TRB Identifies Ten Critical Issues in Transportation

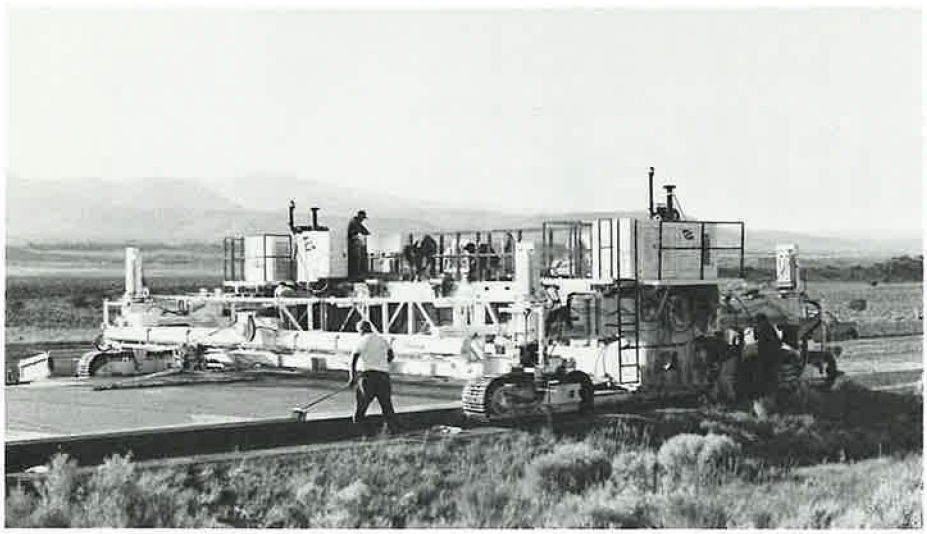
Better Management of Public Capital Investments in Transportation

The infrastructure crisis that captured attention in recent years raises fundamental questions about how public capital investments in transportation are being made. Are resources adequate? Are they directed at the right modes and locations? Are they generated from an appropriate mix of funds from users and various levels of government? Can the budgetary and legislative processes that control the nation's infrastructure be made more responsive and more efficient? These questions cut across all modes: highways, railroads, airports, pipelines, and waterways.

Efficient targeting of transportation investments requires a much better understanding of the underlying trade-off between capital investment and maintenance. For highways, the mode that accounts for most personal and commercial travel, the life of pavements can be extended by designing stronger pavements, by limiting the loadings that they must carry, and by practicing preventive maintenance. Research on how climate, soil, traffic loadings, and local materials affect pavements can lead to engineering practices that more effectively balance capital investments and maintenance. There are similar trade-offs between capital investment and operating costs for railroads, airlines, waterways, trucking, and transit.

Although major investments in new facilities may still be warranted, the age of our existing facilities demands that the nation pay much greater attention to maintenance strategies. Surprisingly, however, despite the substantial collection of inventory data on highways and bridges, no comprehensive body of procedures or methodology has yet been conceived to apply or correlate these data in making better maintenance decisions. Recently developed systems concepts have not been vigorously applied to the maintenance of transportation assets. Improvements in the efficiency, effectiveness, and productivity of methods and manpower can come from automation, better records, and better use of records. But these gains will be realized only by systematic resolution of the problems in transportation maintenance.

Any solution to the nation's infrastructure problem will require financial, organizational, and procedural improvements. Also involved is increased technological understanding. The complex engineering relationships that characterize construction and maintenance must be better interrelated and linked to real investment decisions. Research leading to a better understanding of these relationships can be a force for improving the management of the nation's transportation capital assets.



Efficient targeting of transportation resources requires better understanding of the underlying trade-offs between capital investment and maintenance.

Improved Transportation Productivity

Because transportation is essential to virtually all industries, improved transportation productivity will affect the price and competitiveness of nearly everything produced by the nation. Improvements in transportation products and services have been so pervasive in recent history that we take continued progress for granted. Jet aircraft, Interstate highways, container ships, automated transit systems, unit trains, and thousands of other innovations have led to safer, less expensive, faster, and more efficient transportation, which has substantially changed the economic structure of the world and the mobility of people. Countless engineering advances and laboratory successes are responsible for these gains. Further improvements in transportation products and services can bring continued advances in economic conditions and lifestyles. Achieving these advances, however, requires investment in innovation.

Innovation in the Public Sector

In the public portion of the transportation sector, investment in innovation has been limited because of tight public agency budgets, the uncertainty of research results, diffused organizational responsibility, the extended development periods associated with innovative techniques, and the short office terms of key officials. The U.S. highway industry, for example, devotes less than one fifth of one percent of its total spending to research and development, although the payoffs of many R&D initiatives could repay their costs many times over.

The Strategic Highway Research Program (SHRP) will tackle some major areas in which new research promises substantial gains. This considerable increase in funding offers researchers a major challenge in coming years to find major breakthroughs in productivity in the building, operating, and maintaining of the highway system.

Trucking Productivity Raises Challenging Research Issues

Highway transportation of goods has risen to the top of private-sector transportation issues. Innovations in the movement of freight on the highway system promise tremendous productivity advantages but bring with them complex safety and regulatory issues. For example, heavy vehicles, which are being used increasingly, account for a disproportionate share of pavement wear. The size and weight of the vehicle fleet affect the costs of building and repairing roads, and the user fees established to recover these costs must reflect an understanding of the basic technological and cost relationships. The safety of heavy trucks

has gained more public attention because wider and longer vehicles are now permitted to operate on the nation's highways. These vehicles also require reasonable access to terminals.

Research in truck productivity, communications, safety, and road wear will continue to play a significant role in resolving these issues. The AASHO Road Test conducted a quarter of a century ago provided key data on the interactions between pavements and trucks. Long-term monitoring of the system—a major activity of the Strategic Highway Research Program—will greatly improve the methods by which roads will be built, operated, and financed in the future.

Research on truck productivity, communications, safety, and road wear is needed to resolve problems related to highway goods transportation.

Priorities for Improved Transportation Safety

Of all of the transportation issues, safety captures the most public attention—and deservedly so. Although deaths due to highway accidents have been decreasing in recent years, some 45,000 persons are killed and 2 million more seriously injured each year. Each day, in homes across the nation, families and friends of accident victims bear the anguish of needless injuries and loss of life.

Despite the attention that transportation safety issues receive in the media, particularly when a major accident occurs, clarity about the safety policies with the greatest potential for improving safety is often lacking. Given limited resources and shrinking public budgets, transportation safety policies must constantly address the basic question of which safety efforts society should invest in for the greatest reduction in deaths and injuries. This concern is most heightened in highway safety because the vast majority of transportation-related deaths and disabling injuries occur on the highways.

Research has helped and can help resolve safety issues in the future. For example, breakthroughs in the engineering of air bag technology have considerably reduced the cost of these devices and promoted their availability in passenger vehicles. The development of crash attenuators for highways promises significant reductions in crash severity. Evaluation research on alcohol countermeasures, the effectiveness of speed limit regulation, and driver-education programs has contributed greatly to understanding the effectiveness of various safety programs.

Research results indicate that some problems affect all forms of transportation. Driving while intoxicated is not only a highway problem, it also affects pleasure boating, private flying, and railroads. Recent analysis suggests that safety problems resulting from alcohol use are so broadly rooted in our society that solutions may lie outside specifically transportation-oriented policies. For example, policies on the distribution and price (affected by taxation) of alcoholic beverages could have profound benefits for transportation safety.

Research has been particularly effective in improving the safety of transportation, but the quality of research depends on reliable data about accidents. Development and maintenance of information about crashes, along with information on exposure to risk, cannot be taken for granted. Nor can adequate funding. Safety research for heavy trucks, for example, has long been stymied by a lack of critical data on the motor carrier industry. Successful research to delineate policies with the greatest potential for reducing deaths and injuries will depend on adequate information about crashes and exposure.

Transportation safety is a major issue of public concern. At the request of the Congress, the Transportation Research Board is conducting a study to examine the causes of school-bus accidents and to evaluate the effectiveness of various countermeasures to address the problem, including the use of seat belts on school buses.

Transportation Finance

Finance of transportation facilities remains critical because of fierce competition for scarce investment funds among regions, modes, and programs, and uncertainties and delays that result from this competition; changing economic pressures; realignment in the roles of different levels of government and users of transportation systems (see discussion in the next section); and the organizational context in which public investment decisions are made.

The proper role of user fees to finance public investment in highways, air travel, waterways, ports, and transit will continue to be a major issue in transportation finance. For the modes that in the past have relied more on general revenues, the issues include determining what fraction of costs should be derived from fees, the forms that pricing structures should take, and balancing the advantages of user financing against the purported social benefits of subsidies.

In the case of highways, the recent federal gasoline tax increase has relieved some of the immediate pressures, but in a few more years additional financing will be needed. In addition, several fundamental issues remain to be resolved. State and local governments are concerned that federal money be distributed equitably and reflect a balanced approach to requirements for preservation, safety, and new construction. At the same time, federal funds for highways are being stretched thin because of reductions in revenue caused by the gasahol exemption and other motor fuels' tax exemptions. Future revenues will be even more thinly stretched as gasoline consumption per vehicle declines because of the introduction of more fuel-efficient vehicles.

An Expanded Role for the Private Sector

Inadequate public budgets for transportation investment have focused more

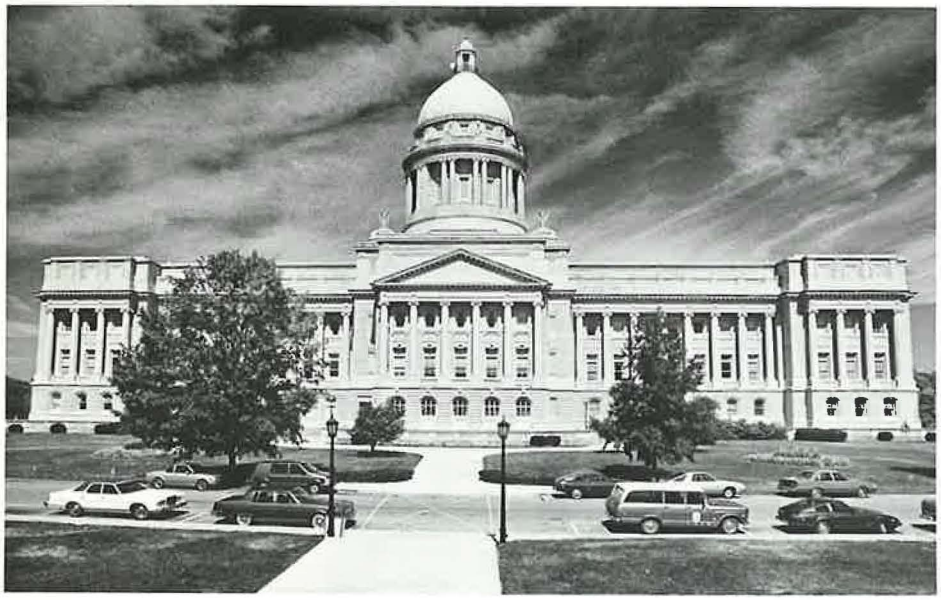
attention on the role of the private sector in financing transportation facilities. In some cases, owing to cumbersome public decision-making processes and overstretched budgets, the private sector has taken the lead. For example, private investors are seriously considering building a privately owned toll road to ease chronic congestion in the rapidly growing suburbs of Northern Virginia.

Transportation construction affects, and is affected by, many private decisions related to zoning, development, expansion, and the like. This is particularly true for transit facilities, which are closely intertwined with the communities they serve. Because of this interaction, the private sector has a legitimate voice both in building new systems and in determining who is best equipped to provide existing services. Also, because private landowners are the chief beneficiaries of increased property values resulting from transit development, the private sector could help government improve the methods by which the public gets a fair share of these gains.

Public Transportation Faces Unique Finance Problems

The financial problems facing urban public transit are unique because of their severity and the high uncertainty about the adequacy of future funding levels to sustain present operations and finance planned expansion and renewal. Transit is dependent on an ad hoc amalgam of federal, state, regional, and local revenue sources for capital and for operating subsidies, and these arrangements are subject to drastic revision on short notice. As the federal government withdraws from past levels of operating assistance, many transit systems desperately need to find a stable and predictable local financing mechanism for long-term revenue.

The proper role of user fees in financing public investment in highways continues to be a major transportation issue. *(photograph by Dan Rosen)*



Responsibility for financing, building, and managing transportation is shifting from the federal government to state and local governments.

Changing Roles of Federal, State, and Local Governments

The balance of federal, state, and local-government responsibility for financing, building, and managing transportation is changing; responsibility is shifting away from the federal government, and more of the burden is being placed on state and local governments. The federal government is also looking to the private sector to take over responsibilities previously assumed by the federal government, for example, the attempt to sell Conrail. Most of the consequences of this shifting balance in government roles, however, are being experienced at the state and local levels.

Public Transportation: Expectations Versus Reality

The consequences of changing attitudes at all levels of government are having the most effect on urban public transportation. Expected to operate like a private enterprise financially, transit services are nonetheless severely constrained by law and custom in exercising normal managerial discretion in fare setting, service decisions, labor negotiations, equipment purchasing, day-to-day supervision, and numerous other aspects of service. Federal, state, and local regulations compound the problem.

As federal operating assistance has been withdrawn, many states have increased their financial support of local transit systems, but nevertheless the strain of paying for existing urban transportation services is approaching the breaking point in many localities. The public continues to voice support for transit while refusing to approve funds for needed repairs and services. Public demand for better services frequently is not matched by subsequent patronage. Public officials, squeezed between high public expectations and limited financial support, increasingly respond by involving themselves in operating decisions. Many of the long-term solutions—such as hiring part-time drivers, subcontracting selected services, enforcing reasonable staff production levels, or facilitation of competing private-sector services—involve complex labor negotiations and appear to management to be remote possibilities or too cumbersome in scope. Many transit managers, who change positions frequently and face a host of urgent, short-run crises, simply cannot afford to spend time on

some of the fundamental structural shortcomings.

The changing character of urban transportation services will be a critical issue for many years, and analysis of the services, organizations, and policies that reflect these changing conditions can contribute substantially to an effective resolution of this complicated issue.

The Future Federal Highway Program

Many states have grown restive with recent congressional initiatives—and stalemates—affecting highway aid. From requirements on enforcing speed limits to setting standards for measuring drunk driving and the minimum age at which individuals are allowed to drink, Congress has increased the number of sanctions on highway aid, even as federal support for enforcement has diminished. Delays in key decisions, such as the legislative approval of the Interstate Cost Estimate and reauthorization of the federal-aid highway program, have needlessly delayed construction projects that have been years in the planning.

As the Interstate system nears completion, the federal government's role in promoting the national interest by funding a nationwide network of superhighways will, of necessity, change. Many of the most pressing highway transportation issues may become local, rather than national, in scope. In view of the trend toward increasing federal intervention and delay and decreasing financial support, as well as the nearing completion of the Interstate system, the federal role needs critical reexamination. A new consensus about federal, state, and local roles is due.

Transportation and the U.S. Competitive Position Worldwide

The ability of U.S. industries to compete in world trade depends on the efficient transport of raw materials, component parts, and finished goods. The United States has lost ground in world competition for many reasons, including high monetary exchange rates, high domestic labor and production costs, foreign trade barriers, and foreign government subsidies; but, so far, transportation has not been a significant factor. This could change, however, if the nation fails to properly maintain its transportation facilities and services or if it develops added freight-moving capacity or takes other steps to lower the cost of moving goods. The United States has, for example, become increasingly reliant on trucks and aircraft for the movement of goods at the same time that highway and air transport, the primary modes of passenger travel, are facing mounting capacity problems.

Many public and private policies must be changed to help restore the competitive position of the United States in world trade. Innovation in transportation, although not a sufficient solution by itself, is certainly necessary. As the cost of shipment inventory increases, greater concern should be given to re-

These new 50-per-hour-capacity container cranes at Norfolk International Terminals, part of the Virginia Port Authority System, are an example of innovations in transportation required to help restore the U.S. competitive position in world trade.

ducing transportation costs, improving the quality of service, and reducing time in transit. Innovations such as just-in-time delivery can cut inventory and labor costs. New facilities in high-traffic corridors may be needed to reduce congestion and improve the reliability of shipment time.

Other improvements in trading strength could be made through public-sector actions that exploit current technological capability and keep public actions attuned to changing needs. The deregulation of transportation, discussed later, has been a major step toward increasing competition, and costs are expected to fall as a result.

Internal transportation policies may also have contributed to declining competitiveness by making U.S. exports more costly to deliver to world markets. Bulk commodities, relatively low-valued exports such as coal and grain, are particularly sensitive to increases in transportation costs. Actions that affect the transportation of these goods, especially policies affecting waterways, railroads, and maritime transportation, can significantly influence the balance of trade.

The ability of the United States to equip its transportation industries is also in question. At one time, U.S. manufacturers completely dominated the domestic transportation equipment industry. The U.S. automakers' declining share of national and international markets is well known, but the same trend has occurred throughout heavy manufacturing. Few domestic firms manufacture domestic transit buses, and these firms account for a shrinking share of sales to American cities. Only one domestic firm produces transit vehicles today, and it has become a subsidiary of a German company. American shipyards have few customers other than the U.S. Navy. Foreign competitors have captured much of the small commercial plane market, and overseas consortia are even threatening the American dominance in large aircraft production.

Many public policy questions relate to transportation and international trade. For example: Is deregulation resulting in lower prices to shippers? Will enactment of domestic user fees place domestic firms at a comparative economic disadvantage? Should there be a redefinition of U.S. maritime policy, and what would be the effect on exports and imports? Will the problems in expanding airport and highway capacity in large urban areas lead to a deterioration in service levels and increasing transportation costs? Should a special network of highways be developed oriented to freight movement? What steps, if any, should be taken to encourage the revitalization of the domestic transportation equipment industry? Should there be an aggressive policy to capture a greater share of world shipping, especially for U.S. exports and imports? U.S. policy on such questions is currently in flux. Research on the impact of alternative policies can help to develop sounder policies.

Roll on/roll off ship at marine terminal, Port Elizabeth, New Jersey. The economy of several states is highly dependent on access to international markets and on the competitiveness of the United States in foreign markets.

Transportation and Economic Health and Development

Like the nation as a whole, individual cities, metropolitan areas, states, and regions must provide transportation facilities and services to maintain their local economies and attract new economic development. For an individual city or state, this link between transportation and economic health can appear to be very direct, especially when the loss of existing transportation service threatens jobs or when congested roads or airports prevent a specific corporation from developing a new plant or regional center. All too often, however, state and local governments react to transportation needs only after the economic issues have become critical and some options have been foreclosed.

Transportation issues with important economic stakes have an impact on virtually all levels of government and all modes of transport. For example, some agricultural states have assumed responsibility for maintaining rail services connecting the state with vital agricultural markets that have been abandoned by private railroads. Some metropolitan areas are expanding their airports—in competition with one another—to become regional hubs for major airlines. Burgeoning suburbs in many metropolitan areas are grappling with highways that remain congested in off-peak periods and are asking tough questions about how public transportation services can best be provided to low-density areas.

In dealing with such problems, local and state governments face many unknowns. How do local transportation investments affect private economic decisions, and what factors besides transportation are essential for economic vitality? How can local governments develop transportation facilities in an orderly manner in tandem with economic development? What should be the role of the private sector in planning and financing these major capital investments? At the national level, how can the federal government best assist local and state governments without encouraging speculative facilities that, when united, far exceed nationwide needs?

Research can help answer these questions and assist local and state governments in making more informed decisions about coordinating transportation and economic development. Greater knowledge of the relationship between transportation and local economic growth could also help shape future federal-aid programs for highways, mass transit, and airports.

Traffic congestion has surfaced as the land development issue of the 1980s. Development is being curtailed because of clogged streets and highways. (*photograph by Dan Rosen*)

One consequence of deregulation is increased airside traffic congestion at many airports.

Effects of Deregulating Transportation

Government no longer plays its former role of economic regulator and protector in most transportation industries; now it simply referees the competitive struggle. As a result, carrier managements have greater freedom—including the freedom to fail. Recent reductions in the amount of economic regulation of transportation industries have profoundly shifted the relationship among government, carriers, and consumers. Labor, in particular, is affected by the regulatory changes for airlines, railroads, trucking firms, and intercity bus operators.

In the era when each market was served by only one or a few regulator-approved carriers, all firms faced similar operating costs, and prices and revenues were generally set by the regulators. In such a sheltered environment, labor was deeply insulated from competition elsewhere in the work force. Some wages, especially those of pilots, locomotive engineers, and other skilled workers in key positions, rose appreciably.

As regulatory barriers began to weaken, new firms entered the field. Small, lower-cost, and often nonunion firms offered tough competition, especially in the regulated carriers' most lucrative markets. High labor costs started to become a burden to unionized operators.

Since deregulation, management, labor, and government have been adjusting to far-reaching changes. As firms and services change, consumers are faced with fluctuating prices and unstable services. Particularly in small towns, users are complaining about discontinued service or increased prices. The safety of deregulated industries has also become a dominant issue. The debate about the shrinking number of major firms in the airline industry raises questions about whether the assumptions of the free-market economic model are being realized. The current talk of deregulation problems may be premature, but it does reflect a deep, permanent concern: finding a stable government role that will create enough competition to increase productivity, afford enough security to permit employees to lead normal lives; and give consumers safe, convenient, and reasonably priced services.

Congestion of Traffic Facilities

Many factors influence the use of transportation facilities. The economy waxes and wanes. The population grows or shrinks or moves to new locations. Inaccurate predictions may lead to undesirable actions. Accurate predictions are not acted on because of budgetary constraints or interpretations of the public will. As a result of these influences, many existing transportation facilities are congested, causing inefficient operations.

Congestion plagues all forms of transportation but is particularly severe for air and highway transportation. The introduction of new, large-capacity aircraft and new air traffic control devices has helped to offset airway congestion. Deregulation, however, has encouraged the use of more aircraft, increasing congestion. Continued growth in air traffic is expected to further compound the problem.

The development of hub-and-spoke operations by air carriers to provide more frequent and convenient opportunities for passengers to make connecting flights has resulted in a large number of flights arriving and departing during peak periods. The choices made by a few people in a single company can create problems that are almost impossible to anticipate. An airport operator, worried about excess capacity, can suddenly discover critical bottlenecks in landside operations because of a rapid increase in passenger traffic. The air traffic control system can be further burdened by a rapid growth in the number of aircraft trying to use the same airspace within a concentrated time period. Recent airline mergers and the possibility of further mergers may reverse the growth in the number of flights; nonetheless, airport and airway congestion is a mounting concern in many locations throughout the country.

Highways, particularly suburban highways, are severely congested in many areas. Engineering solutions to many of these problems are intertwined with environmental, safety, and aesthetic concerns. Some of these problems can be circumvented by extracting more capacity out of the existing physical plant. Traffic-operation techniques, based on sophisticated technology, could substantially increase capacity and traffic-flow efficiency. Research on techniques to increase the capacity of existing facilities and on methods to increase the capacity of facilities in ways that are harmonious with other community objectives will help shape innovative solutions to highway and air traffic congestion problems in the years ahead.

The projected growth in automobile and air travel may well exceed the abilities of planners and engineers to get the most use out of existing systems. Research is needed to guide public policy to separate the genuine needs for new capacity from the many, competing demands for new facilities.

Research on traffic operation techniques and on methods to increase the capacity of existing facilities can help provide solutions to congestion, which plagues all forms of transportation, but is particularly severe for air and highway facilities. *(photograph by Dan Rosen)*

Environmental Consequences of Transportation

Transportation, concentrated by its nature around industrial and population centers, frequently conflicts with its environment. Noise, air pollution, visual blight, water pollution, damage to wildlife, and dislocation of existing activities count among the by-products of transportation. Technology has helped greatly in diminishing many environmental problems, but, as more goods and people are being transported, environmental issues continue to dominate many decisions.

Although all modes of transportation make noise, emit chemical pollutants, consume valuable space, and otherwise affect the environment that surrounds them, the greatest environmental disputes appear to center around road and air transportation, owing to their scale, noise, and growth. Remnants of the incomplete combustion of carbon-based fuel can cause respiratory irritation; traffic noise can cause both physical and psychological harm; water quality can be impaired as chemicals used on roads leach into the soil; scenery can be scarred as highways are constructed through geographically interesting or architecturally noteworthy areas; homes and businesses may be forced to relocate because of highway construction; and wildlife can be displaced by roads and their traffic. Public agencies have taken numerous actions to improve the harmony between highways and the environment. In spite of the impressive ingenuity and adaptability that the highway sector has demonstrated in combating environmental problems, the massive scale and ubiquitousness of the nation's highway system mean that environmentally damaging aspects of this system will require continual monitoring.

Aircraft noise also commands priority attention among transportation environmental issues. Engineering research has pushed aircraft noise-reduction technology to the point that further reductions in noise will only be incremental. The newest aircraft coming into service are considerably quieter than earlier models. The problem of noise exposure, however, will continue to grow as air traffic increases and airports expand. Urban development around airports has often been permitted to proceed unchecked. Airports have often been unable to establish noise covenants that would help ensure that growth in surrounding areas is compatible with the environment. Passenger preference for convenient, close-in air terminals and for frequently scheduled flights has resulted in high noise exposure for many urban neighborhoods. Although new aircraft and flight plans have greatly reduced noise levels for individual flights, communities continue to struggle for better solutions.

Research can aid in creating a more harmonious relationship between transportation systems and the environment through advances in vehicular technology, refinement of operating practices, and alteration of transportation decision-making procedures to accommodate growing environmental concerns.

Technological advances have greatly helped to diminish many environmental problems; for example, the use of noise barriers has improved the harmony between highways and environment.