvement program (CMAQ). Flexibility is the cornerstone of the program. Funding covers a wide variety of projects such as transit improvements, inspection and maintenance programs, conversion of publicly owned fleets to cleaner fuels, shared ride services, demand management, and employee trip reduction programs. On the basis of a joint review of the program by U.S. DOT and the Environmental Protection Agency, the decentralization of planning and implementation responsibility is taking hold. Many metropolitan planning organizations (MPOs) in air quality nonattainment areas have developed effective processes to set their own funding priorities, with the states becoming willing partners. CMAQ has pushed the planning process toward intermodalism because by its nature it requires new players beyond the traditional types. For example, air

ISTEA-mandated management systems occupied center stage this year.



quality agencies are having a more direct impact on transportation planning. Other positive aspects of ISTEA include the increased emphasis on public involvement and outreach activities at both the state and metropolitan levels, commitment by local public officials to work together regionally with state DOTs and state air quality officials, and greater interaction with the private sector through increased emphasis on intermodal aspects of transportation and freight transportation issues in particular.

FINANCE

With Congress focused on curtailing spending to reduce the deficit and possibly allow a federal tax cut, there is great uncertainty about the future of the federal transportation programs. Highways, transit, and aviation constitute about 10 percent of the federal domestic discretionary budget.

CMAQ provides funds for wide range of transportation projects to encourage alternatives to driving alone.
HALL/SANTA CLARA
COUNTY
TRANSPORTATION
AGENCY

As vehicles become more fuel-efficient, and as vehicles using alternative fuels and electricity multiply...the question of how to allocate the costs to all vehicles using transportation facilities becomes more critical.



Don Dean (left) and Wesley Lum, California Department of Transportation, demonstrate electric vehicle.
KING

Although some political forces are trying to take the transportation trust funds "off budget," other forces recognize that to do so would require even greater budget cuts for those programs remaining in the federal discretionary budget. In addition, the current trust fund balances are being used to help offset the federal annual deficit and part of the motor fuel tax revenues is being applied to the general budget. Until these major financial issues are resolved, the future of federal funding for transportation will remain uncertain.

Further complicating the financial picture are factors that may require major reductions in programs:

- The administration has proposed a major reorganization of U.S. DOT, raising uncertainties about the consolidation of programs and the resulting funding levels.
- Congress has not yet acted (at the time of this writing) on the designation of the National Highway System that must be approved to continue future funding for the Interstate system.
- Proposals exist for combining the federal modal trust funds into a unified trust fund.

Although current attention is focused on the impacts of budget-cutting efforts, in the longer term some states are concerned about their own motor fuel tax base. State and local fuel tax receipts increased by 4.5 percent last year. Because state legislatures usually do not dedicate gasoline taxes to transportation, state highway user taxes have not increased significantly, with a few exceptions. As vehicles become more fuel-efficient, as vehicles using alternative fuels and electricity multiply, and as more urban areas opt to use alcohol-based fuels that are taxed at a lower rate, the question of how to allocate the costs to all vehicles using transportation facilities will become more critical.

HUMAN RESOURCES AND MANAGEMENT

State transportation agencies continue to be caught up in the downsizing of government. Though most states have completed their programs of early retirements to reduce the number of state employees, many state DOTs continue to be required to further reduce their total work force. As a result, a number of states are going through an extensive organizational review in an effort to improve their efficiency and effectiveness with fewer employees. A significant aspect of the downsizing of transportation agencies is a reduction in the number of middle managers and a greater decentralization of management responsibilities.

The characteristics of the work force are changing to include more individuals from nonengineering disciplines, and an increasing number of top management positions in both federal and state transportation agencies are being held by women and minorities. Contracting out of all types of state DOT services continues to increase. Issues arising from a reduced work force and contracting out of services include the need for performance measures to ensure quality of product, timely responsiveness of private contractors, and minimized costs. To improve management systems, many states are now beginning to apply total quality management and continuous quality techniques.

INTERMODAL TRANSPORTATION

Congress verified the importance of intermodalism with the passage of ISTEA. Intermodalism in its broadest context is a systems approach to optimized transportation, and a shift toward intermodalism can be seen at all levels of government. Intermodal transportation is characterized by interconnections between the modes, use of multiple modes for a single trip, and the evolution of a coordinated transportation policy.

The Congress that enacted ISTEA in 1991 was radically altered by the past election, which changed the congressional transportation committees and their memberships. The new House Surface Transportation and Infrastructure Committee will play a major role in interpreting and funding the future of intermodal transportation. ISTEA also mandated a report to Congress from a National Commission on Intermodal Transportation. After an extensive national outreach effort, this 1994 Commission Report puts forward a substantive list of recommendations intended to speed national conversion to an efficient intermodal system and identifies the resources necessary to do so.

At U.S. DOT, ISTEA's intermodal thrust contributed to the launching of a reorganization proposal. The proposal would consolidate the department's ten agencies into three: the U.S. Coast Guard, a new aviation administration, and a new integrated intermodal transportation administration. In addition, proposals to eliminate regulatory commissions, such as the Interstate Commerce Commission and the Federal Maritime Commission, reflect another facet of how the regulatory approach is shifting.

Concurrent with the comprehensive ongoing review of the federal mission in transportation, state DOTs and MPOs have been growing into their new intermodal and multimodal planning responsibilities. Each state is mandated by ISTEA to develop an intermodal management system, and the role of the MPOs has been enhanced to make them partners with state DOTs in the development of transportation improvement programs (TIPs). As states and MPOs assume their new intermodal responsibilities, they have greater financial and planning flexibility to develop a balanced intermodal system. The flexible use of funds and the planning partnerships permitted under ISTEA are still in the developmental stages. To stimulate intermodal innovation and leadership, the Federal Highway Administration funded six demonstration grants. These projects are well under way in Alaska, Florida, Louisiana, New Mexico, New England, and Ohio.



The growth of intermodalism in the public sector can be characterized as evolutionary instead of revolutionary. Four years into ISTEA the practice of intermodalism remains a challenge, and planning officials affirm that more tools and training are necessary. Ironically, although ISTEA has expedited new intermodal relationships and increased flexibility in funding, fewer dollars are available to address a larger and more complex array of issues. In addition to the challenge of scarce public dollars, other challenges to intermodalism include a need for more comprehensive data, development of new planning models, and the clear requirement for intermodal training for mid-career and entry-level transportation planners.

The motivation to instill intermodalism into the public transportation sector was largely spurred by its success in the private freight sector. Increased customer demands, a desire for enhanced mobility, deregulation, and the financial imperative for efficient operations forced the intermodal freight revolution.

In contrast to public sector intermodalism, the private sector intermodal revolution has been under way for about 20 years. U.S. freight intermodal operations are among the best in the world. Stimulated by the deregulation of the trucking and rail industries, a hybrid industry of integrated truck, rail, and steamship organizations has evolved since the 1980s. This intermodal shift is rapidly progressing without any significant government actions or policies; the intermodal freight revolution can be attributed to market forces and user demands. Freight service providers that deliver door-to-door services on a just-in-time basis dominate the intermodal frontier. The freight industry continues to innovate by creating new carrier alliances, rationalizing services, and devel-

U.S. freight intermodal operations are among best in world.
PORT OF SEATTLE

oping integrated information systems, all of which contribute to lower cost and more efficient delivery of goods.

RAIL TRANSPORTATION

1994 was another record-breaking year for the freight railroads with total traffic of 1.75 megagram-kilometers (1.2 trillion ton-miles), setting a record for the eighth consecutive year. Intermodal traffic (highway trailers and containers) recorded growth for the thirteenth consecutive year, reflecting among other factors the major trucking companies' increased use of intermodal services. The rebounding economy combined with improved railroad service quality and new equipment led to record levels of carload traffic in addition to intermodal service.

New technology is helping the railroads handle larger volumes of traffic and improve service.



Amtrak is seeking opportunities to develop new markets.
TILLOTSON

Many Class 1 railroads are introducing alternating-current traction locomotives into their fleets, tests of which point to huge savings in fuel consumption and decreased running times. Benefits to shippers and carriers are just beginning to be realized from the electronic tagging of rail equipment. A network of 1,200 trackside readers around the country scans automatic equipment identification (AEI) transponder tags attached to more than 1 million freight cars and 22,000 locomotives. Improved service benefits will result from timely, accurate AEI data. Although AEI standards were developed in conjunction with the trucking and maritime industries, the rail industry is the first to mandate its use, and tagging of all rail equipment will be completed this year.

The American railroad map is undergoing major changes. The ICC has approved the Burlington Northern-Santa Fe merger. Union Pacific

Railroad has completed its purchase of Chicago and North Western Railway Company and has offered to purchase the Southern Pacific Lines. In addition, Class 1 railroads have completed some major sales of secondary lines to regional and shortline carriers.

ICC will be eliminated in 1995 and discussions are still under way on what rail regulations will be retained and to which federal agency the functions will be transferred. Likely to be retained are railroad merger review, maximum rate regulation, rail line sales, and freight car interchange and car distribution rules; these functions will probably be transferred to U.S. DOT.

Facing a deteriorating financial condition, Amtrak has substantially cut back staff and services and, in a few cases, actual routes. Several states have agreed to pay more, at least during the short term, to retain services of local or regional importance. Reorganized into three regionally based strategic business units, Amtrak will be looking for opportunities to work with states and other partners to develop new markets, as recently demonstrated in Washington State. Providing higher-speed service in the Northeast Corridor remains a high priority for Amtrak, which is completing electrification from New Haven to Boston and planning to purchase new high-speed train sets. Political support for Amtrak is strong, but the question remains whether adequate federal funding will be provided to advance Amtrak's plans.

The Federal Railroad Administration has identified grade crossing safety as the most serious source of rail-related fatalities and is investigating several alternative technologies that may provide solutions, including barrier systems and locomotive warning systems. FRA's contribution to the TRB Innovations Deserving Exploratory Analysis program on intelligent transportation systems (ITS) is directed toward the problem and a search for high-technology solutions. Grade crossing accidents and fatalities have declined in recent years as a result of grade crossing improvements and the educational efforts of Operation Lifesaver. Technology for another major safety area—positive train control (or positive train separation)—is being explored by rail freight carriers for their own operations and by FRA for high-speed corridors.

Continued federal funding for the Local Rail Freight Assistance Program (LRFA) is once again in doubt. Many states are reaping economic benefits from investments in continuing rail freight services on branch lines that could not be sustained by Class 1 railroads. A number of states are using loan programs to maximize the use of

existing funds. Nearly half of the states have invested their own funds in rail freight preservation projects in recent years. Several states continue to explore the potential applications of high-speed rail technology, but insufficient funds continue to delay implementation of these projects.

MARINE TRANSPORTATION

Within the marine community, there were high hopes that the passage of ISTEA would bring much-needed support for improved port access and development of intermodal facilities; however, the progress in securing a significant level of support for revitalizing the freight infrastructure has been limited. This realization suggests that the port community will have to continue its public education campaign and press for funding attention at all levels. The expanded role for MPOs in developing regional TIPs necessitates that ports and other freight interests continue to work closely with these organizations and state DOTs to better inform planners and the general public about the economic implications of efficient goods movement. Several DOTs and MPOs have made significant progress in the development of freight advisory councils to improve their understanding of goods movement and in soliciting input to the development of intermodal management systems.

In 1994 0.9 billion megagrams (1 billion tons) of import and export cargo valued at \$571 billion was shipped through U.S. ports. The industry invests more than \$668 million annually in capital projects, and the projected investments for 1992 through 1997 total \$5.3 billion. Continual investment in improved operations is necessary, yet competition for public infrastructure development funds is intense and ports must continue to stave off potential diversions of port funds to nonmaritime activities. Another challenge is shifting trade logistics that require capital-intensive intermodal innovations in shoreside infrastructure. Seaports need to simultaneously invest in channel maintenance for waterside access and to provide shoreside systems to accommodate vessels of increasing sizes (4,500 Twenty-Foot Equivalent Units or more). To move cargo inland, intermodal transfer facilities on or near docks must be planned and financed.

Channel deepening, harbor maintenance, and dredged material disposal remain major challenges for the nation's deep-water ports. Channels must be continually dredged to allow safe passage of deep-draft vessels. Ports must grapple with a grueling dredge approval process to accommodate environmentally acceptable disposal plans, and they face escalating costs for feasibility studies



and disposal projects and mitigation efforts. Continual efforts to impose higher user fees for channel improvements also significantly affect the competitive position of ports.

For the past two years, the American Association of Port Authorities (AAPA) has been encouraging Congress to enact its proposed National Dredging Policy. Concurrent efforts to solve the dredging crisis, including the presentation of an action plan for improvement to the Secretary of Transportation, were led by the Maritime Administration (MARAD). MARAD's work with a federal interagency working group focused on a process to ensure that the myriad agencies involved in the permitting process facilitate instead of stall the dredge approval process.

Maritime reform remains a top priority for U.S. DOT leadership. U.S. DOT and MARAD are promoting the Maritime Security Act of 1995, a \$1 billion, 10-year program intended to support the rapidly diminishing U.S. flag fleet.

Continuing to provide a cost-effective inland waterway system is of critical importance, but funding the necessary infrastructure is a major challenge. River traffic is expanding, lock capacity and maintenance are seriously stressed, and the aftermath of the devastating floods of 1993 presents a host of new challenges. The U.S. Army Corps of Engineers (USACE) is operating an ongoing rehabilitation program to maintain present lock and dam efficiency and is assessing enhanced system improvements in a system navigation study.

USACE seeks guidance from the Inland Waterways User Board to set priorities for inland

Port managers face intense competition for public infrastructure funds.
SEA-LAND SERVICE, INC.

waterway modernization projects. There are serious concerns that the Inland Waterways Trust Fund could be depleted by pressing construction needs, thereby renewing the pressure for increased waterway fuel and user taxes. In the current operating environment of higher costs and depressed freight rates, operators are additionally challenged by a host of new safety requirements being proposed in response to waterway collisions. A number of regulations regarding vessel inspections and certification, equipment, and operator training are under consideration by the Coast Guard.

ISTEA funds have allowed the enhancement of certain ferry routes that alleviate roadway congestion, offering alternatives for both the commuter and tourist. Passenger ferry services fill a unique transportation niche, but to ensure adequate ridership, local sponsors must address the challenge of efficient intermodal connections to terminals, integrated fare structures and schedules, and safe vessel operations. Enhanced ferry operations are under development in Alaska, the Puget Sound region, San Francisco, Puerto Rico, New York, and Boston. Large and small ferry operators alike face complex and costly Americans with Disabilities Act (ADA) regulations with little guidance for practical implementation.

TRANSIT

Every now and then in the field of transit a fundamental turning point occurs. Such moments may promise hope or pose serious challenges. Transit agencies viewed ISTEA as offering hope, but they are now concerned that current proposals for organizational and program changes and congressional budget proposals will redefine the federal role in transit in a way that instead may result in challenges. Whatever the outcome, potential ramifications cascade quickly to the state and local governments, private sector, and most important, to the citizens.

Local transit providers find themselves in a dilemma. Although more decision-making freedom may result from the proposed changes, there is the high probability of lower federal funding support. Given this basic environment of intense and continuing uncertainty, operators are tasked with providing economic and efficient service that is both effective and productive. Meanwhile none of the usual concerns have disappeared: finance, labor relations (several strikes have occurred in the past year), deteriorating equipment and infrastructure, safety and security, and legal challenges to service decisions (the question of bus versus rail equity persists in a number of major cities).

Transit operators ironically are making substantial progress in starting new services for light rail

and commuter rail, developing new technologies to take advantage of ITS and alternative fuels, and developing rational fare policies. In some areas momentum is building toward an integrated intermodal urban transportation system (e.g., terminals, transfers, fares, fare media, and user convenience). Commuter rail ridership is up. New bus and rail vehicles incorporate ADA and environmentally friendly features while capital facility improvement programs continue. By any standard these are meaningful improvements.

All in all, transit is experiencing a dynamic period of change. How intense it will be should become evident in the next year.

AVIATION

For the first time in many years there is fragile optimism in the U.S. airline industry. Unfortunately, even after years of deficits, sluggish demand, and intensified competition there is little indication that industry planners and managers are due for a lengthy respite. The industry's 1994 global profits, estimated as high as \$1 billion, were underpinned by low fuel costs and counterbalanced by the competitive need to reduce available seat-mile costs. More traditional major carriers remain under competitive pressure from low-cost carriers, and these in turn will be challenged by new start-ups and competition for specific service niches. Airline managers, facing thin profits and well aware of the cyclical nature of the industry, have been reluctant to repeat past mistakes and are understandably slow to invest in fleet replacement or new capacity.

This reluctance has had a direct impact on the manufacturing sector, particularly the major players such as Boeing, Airbus, and, to a lesser degree, McDonnell Douglas Corporation. Regional suppliers may fare better. Generally favorable prospects for regional air carriers have been tempered by public and official concerns about disparate safety standards between major airlines and smaller regional airlines. The trend is to eliminate, wherever possible, real and perceived differences in safety standards between the two.

Even with optimistic forecasts through 1996, airline observers caution that interim profits will be insufficient to restore the industry to health before the next recession. That may be the real crisis period and could cause significant disruptions in the levels and frequencies of services the public has come to expect. The threat of recession, a rise in fuel costs, and the possible termination of the current aviation fuel tax break of 4.3 cents per gallon are all key factors in this equation.

Industry efficiencies gained through cutting operating costs are being offset somewhat by

capacity limitations at airports and within the air traffic control system. Current system inefficiencies have been estimated to cost major airlines as much as \$5 billion annually. One FAA estimate projects that passenger enplanement will increase by 3.5 percent and flight operations 1.9 percent annually through 2007. Without increased ground and air capacity to meet this new demand, delays and costs will rise. One federal response has been a strategy to enhance airport and airspace capacity: FAA's Aviation Capacity Enhancement plan. This approach focuses on the entire system and on leveraging investments in new airports that would improve system capacity, as well as restructuring en route and terminal airspace, implementing the Global Positioning System (GPS), expanding traffic alert and collision avoidance systems, improving communications through advances in satellite and data link technologies, and using reliever airports more effectively.

FAA has already reorganized internally; however, the administration's proposal to privatize significant portions of FAA to enhance operational efficiency and safety has not met with overwhelming congressional enthusiasm. Concerns about safety, personnel, and financing have yet to be fully addressed.

The remaining civil aviation sectors—business aviation, helicopters, and light general aviation—are showing a few bright spots. The passage of the General Aviation Revitalization Act generated optimism. When the law passed, approximately 90,000 aircraft—half of the country's general aviation fleet—were no longer subject to product liability claims. With potential litigation and insurance costs cut by two-thirds, Cessna Aircraft Company declared it would reactivate production lines that had been dormant since the mid-1980s.

The National Aeronautics and Space Administration and FAA are also supporting general aviation programs aimed at reducing the manufacturing and operating costs of new aircraft and improving all-weather safety through technology and training. Even with improved opportunities within the sector, social changes and choices affecting leisure time make it unlikely that general aviation will regain its former status in the foreseeable future.

As in past years, helicopter operators continue to struggle with high costs and numerous operating restrictions. A proposal by the U.S. Army to retire 3,000 helicopters by the end of the decade has caused dissension among those in the industry who believe that their civil markets are threatened and operators who see an exceptional opportunity for low-cost acquisition.

For the first time in many years, there is fragile optimism in the airline industry.



Widespread use of GPS offers potentially enormous advantages in safety and efficiency to the entire aviation community. FAA recognizes this and is aggressively pursuing early implementation of the basic navigational system and the complementary wide-area augmentation system, which will enable improved navigation and precision approaches to many runways and airports not currently equipped for them. Although technical difficulties are becoming more manageable, political problems hamper full acceptance across the international community. European countries and some others have expressed reservations about accepting a system developed and controlled by the U.S. Department of Defense. President Clinton has stated, "The United States remains committed to provide GPS signals to the international civil aviation community and to other peaceful users of radio navigation and positioning systems." However, this offer has yet to be accompanied by specific technical details or guarantees satisfactory to the international community.

Reduced investment in fleet replacement and new capacity has had an impact on major manufacturers in aviation.
BOEING

HIGHWAY TRANSPORTATION

ENVIRONMENT

Environmental concerns continue to be both major impediments and opportunities in the development and improvement of transportation sys-



Current air quality legislation emphasizes transportation control measures such as programs to encourage transit use.
PAT TRANSIT

tems. Perhaps the most difficult aspect of ISTEA has been the implementation of the conformity standards in the Clean Air Act Amendments (CAAA) and in particular the State Implementation Plan (SIP). One key penalty under CAAA is the withholding of federal-aid highway funds, which has occurred in some regions. The cost of implementing CAAA is high, and in many situations some alternatives proposed in the name of clean air have been found to contribute little to cleaning up air pollution. Increased costs also are being incurred as a result of the need for new modeling and planning programs.

Urban air pollution has been reduced significantly since the Clean Air Act was passed in 1970. Emissions of polluting exhaust gases from motor vehicles have substantially declined in the past 10 years. Carbon monoxide has decreased by 40 percent, and hydrocarbons by 39 percent, whereas total vehicle miles traveled have increased by 41 percent. In many urban areas, further decreases in air pollution are needed. Oxygenated and alcohol-based fuels are being used in about 40 urban areas in the winter months to reduce the amount of motor vehicle pollutants.

Alternative fuels and electric vehicles are still being considered as a way of reducing urban transportation air pollutants. However, major im-

Without more effective land use controls, current air quality requirements are inadequate to address congestion and pollution.

pediments in the application of electric vehicles are the cost of producing the vehicles and the lack of new battery technology that will reduce the weight of the vehicle, extend the driving range between charges, and be quickly rechargeable. Critics contend that electric vehicles, even with these characteristics, would only move the point source of the pollution to the power-generating stations instead of the vehicle itself. The use of compressed natural gas is increasing, especially in fleet vehicles, because it requires minimal conversion of the engines currently designed for gasoline.

Current air quality legislation and the requirements for conformity to air pollution reduction standards attempt to limit pollution through transportation control measures and by limiting the expansion of urban highway capacities. However, these provisions alone are inadequate to address congestion and pollution. Most important, more effective land use controls are needed.

Other areas of continuing environmental concern are the control and treatment of hazardous wastes, pollution caused by highway deicing and other runoff, historic bridge preservation, and preservation of wetlands.

DESIGN

Pavement management systems (PMS) continue to be an area of interest for many states. Most states have their PMS in place and are realizing the benefits. The current challenge is to integrate the PMS with other management systems mandated by ISTEA to provide information for the decision-making process. Standards for all aspects of the PMS process are being formulated by the American Society for Testing and Materials (ASTM), and researchers have been greatly expanding the knowledge base of the PMS and related technologies. The Third International Conference on Managing Pavements, conducted by TRB, provided much useful information on PMS. The Strategic Highway Research Program's Long-Term Pavement Performance data base is providing information on pavement performance that will lead to improved pavement design and rehabilitation techniques. Some related areas of current research are rapid, automated, nondestructive pavement

testing (surface condition, structural support, thickness); mechanistic/empirical pavement design; and data collection, handling, and analysis techniques.

New bridge design specifications based on the Load and Resistance Factor Design (LRFD) approach have been adopted by the American Association of State Highway and Transportation Officials' Highway Subcommittee on Bridges and Structures. These specifications were developed under an NCHRP project. Individual states are now making decisions on adoption of LRFD. Susceptibility of scour at bridge piers and foundations is another aspect of structures that is receiving considerable attention, and two NCHRP research projects are under way on this topic.

In the study of roadside safety features, the states continue to move toward the use of *NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features*, which replaced Report 230, the previous basis for crash testing. Efforts also continue toward international harmonization of testing and evaluation procedures for roadside safety features.

Metritication is another major issue for the states. FHWA's plan to comply with the Omnibus Trade and Competitiveness Act of 1988 will lead to the use of metric (SI) units in direct federal and federal-aid construction contracts by September 30, 1996. AASHTO's Highway Task Force on Metritication is working to bring about a smooth transition to metric units. *ASTM Manual E 380-91: Standard Practice for Use of the International System of Units* has been adopted as the standard for all federal agencies for metric conversion. A metric information clearinghouse has been established at the Texas Transportation Institute under an NCHRP project to assist and share information in this area. TRB now requires metric units in its publications.

MATERIALS AND CONSTRUCTION

Several challenges dominate the attention of state transportation materials and construction engineers: environmental issues, the incorporation of nontraditional construction materials into the transportation infrastructure, the implementation of products from SHRP, and efforts to improve the quality of the constructed infrastructure with fewer experienced workers and under increasingly more restrictive field construction conditions. State agencies and industry are seeking the following:

- A rapid, safer, and more accurate method of determining asphalt content from asphalt mix samples. New methods are needed to replace the chlorinated solvent extraction process. Biodegradable nonchlorinated solvents and the nu-



clear asphalt cement content gauge are currently being used, and a new procedure being evaluated involves the ignition and incineration of the asphalt in a high-temperature oven.

- Better solutions for lead paint removal from existing bridges and contaminated soils found on construction sites.
- Cost-effective methods for the use of waste materials and by-products in highway construction. Material engineers and researchers are placing special emphasis on evaluating the use of scrap rubber tires as an engineering material in asphalt pavements and other infrastructure items.

Stone mastic asphalt (SMA) pavement, a design borrowed from Europe, continues to gain popularity among the state agencies. Additional states are experimenting with the concept to reduce their asphalt pavement rutting problems, and a few are moving toward making it a routine design for major highways.

State agencies continue to work toward implementing the new SHRP binder and mix design specifications. The mix design (SUPERPAVE) specifications were adopted this past year as provisional specifications by AASHTO. A few states are also letting projects to experiment with the SHRP performance-graded asphalts as a preliminary step to implementation of the SHRP asphalt binder provisional specifications adopted earlier by AASHTO.

The implementation of quality control and quality assurance specifications continues to advance among the state agencies. More states are beginning to see the advantages of these specifications, particularly with the reduction in their experienced work forces.

SOILS, GEOLOGY, AND FOUNDATIONS

The primary concerns in this area include properties of conventional and unconventional aggre-

Bridge safety maintenance issues, such as scour at bridge piers and foundations, continue to receive attention (Mackinac Straits Bridge, Michigan).
ALDEN-ROBERTS



Destruction of Colorado State Highway 133 by April 1993 landslide near Paonia Reservoir, western Colorado. TAYLOR/COLORADO STATE PATROL

gates related to performance of asphaltic and portland cement concrete, landslides and rockfalls, and scour of bridge foundations. Correlations need to be established between aggregate properties and performance of pavements and structures under various service conditions. Many of the current aggregate test methods are inadequate. The emergence in recent years of waste and recycled materials for use as aggregates requires their incorporation into the test methods. Related research is consequently being conducted at the local, regional, and national levels. Three NCHRP projects are under way on the effects of the properties of aggregate and unconventional materials on performance of transportation facilities. Slope failures, both soil and rock, along transportation routes are a concern to states because of the safety implications and the costs involved in mitigating such problems. A TRB Special Report on the investigation and mitigation of landslides is scheduled for release in the near future.

Current methods of predicting scour of bridge foundations are considered inadequate. Better methods are needed for making prediction of scour susceptibility and for the selection and implementation of scour countermeasures. New approaches should be based on a holistic view of the entire fluvial system.

MAINTENANCE

Safety, environmental issues, roadway weather information, total quality management, pavement maintenance management systems, and equipment fleets are the major areas of improvement and concern in maintenance. Work-zone safety remains a high priority for transportation agencies. Aside from improving the safe and efficient flow of traffic through work areas, agencies are renewing their efforts to train and educate county, city, state, and contract forces in the safe performance of work activities.

States are continuing to work with the private sector to assess, clean up, and recycle hazardous materials at maintenance sites, including dump areas and underground fuel tanks. Several agencies are carrying out roadside vegetation manage-

ment strategies based on the use of natural resources and ecological principles. The removal, containment, and disposal of lead-based paints from bridges continue to have a significant impact on funding availability for structure repairs. Several agencies noted an increase in the repair and replacement of culverts and drainage pipe.

The use of roadway weather information systems for snow and ice control is continuing to expand. These systems are being used to supplement and forecast roadway condition information used in management decisions. Cost savings have been attributed to reductions in labor and equipment requirements and the use of deicing chemicals. Anti-icing experiments are being conducted by several states with positive results in reduced costs by delaying and sometimes preventing ice-roadway surface bonding.

Many agencies are exploring the use of total quality management and continuous quality improvement to perform highway maintenance. Results to date are encouraging, with self-directed work crews displaying innovative techniques and improved efficiencies when compared with traditional approaches. The application of these techniques in a work force that is dispersed across the entire state and the training requirements for crew and management are anticipated to be long-term challenges.

Several agencies are finding that some higher-priced patching materials for pavements are cost-effective when considering labor, equipment, and longevity of the patch. Proactive preventive maintenance programs are proving to be more cost-effective than reactionary maintenance.

Several states are evaluating their maintenance management systems (MMS) in response to the need to integrate them with other management systems developed under ISTEA. Technology advancements provide capabilities not available when many MMS were developed, such as handheld computers for field data collection, GPS to locate maintenance activities, and geographic information systems for storage and retrieval of maintenance information by location. Each of these improvements can have a positive impact on reducing paperwork for field supervisors and improving the accuracy of the management system data. The incorporation of contract maintenance requirements is being considered as MMS are being improved.

The primary issues in equipment fleet management include the impact of CAAA on diesel fuels and engines, waste management techniques and procedures, facility and vehicle modification to accommodate alternative fuels, human resource

management, training, and worker safety. Tighter fiscal constraints are prompting managers to reevaluate rehabilitation, purchasing, and leasing options.

TRAFFIC OPERATIONS

Increased traffic congestion, the transition of ITS from R&D into deployment, federal and state budget deficits, reductions in labor forces, environmental concerns, the need to do more with less—all these factors and more significantly affect the way traffic engineers are and will be providing transportation services.

Approximately 50 percent of the urban freeways in the United States operate at capacity during peak hours, and the estimated total cost of congestion exceeds \$34 billion annually. By 2005, delay due to congestion is projected to be five times what it was in 1984.

Traffic congestion, coupled with CAAA and the financial hardships facing most states, is causing traffic engineers to seek alternative ways to add capacity within existing rights-of-way. Current approaches include using freeway shoulders as lanes, narrowing existing lanes by restriping to provide additional lanes, and designating reversible lanes on both freeways and arterial streets.

As a result of the \$660 million Intelligent Vehicles and Highway Systems program (IVHS) in ISTEA, ITS is now the major research focus in traffic operations. However, the major emphasis has now switched to the deployment of ITS technologies. The portion of ITS that addresses the traffic operations area is called advanced traffic management systems. ATMS use advanced technologies to integrate traffic management and control systems to facilitate direct response to actual traffic conditions. However, real-time traffic monitoring and data management capabilities still must be further developed. These capabilities include advanced detection technologies, such as image-processing systems, and automatic vehicle location and identification strategies. Research on traffic models, dynamic traffic assignment models, real-time traffic simulation models, corridor



optimization techniques, rapid incident detection, congestion anticipation and control strategy selection, among others, must also be further developed and tested before the full benefits of ITS and ATMS are realized.

Although the state of the art in ATMS is not yet at the full level envisioned in the ITS scenarios, major gains can now be made in the traffic-carrying capabilities of the street system through the deployment of the currently available traffic-control hardware and software. Many states are deploying ATMS technologies through the development of advanced traffic management centers. These TMCs control traffic at the corridor level, instead of just on the freeway, integrating real-time data from areawide surveillance and detection systems. They include features such as integrating systems from multiple jurisdictions and multiple modes, coordinated operation of ramp metering, lane and signal control, changeable message signs, advisory radio, and closed-circuit television cameras. In these integrated systems, traffic information is shared among several operating agencies and the traffic control decisions are made jointly.

Nonrecurring traffic congestion that results from accidents and vehicle breakdowns accounts for more than 60 percent of the delay on urban freeways. As a result, techniques for freeway incident management are receiving considerable attention in many states and urban areas. Many areas of the country already have comprehensive incident management programs in place, and stud-

Work-zone safety remains a high priority for transportation agencies.
CALTRANS



Aging drivers pose a new challenge for traffic operations professionals.

ies of existing programs clearly demonstrate that they are cost-effective in reducing traffic congestion, enhancing safety, and improving air quality.

Another approach to better use the existing freeway system is to reduce traffic demand during peak periods of the day. One method for reducing the traffic demand while increasing a freeway's person-carrying capacity is through the implementation of high-occupancy-vehicle lanes. These restricted-use lanes are an important element of transportation management programs in more than 20 urban areas and are under consideration in many others because of their effective use of existing facilities. The availability of HOV facilities serves as an incentive for commuters to form carpools or use transit service. In view of the success of freeway HOV lanes, officials in some



High-occupancy vehicle lanes are important element of transportation service in more than 20 urban areas.
CONNECTICUT DOT

areas are now examining the feasibility of HOV operation on arterial streets.

The aging population poses a new challenge for traffic operations professionals. General improvements in the design, use, and application of traffic control devices are being implemented to accommodate the changing driver and pedestrian population. For example, states are adjusting pedestrian signal phasing to accommodate slower walking speeds, using larger lettering on traffic signs, placing street name signs overhead to improve visibility, and using higher levels of retroreflection or illumination on signs to improve the conspicuity and readability.

TRB *Special Report 209: Highway Capacity Manual* is one of the most widely used documents in the transportation community. Translated into

several languages, HCM is the standard reference on which transportation analysts around the world rely for state-of-the-art methods. At the end of 1994 TRB published a major revision to HCM that incorporates seven revised chapters. Developed through research activities funded by FHWA and AASHTO through NCHRP, these chapters contain changes in analysis procedures for signalized and unsignalized intersections, freeways, ramps, and arterial streets.

SAFETY

The 1994 highway fatality rate is estimated at 1.7 per 100 million vehicle miles, the same as 1993. However, there was a 1 percent increase in the number of fatalities compared with 1993 (40,440 versus 40,115). Compared with 1993 the number of crashes increased 3 percent in 1994, but the number of resulting injuries (3,125,000) is estimated to be essentially unchanged. Within these results it should be noted that pedestrian fatalities decreased by 3 percent but bicycle fatalities increased by 2 percent. Male driver fatalities increased by 2 percent; for females the increase was 5 percent. Young driver fatalities increased by 2 percent, whereas older driver fatalities were up by 5 percent.

Daytime running lights are the most recent safety feature introduced on U.S. vehicles. Canada has used DRLs since 1989. On the basis of a three-year study, Transport Canada estimates that the use of DRLs reduced accidents by as much as 11 percent.

Several other evaluations were reported in 1994 noting the effects of various safety countermeasures and treatments that have been operative for a number of years:

- In a preliminary National Highway Traffic Safety Administration analysis of five states that implemented legislation to lower the legal blood alcohol concentration to 0.08, four showed significant decreases (4 to 30 percent) in alcohol-related crashes.
- National seat belt use reached 67 percent in 1994. During the previous 10 years belt use saved 55,600 lives and avoided 1.3 million injuries with economic savings of more than \$105 billion. States with a primary seat belt law generally have a 10 percent higher use rate and

greater reductions in fatal and serious injury resulting from motor vehicle crashes. When California made the transition from a secondary to a primary law, seat belt use went from 70 percent in the summer of 1992 to 83 percent in the fall of 1993. When combined with airbags the results are even more impressive. For front and front-angle crashes deaths are reduced an additional 23 percent because of airbags.

- Motorcycle helmet laws were shown to be highly effective by Washington State. After its helmet law was repealed in 1986, motorcycle deaths increased 124 percent. The law was reenacted in 1990 and motorcycle deaths declined by 50 percent and hospitalizations due to head injuries by 60 percent. The Harborview Medical Center in Seattle found that 63 percent of the cost for motorcycle injuries was paid by public funds, 22 percent by insurance companies, 1 percent by motorcyclists, and the remainder by the state or military health care.
- FHWA evaluated 20 years of the Highway Safety Improvement program. The hazard elimination part of the program had a 5.2:1 benefit-to-cost ratio and prevented 23,300 deaths and 658,000 injuries during two decades. The rail-crossing program had a 2.7:1 benefit-to-cost ratio and saved 7,600 lives and 33,500 injuries. Combined with other state and federal safety improvement programs, 83,000 deaths and 1.6 million injuries were avoided (benefit-cost ratio of 2.7:1). Twenty specific types of improvements had benefit-cost ratios ranging from 3:1 to 21:1. Illumination, relocated or breakaway utility poles, traffic signs, and upgraded median barriers were the four most effective improvements, with benefit-cost ratios ranging from 13:1 to 21:1.
- The safety consequences of allowing right turns at red lights have been questioned. A NHTSA report to Congress on the topic concluded that a relatively small number of deaths and injuries each year are caused by right turns on red, which represent only 0.4 percent of crashes at signalized intersections. Pedestrian and bicycle accidents account for 22 percent of all such crashes.
- The magnitude of crashes and fatalities related to driver drowsiness or fatigue is extremely hard to quantify. According to a NHTSA estimate, a minimum 1 percent of fatal and injury crashes involve these factors. Rumble strips are being built into roadway shoulders by an increasing number of states as a countermeasure to this problem and for vehicles wandering off the roadway. Generally these stripes are 45 to 61 centimeters (18 to 24 inches) wide so that there is still some shoulder remaining for bicyclists.



National seat belt use reached 67 percent in 1994.