Transportation Impacts on the Environment in 2003

LOUIS F. COHN

ABSTRACT

The year 2003 is a generation away. Yet the transportation system that will be in place to serve the United States at that time is basically in place in 1983. Many billions of dollars have been spent in the last 150 years to create the transportation infrastructure of today, and billions more need to be spent to solve immediate problems and to maintain the system already in place. The status of transportation impacts on the environment in 2003 is examined by first discussing the evolution and condition of the transportation system of 1983. Conclusions are drawn concerning the system in 2003, and predictions are made concerning the likely situations to be encountered 20 years in the future. For example, noise levels are expected to be higher, air quality to be better, and water quality to be no worse than today.

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 attempting the prediction of future events and conditions through the subdisciplines of transportation planning and environmental planning. Combining these two fields should provide the means to assess transportation impacts on the environment in the year 2003.

Before charging off into the future with confidence based on naiveté, one should be aware of the limitations of planning. For example, the author and two colleagues at Vanderbilt were recently employed to do a traffic planning study for a proposed 2,200-acre research park in Huntsville, Alabama. One question posed to the clients was, "What development rate do you expect for the park?" They replied, "Between 35 and 100 acres per year." Assuming that development begins in 1985, the park will be fully developed sometime between 2007 and 2048, thus providing a "window" of 41 years. Several different methods were used, including ITE and NCHRP procedures, to determine the number of peak-hour trips that could be expected to go to the park at whatever year it reached full development. These different methods gave numbers ranging from 8,000 to 17,500 trips per hour. Working with exact information like this, the client wanted to know when to build entrances, how many lanes to make them, and so on.

What does all this have to do with transportation impacts on the environment in 2003? Nothing really, except that it must always be remembered that whatever else the future holds, it holds change. Some change can be anticipated but some change cannot. Given this premise as the foundation for discussion, a framework for the assessment of the future of transportation must be established. In so doing, it should

1. Define where we have been,
2. Define where we are,
3. Speculate on why we got here, and
4. Speculate on where we are going.

"We" in the foregoing points and the pages to follow should be defined as the aggregate mobile society in the United States. Other definitions might include transportation consumers or system users.

WHERE HAVE WE BEEN?

Wilfred Owen of the Brookings Institution has categorized (1) the evolution of transportation into five stages:

1. Immobility and isolation (before 1830),
2. Mechanization and regional trade (1830-1900),
3. Motorization and aviation (1900-1950),
4. International transport and global economy (1950-?), and
5. Unified global economic system (?-?).

Keeping in mind that the topic concerns the environmental impacts of transportation, these phases should not be belabored. It is apparent, however, 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 large cargo ship had a dead-weight capacity of about 35,000 tons. Today's container ships, by contrast, 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 was 176 million. World trade today is increasing at twice the rate of the gross world product. In the United States, 20 percent of the industrial workforce is filling foreign orders.

What is it that is causing this astonishing increase in trade and economic interdependence? Obviously there are many answers to that question, but certainly they would include evolution of air transportation, evolution of goods movement, and telecommunications. If we ever get into the final phase, the 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.

Again, what does this have to do with transportation impacts on the environment in 2003? This time the answer is: a great deal. What is seen when considering the five phases of transportation evolution is actually exponential development. It happens that we are now in the part of the curve where the rate of change in development rate is wildly increasing, as in 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 of infrastructure obsolescence. Members of the ASCE are well aware that there is a rising concern over the crisis in infrastruc-

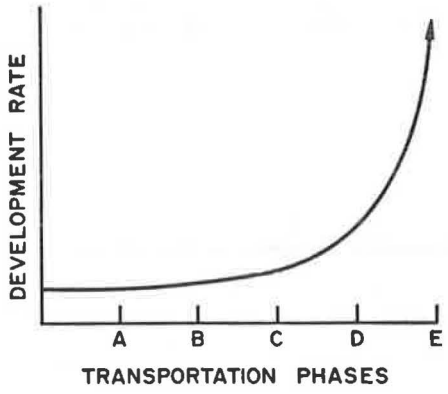

FIGURE 1 Transportation evolution.

ture decay in the United States. Thus, we arrive at the second point in the establishment of our framework.

WHERE ARE WE?

We can establish our location, or where we are in the development process, by reviewing a catalogue 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, and 2,000 more miles are 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-aid road networks, is more than $360 billion in 1980 dollars and that it 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. 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). To confirm that the U.S. transportation network has been established for a significant time period, it should be noted that nearly 40 percent of the 557,516 bridges inventoried are at least 45 years old.

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, just to 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 because of 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 2003. 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 per year over a 5-year period in airport development aid.

So where are we, at least with respect to the physical inventory of our transportation system? We are the owners of a multi-billion-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 indicated in Figure 2, peak-hour congestion will significantly

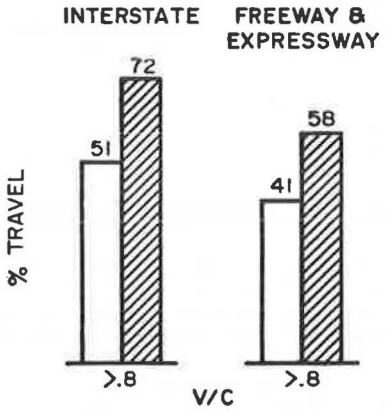

FIGURE 2 Impact of 15 years of travel on peak-hour V/C (unshaded bars, 1980; shaded bars, 1995).

deteriorate in the next 15 years. It appears that about two-thirds of the urban peak-hour travel will take place under conditions of volume to capacity (V/C) ratio of 0.8 or greater. This constitutes level of service C or worse. The solution to congestion has traditionally been increasing capacity through widening projects; however, the FHWA 1981 Status Report indicates that nearly 50 percent of the roads and streets on the current system cannot be widened because of adjacent development. For these, only traffic engineering and use management projects are feasible to increase capacity (2).

In summary, the U.S. transportation system is 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 or so. 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 show 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

TABLE 1 Federal Environmental Legislation Influencing Transportation

Date	Legislation
Pre-1960	The Rivers and Harbors Act of 1899
	Fish and Wildlife Coordination Act of 1958
1960	Federal Aid Highway Act of 1962
	Clean Air Act of 1963
1965	Housing and Urban Development Act of 1965
	Department of Transportation Act of 1966
	Air Quality Act of 1967
	Control and Abatement of Aircraft Noise and Sonic Boom Act of 1968
	Wild and Scenic Rivers Act of 1968
	National Flood Insurance Act of 1968
	National Environmental Policy Act of 1969 (NEPA)
1970	Federal Aid Highway Act of 1970
	Executive Order 11514, Protection and Enhancement of Environmental Quality, 1970
	Environmental Quality Improvement Act of 1970
	Airport and Airway Development Act of 1970
	Noise Control Act of 1972
	Federal Water Pollution Control Act of 1972
	Coastal Zone Management Act of 1972
1975	Coastal Zone Management Act Amendments of 1976
	Executive Order 11988, Floodplain Management, 1977
	Executive Order 11990, Protection of Wetlands, 1977
	Clean Air Act Amendments of 1977
	Clean Water Act Amendments of 1977
	Executive Order 11991, Protection and Enhancement of Environmental Quality (amended), 1977
	Quiet Communities Act of 1978
1980	

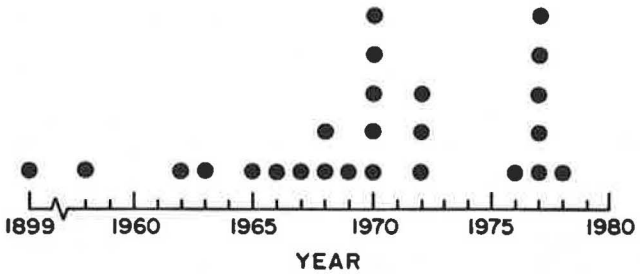

FIGURE 3 Distribution of 25 environmental laws influencing transportation.

most important with regard to their influence on transportation. It is not to be argued that this list is all inclusive or otherwise perfect; however, the 25 actions listed certainly merit consideration as consequential.

In reviewing the list, it becomes obvious that there have been no significant laws enacted in the last 5 years, although some are currently under major revision. There are several political reasons for this recent lack of activity, but definitely a fundamental reason is that the 25 laws already in place constitute a solid and relatively complete framework for considering transportation impacts on the environment. Certainly some adjustments, additions, and even deletions are in order and may be implemented, but the question could be posed, "Does the United States need any additional environmental laws affecting transportation project development?" This writer thinks not.

Where are we in terms of the analytical tools and techniques necessary to quantify transportation impacts on the environment? The answer is that we are in fairly good shape. 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 decision-making 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. Obviously improvements to all the models will evolve, but generally it can be said with confidence that engineers have the tools needed to quantify most environmental impacts and in many cases design mitigation strategies.

HOW DID WE GET HERE?

How did the United States come to have an inventory-intense, underfunded, incomplete transportation system? The answer to this question must relate to the natural evolutionary 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. The airline industry is a good example. In the mid- to late 1960s the problem was that anticipated growth rates in passenger travel meant that not enough airplanes were available. The solution was to buy more airplanes. Then the economy turned sour, and one of the problems was that many of the airlines were too heavily inventoried; that is, they had bought too many airplanes. Compounding the problem was the fact that energy costs were skyrocketing, and many of the airplanes purchased in the 1960s were not fuel efficient and also were officially designated [Control and Abatement of Aircraft Noise and Sonic Boom Act of 1968 (U.S.C., Title 49, Sections 1421-1430)] as being noise incompatible and in need of engine retrofit. Thus, the solutions to the 1960s problems became the 1970s problems, given the new emphases on energy conservation and environmental compatibility and a different economic climate.

Thus 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 currently threatened. In fact, the great maintenance and rehabilitation needs mentioned earlier are providing opportunities to reduce unemployment in the hard-pressed construction industry. The nickel-per-gallon gasoline tax that took effect earlier in early 1983 was passed in large part on the basis of its being an economic stimulant. And stimulate it has. The Tennessee Department of Transportation (TDOT), for example, now has more than 400 highway projects under construction, with $224 million committed, which is tops in the nation. More than $75 million has been attributed by TDOT directly to the tax increase. The TDOT construction program for 1983 is 380 percent greater than it was in 1982 (10).

WHERE ARE WE GOING?

A status check on several key issues may be the best way to answer the question of where we are going. A check will be made on the 2003 status of

1. The system,

2. The laws,
3. The pollutants, and
4. The methodologies.

To assist in providing answers to these 20-year status queries, the members of TRB Committee A1F02, Environmental Analysis in Transportation, were asked for input. Their responses are included in the discussion to follow but without individual identification.

The System

The year 2003 will present a transportation system similar to that in 1983 but worse. In fact, more than 99 percent of it will be identical to that in 1983, only 20 years older. As a result, maintenance and rehabilitation will receive the greater share of emphasis. One committee member said, "On an overall basis, transportation improvement programs seem to be headed more toward '4R' type activities and away from new construction." (Note, 4R means resurfacing, restoring, rehabilitating, and reconstructing, from the 1982 Surface Transportation Assistance Act.)

In addition to the ever-present headaches of infrastructure decay, 2003 will also bring about projects designed to reduce worsening urban congestion. Recall the earlier comment that two-thirds of the urban peak-hour travel will face level of service C or worse in 15 years. Several major cities are also actively engaged in major urban redevelopment efforts that could serve to worsen urban congestion problems. Three such cities that come to mind are Louisville, Memphis, and Nashville. An A1F02 committee member from the urbanized Northeast commented:

> There will be a substantial increase in transportation projects which are involved with urban revitalization, joint development. This will include rail stations, ports, and urban road network improvements. Preservation of historic and culturally significant buildings and other facilities will be an important environmental component of this work.

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.

Last, the system will also be forced to accommodate more exotic freight as technologies and needs evolve. A committee member notes:

> 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 2003 there will surely be some new environmental laws in place, and some existing laws will have been modified or deleted. However, just as the last 5 years have not brought 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 as 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" (11). This line of reasoning is perfectly acceptable as long as it is not used as a basis for retreating from the commitment to environmental protection, which CEQ says is still strong.

An A1F02 committee member from the Southwest observes:

> People will have to become more sophisticated and knowledgeable in environmental matters. Engineers must take the lead in this effort. Otherwise, well meaning, but frequently ill-informed individuals will lead society into tragic errors, both environmentally and economically.

A friend of the committee who works for the federal government in intermodal policy and planning suggested by telephone that the best way to consider environmental impacts in 2003 is to study the environmental laws in place in 1983. This makes sense, given the 15- to 20-year period to complete a major transportation project from conception to construction.

One can never be sure of what will happen in the legislative bodies of the United States. One committee member wrote of an educational TV show he watched concerning the possible Shin-Kansen between Los Angeles and San Diego. (Shin-Kansen is Japanese for Bullet Train.) This concept obviously has great potential to reduce automobile congestion and air pollution and to save energy. Yet the Japanese interviewed on the program complained about vibration and noise problems relating to the train's operations. First-hand observations indicate that Japan is spending millions on environmental controls on its bullet train lines, both for new and existing lines. What has the California legislature done? According to the TV program, it has waived environmental assessment requirements for the high-speed rail project.

The Pollutants

Will the problems of noise, air, and water pollution be worse in 20 years? The answer is 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. Also, the truck noise reduction requirements from the 1972 Noise Control Act have been rendered useless by the elimination of the U.S. Environmental Protection Agency noise program. This will certainly result in higher noise levels in 2003.

Air quality should improve in the next 20 years, provided that the Clean Air Act is not diluted and vehicle emission limits are 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 competitive, fuel-efficient, nonpolluting passenger cars that will compete with the imports.

An overriding issue for both air quality and noise levels in 2003 is the increased urban congestion projected by FHWA. Fortunately, level-of-service E and F traffic conditions do not generate much noise. Nevertheless, increased congestion will lead to more noise and worse air quality.

Water quality and other ecology-related impacts will be lessened to some degree by 2003. This is because most intracity high- and medium-service facilities are already in place, and the emphasis has shifted to maintenance and rehabilitation. One factor that could affect the quantity and quality of rural roads is whether 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 2003 is to examine other nations where population densities are greater and cities older. A committee member commented, "Transportation impacts in 2003, 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 regions, 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 than among their American counterparts. This leads to the conclusion that the problems are at least perceived to be worse abroad. Bluntly stated, environmental problems resulting from transportation facilities will not just go away if ignored. Those governments genuinely concerned with the quality of life for 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 2003 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 be significantly improved by 2003. Of course, there will always be room for improvements, but it is predicted that the basic modeling techniques for virtually all environmental issues will be in place and properly functioning by 2003.

CONCLUSION

The impact of transportation on the environment in 2003 will most likely be worse than in 1983. Fortunately, as a nation the United States will have the wherewithal to adequately deal with the situation, provided that the entire transportation infrastructure does not mortally damage the economic system first, because 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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