Transportation Impacts on Environment in 2004 Depend on 'Bottom-Line' Commitment

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How difficult is it to predict the future? Who knows what anything will be like in 20 years, much less the status of transportation impacts on the environment? Fortunately, the transportation engineering community has committed itself to at least attempt the prediction of future events and conditions through the subdisciplines of transportation planning and environmental planning. Combining these two areas should provide the means to assess transportation impacts on the environment in the year 2004.

Given this premise, a framework for the assessment of the future of transportation must be established. It should

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(a) define where we have been, (b) define where we are, and (c) speculate on why we are where we are. "We" is defined here as the aggregate mobile society in the United States. Other definitions might include transportation consumers or system users.

WHERE HAVE WE BEEN?

Wilfred Owen (1) of the Brookings Institution has categorized the evolution of transportation into five stages: Immobility and Isolation (before 1830), Mechanization and Regional Trade (1830-1900), Motorization and Aviation (1900-1950), International Transport and Global Economy (1950-??), and United Global Economic System (??-??). It is apparent that we are currently in the fourth phase, "International Transport and Global Economy."

The international aspects of this phase are such that they greatly favor free rights-of-way—that is, the water, the air, and the air waves. In 1950, for example, a very large cargo ship had a dead weight capacity of about 35,000 tons. Today's container ships, on the other hand, have capacities up to 500,000 tons. In the late 1960s there were 1.2 million overseas telephone calls made each year, but in the early 1980s, the yearly average is 176 million. World trade today is increasing at twice the rate of gross world product. In the United States, 20 percent of the industrial work force is filling foreign orders.

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What is causing this astonishing increase in trade and economic interdependence? Obviously there are many answers to that question, but certainly they would include the evolution of air transportation, the evolution of goods movement, and telecommunications. If we ever get into the fifth phase, A Unified Global Economic System, we will be thrust there by that new but ubiquitous form of transportation—telecommunications. The electronic revolution spawned by advances in microprocessor technology is quite simply changing the way we live our lives, fulfill our travel needs, and conduct our business.

And what does this have to do with transportation impacts on the environment in 2004? The answer is "a lot." When considering the five phases of transportation evolution, what stands out is exponential development. It happens that we are now in the part of the curve where the rate of change in development is wildly increasing (see Figure 1). To get to this point, however, a lot of development, and therefore transportation inventory, has been generated over a long period of time. Hence the problem becomes one of "infrastructure obsolescence."

WHERE ARE WE?

We can establish our location, or where we are, by reviewing a catalog of facts.

The United States has nearly 4 million miles of highways, streets, and roads, including 42,944 miles on the nearly completed Interstate system. Nearly 8,000 miles on the Interstate system are in immediate need of resurfacing or reconstruction, with 2,000 more miles added to that list each year. The U.S. Department of Transportation reports that the cost to remove all highway deficiencies, not counting bridges and non-federal road networks, is more than $360 billion in 1980 dollars, and would take 15 years (2). The 1980 National Transportation Policy Study Commission reported that the total of national highway capital needs through the year 2000 is more than $1 trillion in 1980 dollars, yet under existing policies, total highway revenue generated at all levels of government would be only $750 billion (3).

Concerning bridges, FHWA reported to Congress in 1982 that 248,357 bridges out of 557,516 inventoried under its Highway Bridge Replacement and Rehabilitation Program were either structurally deficient or functionally obsolete and in need of major work. (Nearly 40 percent of the bridges inventoried are at least 45 years old.) This represents

nearly 45 percent of U.S. bridges. From 1972 to 1982, 8,658 bridges were replaced or rehabilitated under this program. At that rate, 866 bridges per year, it will take 287 years to correct all the bridges that need it now. The current price tag for this work is $47.6 billion (4).

The American Public Transit Association reports that $16 billion will be needed in the next 10 years to modernize and improve fixed rail systems and bus facilities. This is in addition to more than $20 billion in established needs for extensions, completions, and new starts (3).

The financial condition of America's railroads is such that there has been no regular program of railroad tie replacement in the last 30 years. Therefore, to just maintain current levels of track use and speed, 50 percent of all ties should be replaced by 1988. In addition, a large number of rail facilities are in urgent and immediate need of capital-intensive work due to obsolescence and deferred maintenance. The American Association of Railroads estimates the costs of these improvements to be about $90 billion over a 10-year period (3).

The FAA expects an annual growth rate of 4.6 percent well into the 1990s. If this projection is accurate, the number of passengers will more than double by 2004. To accommodate this increased demand, as well as similar growth in general aviation, the FAA National Airport System Plan identifies $13.5 billion in airport development requirements by 1993 (5). The 1982 Airport and Airways Improvement Act, however, provides less than $1 billion/year over a 5-year period in airport development aid.

Thus, at least with respect to the physical inventory of our transportation system, we are the owners of a multibillion dollar collection of facilities that is wearing out at a rate outstripping our ability to maintain it.

Given the system now in place and the expected growth in travel, is the system adequate? Probably not, at least for urban highways. As Figure 2 indicates, peak-hour congestion will significantly deteriorate in the next 15 years. It appears that about two-thirds of the urban peak-hour travel will take place under conditions of a volume-to-capacity (V/C) ratio of 0.8 or greater. This constitutes Level of Service C or worse.

Figure 1. Transportation evolution.

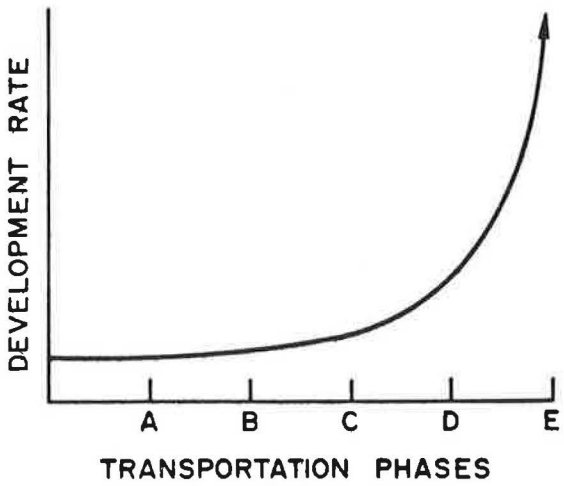
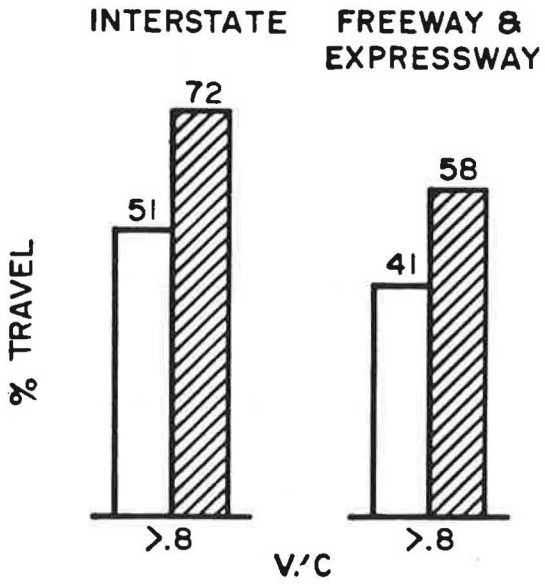


Figure 2. Urban congestion, peak-hour V/C: impact of 15 years of travel.



The U.S. transportation system is, in brief, inventory intense, underfunded, and not complete. It is inventory intense in the sense that it represents many billions of dollars of facilities put in place in the last 100 years. It is underfunded in the sense that maintenance needs alone now appear to demand more capital than is available through existing funding policies. And it is not complete in the sense that current and projected problems and needs demand transportation solutions that have yet to be implemented.

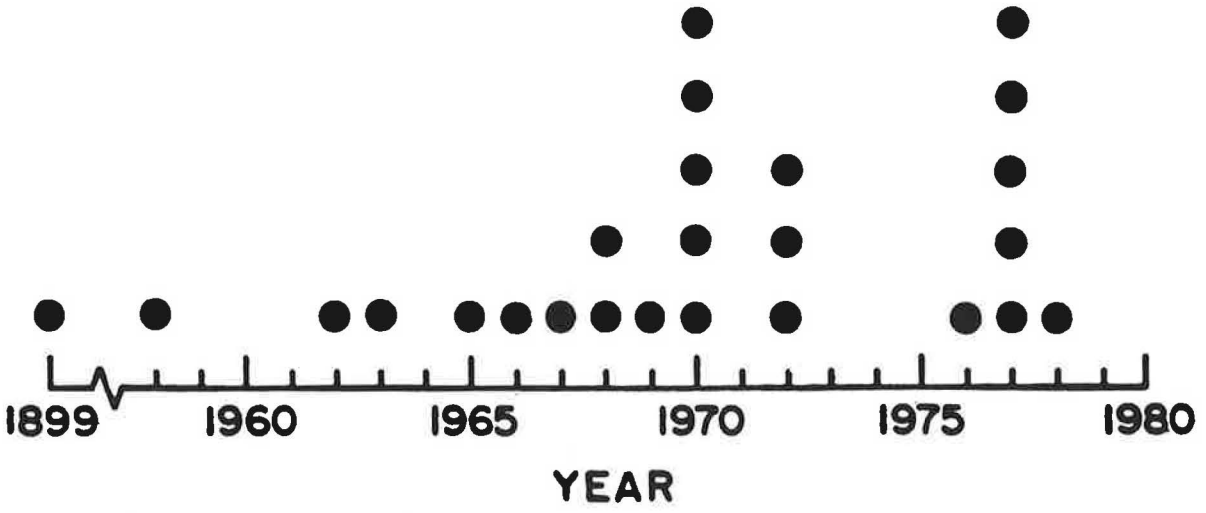
Where are we in terms of environmental laws and regulations affecting transportation? Table 1 and Figure 3 illustrate that the past 20 years have witnessed the adoption of a significant number of laws. The 25 laws and executive orders shown were judged to be most important with regard to their influence on transportation. However, this list is not all-inclusive or otherwise perfect.

We are in fairly good shape, though, in terms of the analytical tools and techniques necessary to quantify transportation impacts on the environment. The last 15 years have seen a phenomenal growth in predictive modeling for air quality, noise, and ecological impacts. The noise models—STAMINA 2/OPTIMA (6) and INM (7)—and the air quality models—CALINE 3 (8) and HIWAY-2 (9)—give sufficiently accurate results for decisionmaking purposes. Habitat evaluation procedures are also quite adequate. In addition, FHWA has recently settled on methods to determine the functional values of wetlands, which represents a major step forward.

HOW DID WE GET HERE?

How did the United States come to have an inventory-intense, underfunded, and incomplete transportation system? The answer to this question must relate to the natural evolution-

Figure 3. Twenty-five environmental laws influencing transportation.



ary growth patterns that are in place for a dynamic society such as exists in this country. These growth patterns have been driven by increasing population and advancing technology, and, as a result, transportation development has been forced to lag. The further problem of limited monetary resources exacerbates this lag. Transportation engineers have been building for years, but still have not "solved" the nation's transportation problems. "Solving" the problems is analogous to the old saying, "Every time I almost make ends meet, they move the ends." Every time the transportation problems are almost solved, the problems change.

So the U.S. transportation system in 1983 is old, worn out, and beset with problems. Nevertheless, it functions, to the point that the economic recovery now under way is not threatened. In fact, the great maintenance and rehabilitation needs mentioned earlier are providing opportunities to reduce unemployment in the hard-pressed construction industry. For example, the Tennessee Department of Transportation has more than 400 highway projects under construction, with $224 million committed, which is tops in the nation. More than $75 million of this total has been attributed by the Tennessee DOT directly to the gasoline tax increase, and its construction program for 1983 is 380 percent greater than it was in 1982 (11).

WHERE ARE WE GOING?

A status check on several key issues—system, laws, pollutants, and methodologies—may be the best way to answer this question. To assist in providing answers to these 20-year status queries, the members of the TRB Committee on Environmental Analysis in Transportation were asked for input. Their responses are incorporated below.

The System

The year 2004 will present a transportation system more than 99 percent of which will be identical to 1983, but 20 years older. As a result, maintenance and rehabilitation will receive the greater emphasis. On an overall basis, transportation improvement programs seem to be headed more toward "4R" type activities [i.e., resurfacing, restoring, rehabilitating, and reconstructing, from the 1982 Surface Transportation Act] and away from new construction.

Table 1. Federal environmental legislation influencing transportation, 1899-1978.

Year	Legislation
1899	Rivers and Harbors Act
1958	Fish and Wildlife Coordination Act
1962	Federal Aid Highway Act
1965	Housing and Urban Development Act
1966	Department of Transportation Act
1967	Air Quality Act
1968	Control and Abatement of Aircraft Noise and Sonic Boom Act
	Wild and Scenic Rivers Act
	National Flood Insurance Act
1969	National Environmental Policy Act (NEPA)
1970	Federal Aid Highway Act
	Executive Order 11514, Protection and Enhancement of Environmental Quality
	Environmental Quality Improvement Act
	Airport and Airway Development Act
1972	Noise Control Act
	Federal Water Pollution Control Act
	Coastal Zone Management Act
1976	Coastal Zone Management Act Amendments
1977	Executive Order 11988, Floodplain Management
	Executive Order 11990, Protection of Wetlands
	Clean Air Act Amendments
	Clean Water Act Amendments
	Executive Order 11991, Protection and Enhancement of Environmental Quality (amended)
1978	Quiet Communities Act

In addition to the ever-present headaches of infrastructure decay, 2004 will also bring about projects designed to reduce worsening urban congestion. Several major cities are also engaged in major urban redevelopment efforts that could serve to worsen urban congestion problems.

The system will be forced to become more responsive to those new forms of transportation like telecommunications. This will enhance diversity and possibly lighten the load on the existing traditional system.

The system will also be forced to accommodate more exotic freight as technologies and needs evolve. The movement by various transportation modes of hazardous cargoes will become an increasingly more significant issue, and there will be undoubtedly much tighter regulation on the movements of these cargoes. This would also include hazardous waste.

On the inland waterways and coastal waterways of the country the barges and tows are likely to increase in size, thereby resulting in more significant aquatic habitat impacts. Also it is likely that new locks and dams and new deep-draft ports will have to be built and there will be serious environmental issues related to these activities.

The Laws

In 2004, some new environmental laws will likely be in place, and some existing laws will have been modified or deleted. However, just as the last 5 years have not generated much that is really new, the next 20 years most likely will not either. Significant changes and additions will only be to accommodate significant technological advances, like deep-draft ports, nuclear waste movement, high-speed rail, and so on. If there are other significant changes, they will likely be a result of economics. According to the President's Council on Environmental Quality (CEQ), current environmental and natural resource policy has "fallen out of touch with the basic economic premise that costs incurred by any requirement should be commensurate with benefits received" (12). This line of reasoning is perfectly acceptable, as long as it is not used as a basis for backing off the commitment to environmental protection, which CEQ says is still strong.

The Pollutants

Will noise problems be worse in 20 years? air quality? water pollution? Yes, to the extent that political and economic pressures result in delays or setbacks in the implementation of control measures.

Recent federal highway law, for example, eliminated separate funding for noise barrier retrofit projects, and made that program part of the 4R project set. This is tantamount to ending the retrofit program, even though there are hundreds of miles of barrier needs identified on the existing system. Given normal traffic growth, roadway surface deterioration, and so on, these identified noise problems will only get worse. In addition, the truck noise reduction requirements from the 1972 Noise Control Act have been rendered useless by the elimination of the EPA noise program. This will certainly result in higher noise levels in 2004, if left as is.

Air quality should improve in the next 20 years, provided the Clean Air Act is not diluted and vehicle emission limits not further delayed. The mix of the fleet is critical, and energy costs will continue to have a dominating impact on mix. The real question may be whether the U.S. automobile industry will start producing fuel-efficient, nonpolluting passenger cars that will compete with the imports.

An overriding issue for both air quality and noise levels in 2004 is the increased urban congestion projected by FHWA. Fortunately, Levels of Service E and F traffic conditions do not generate much noise. Nevertheless, increased congestion will lead to more noise and lower air quality.

Water quality and other ecology-related impacts will be lessened to some degree by 2004. This is because most intracity, high- and medium-service facilities are already in place, as the emphasis shifts to maintenance and rehabilitation. One factor that could affect the quantity and quality of rural roads is whether or not this or a future administration will be successful in turning the primary and secondary road systems back to the states.

Possibly the best way to anticipate the status of the pollutants, and even environmental impacts in general, for the year 2004 is to examine other nations where population densities are greater and cities older. Transportation impacts in 2004 in this country will be similar to impacts experienced now in highly developed and densely populated areas like central Europe and Japan. When traveling in either of these places, one cannot help but be impressed with the number of noise barriers (many of which are absorptive), the relative quiet of the trucks and buses, and the fuel efficiency of the passenger vehicles. Yet the need for further attention to environmental concerns seems to precipitate a higher degree of concern among Japanese and European transportation officials, when compared with their American counterparts. Environmental problems resulting from transportation facilities will not just go away if ignored. Those governments genuinely concerned with the quality of life of their citizens must build environmental thinking into the project development process.

The Methodologies

Serious research and development in noise, air quality, and ecology modeling has been under way for at least 20 years, and has brought the state of the art a long way. Federal transportation research administrators have indicated that by 2004 assessment techniques should be fully adequate. Even today, noise and air quality models are felt to be sufficiently accurate for most applications. Other methods, including those for wetlands and habitat assessment, will significantly improve by 2004. Of course, there will always be room for improvements here and there, but basically the prediction here is that the modeling techniques for virtually all environmental issues will be in place and properly functioning by 2004.

CONCLUSION

Transportation impacts on the environment in 2004 will most likely be worse than they are now. Fortunately, as a nation the United States will have the resources to adequately deal with them—that is, provided the entire transportation infrastructure does not mortally damage the economic sys-

tem first. Regardless of how accustomed Americans have become to a deficit-based society, the provision of transportation services is ultimately a bottom-line venture.

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Got A Problem? A TRB Staff Field Visit Could Help Solve It

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Potholes, planning, productivity . . . airports, asphalt, administration . . . soils, safety, slopes . . . rail, rights-of way, ridesharing . . . transit, tunneling, taxation . . . law, LRVs, liability . . . design, deicing, data collection . . . the beat (and the list) can go on for pages. The trios of terms noted here represent only a small sampling of the topics that are the "stuff RCS visits by TRB staff to the states are made of."

Each year members of the Transportation Research Board's Division A staff pay a visit to every state highway and transportation department as part of TRB's Research Correlation Service program. The principal objectives of these visits are to learn of problems that exist and to transfer information related to these problems, as well as to find out about research activity either in progress or contemplated. During these field visits, which usually last about two days, TRB staff also discuss TRB activities, identify personnel qualified to serve on TRB committees and task forces, urge researchers to report on their work through the TRB Annual Meeting, and encourage the practical application of useful research findings. In addition to the transportation department, the TRB staff member will also visit universities, along with rail, aviation, transit, safety, and industry organizations, that have ongoing and mutual transportation interests.

Feature

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What follows is a summary of some of the transportation trends, research activities, and highlights noted on these visits earlier this year.

PLANNING

Transportation planning throughout the states continues to change emphasis. A new framework is emerging for managing state transportation planning that has a technical or substantive side and a management side. The former deals with the design of physical systems and services. In the majority of the states this side of the planning process has been well developed over the past 10-15 years, and no strong trends or new techniques stand out. However, on the management side change and improvement continue. This includes the areas of policy planning with heavy emphasis on financial analysis, communications, allocation of resources/programming, and performance monitoring. The development of performance indicators is occurring in many states to better inform management regarding trends in such areas as travel volumes and characteristics for all modes, condition of transportation facilities and services, financial resources and expenditures, safety and security, energy consumption, and economic trends. As a result, reports are being developed that are informative both to the policymakers and the public at large.

A noticeable trend in many state agencies that cuts across both the substantive and management sides of planning is toward the use of computers by which data can be accessed from terminals throughout the agency. Agencies are switching to computers in which data are stored on disks or diskpacks with massive storage capabilities with instant access. Improved computer capabilities are greatly assisting planning