

SOME THOUGHTS ON DATA NEEDS AND CRITICAL ISSUES

Alan E. Pisarski

This cycle, in contrast to the past, TRB has opted for a large number of issues. This should in some ways make it easier to focus on the data needs for the 14 issues presented. Overall it will put pressure on us to stay brief in order to produce something that will fit in the TR News. We may choose to produce two products – a larger, more tangible study of the data needs – running roughly one page per issue built by each committee's inputs; and a shorter piece – a few paragraphs per issue to stay within a normal TR News scale piece.

In order to get us started the following are my observations re the issues. Also appended is what I hope is the final draft of the critical issues piece. AEP

SECURITY

Through the fifties, sixties and seventies concern for aspects of security were an embedded part of transportation policy analysis and planning. Concern for system redundancy, vulnerability and the ability to support emergency/military needs were part of the standard focus of transportation professionals. These concerns have been replaced by others and our present systems exhibit the resulting weaknesses. Present security concerns will send us back to basics regarding the ability of the transportation system to serve to protect the economy and society. A key part of present interest and capability that will be abetted by the security concern is the focus on operating the system better. Almost all of the benefits to security from better operations also serve the community better outside the security need. Planners will need to know more about serving flows and the ability of the system to serve demand when challenges arise whether from natural or other emergencies.

SAFETY

Growing travel demand and a demographic structure that increases risks will be immense challenges to future safety. Using new tools and technologies will be key. Also, identifying road investments that can protect the user will be an important research area. The interaction between trucks and vehicles of all sizes and capabilities will need to be better understood.

CONGESTION

There is startlingly little focus on measurement of congestion and its interactions given its costs and the level of frustration among the public. There is no national congestion reporting capability that is current and comprehensive.

INSTITUTIONAL CONSTRAINTS

It is not clear that there are data components to this topic which is directed at the need to transition planning and construction-based organizations to operations-based entities. This will be more about power and roles and money than data. Data can show where the issues are and where the resources are going. It can show how many different entities are engaged in the processes – 36,000 road owning agencies. State DOT's and MPO's will be reluctant to let new players control the operations process. A more real issue may well be private-public interactions re building, owning and operating the system. There is a tendency to believe that Transportation agencies are old and tired, mired in the 1750's but I would think they are responsive to change and quick adapters.

ENVIRONMENT

There are tremendous pressures to respond to environmental concerns but immense ignorance all around re threats, benefits and problems to be addressed. It is astonishing how much action and money is predicated on such weak information. The recent FHWA Air Quality Facts and Figures is a great help – how many states and MPO's could do it?

ENERGY

One of the keys here will be describing the vehicle fleet, its size and age – and how it might respond over time to energy changes. I would think we should stay out of blessing any forecasting of the availability of fossil fuels, unless one of the cognizant committees wants to survey the sources. The potential for hybrids, etc. would be worth looking at. One area of value would be the number of special fuels that have been spawned (see environment above) and the volatility that breeds in prices and supplies throughout the year. We are having our usual Spring price bounce right now.

AGING INFRASTRUCTURE

This is a very meaty topic. The data sources are relatively strong – gaps exist and need to be identified. I have used the National Bridge data that show the immense bridge building that went on in the sixties, for instance, but many systems do not have that capacity. Transit is weak in this regard.

FINANCE

This is again a meaty topic that will need some focusing. One area is the trends in fuel taxes and their declining real worth. Linkage to future fuel changes will be key. Noone has inventoried the use of sales taxes and the role they are now playing. Another part of the topic is the area of innovative finance. States and others need to know who is doing what and how. We need to know what shares of spending are going to bonding etc. and what is its potential.

HUMAN RESOURCES

I have been talking a lot about the declining availability of labor force and skilled workers in general – someone needs to focus this on the transportation profession.

INDUSTRY CONSOLIDATION

Another trip down memory lane. When I first began in the feds there were 70-some first class railroads – now we have 7 at best. Similar trends are in the airlines, bus lines etc. Is this really an issue or is it self-solving? When do we stop consolidating? Do we need to reconsider aspects of our regulatory structure. Are we capable of defining the data issues here.

AGING POPULATION

This was identified earlier as part of the safety topic. There is a great need for more and better interpretive data re the transportation needs and activities of the aging population. How big a problem will it be? Something we are doing for NCHRP says that we will add 350 fatalities per year each year as a result of aging.

EQUITY

This is an odd topic. The equity question has useful and interesting aspects but the way it is posed here as a problem of people spending too much on transportation is just short of farce. We need a good data treatment of spending on transportation and the tradeoffs with housing etc.

IMPACT OF TELECOMMUNICATIONS

Remember this? It was hot stuff a few years ago. It will be again but with a more measured tone. There is a great opportunity to talk about the data that will help us understand the tradeoffs and respective roles played here.

BARRIERS TO INNOVATION

This can be an important research topic for some of the committees re the roles they play. There is data about barriers and data as one of the barriers.

INCIPIT LUDE!

CRITICAL ISSUES IN TRANSPORTATION 2001

October 15, 2001

Draft

Given the importance of transportation to both the economy and individual well-being, the Executive Committee of the Transportation Research Board periodically provides an assessment of issues it considers critical. In so doing, the Executive Committee hopes to bring attention to these issues, to facilitate the debate on how to address them, and to encourage the conduct of research that could serve to resolve them.

Americans have taken for granted an ability to travel conveniently, safely, and at reasonable cost that has been disrupted by the terrorist attacks on September 11, 2001. Much of the success and efficiency of the transportation system is attributable to its easy and convenient access by travelers and shippers – attributes that also make the system vulnerable to terrorist attack. Clearly, much greater attention must be focused on improving the security of our transportation systems. Research can play an important role in this effort. At the same time, we must not neglect other issues that are critical to maintaining the levels of transportation service that Americans have become dependent upon.

John Samuels

Senior Vice President, Operations Planning and Support, Norfolk Southern Corporation
Chairman, TRB Executive Committee

Introduction

Historically, the U.S. transportation system has been among the best in the world, providing a remarkable level of mobility and access to goods and services. Moreover, the system's quality and pervasiveness have been influential in shaping development patterns both locally and nationally. In many respects, however, the system has become the victim of its own success. The very affluence it has helped create has resulted in a demand for travel and access that is increasingly difficult to meet, as witnessed by the growing congestion and delay that characterize all transportation modes. Although this congestion may abate in the short term, in time the problems will return. In addition, as the infrastructure of the system has expanded, it has increasingly intruded on neighborhoods and the environment. Society's responses to the complex challenges thus posed--even the failure to respond--will have fundamental consequences for the nation's future prosperity and quality of life, as well as for the environment.

The U.S. Transportation System and Its Importance

In a country as vast as the United States, it is easy to lose sight of the tremendous size of the transportation infrastructure and the magnitude of its consequences:

- The scale of the system and its usage is extraordinary (see box). All modes of transportation combined account for more than 4.6 trillion passenger-miles of travel annually over the existing networks. The value of the goods shipped each year totals nearly \$8 trillion, and transportation's contribution to the global nature of the U.S. economy is reflected in the \$1.5 trillion in international cargo that moves through U.S. ports by various modes annually.
- Transportation is a major component of gross domestic product (GDP) (11 percent), roughly equivalent to the share of health care and food. It is also a major component of family expenditures (19 percent), second only to expenditures for housing (see Figure 1).
- Individuals spend roughly a full hour each day, on average, traveling for work, shopping, medical appointments, socializing, and recreation. While the population has grown but 9 percent in 25 years, trip making per capita has grown by 50 percent, as has the distance of daily travel (see Figure 2).
- The nation's inventories, which once resided in stationary warehouses, are now almost constantly in motion in seagoing containers, rail cars, and trucks. Any significant disruption in the flow of this inventory would have dramatic negative consequences for the American economy. More than 15,000 ton-miles of freight per capita is moved each year.
- As the globalization of the economy continues, the country's national and international competitiveness will depend upon the ability to move people, goods, services, and information quickly, cheaply, and safely.

MODE	COMPONENTS	ANNUAL OUTPUT (1997)
Highway	3,921,000 road miles	4,130,200,000,000 passenger miles 1,051,000,000,000 ton miles
Air	5, 352 public airports	463,000,000,000 passenger miles
Urban Transit	Bus: 156,000 route-miles Rail: 6,600 route-miles	20,400,000,000 passenger miles 21,300,000,000 passenger miles
Rail	120,000 freight rail miles	1,348,900,000,000 ton miles
Water	20,000 port terminals	707,410,000,000 ton miles
Oil Pipeline	200,500 miles pipeline	617,000,000,000 ton miles

Critical Issues

Although many important challenges face those who use and provide transportation services, the TRB Executive Committee has identified the following issues as most critical. Many of these issues are interrelated, but they are described here separately for purposes of explication.

CRITICAL ISSUES 2001	
SECURITY	FINANCE
SAFETY	HUMAN RESOURCES
CONGESTION	INDUSTRY CONSOLIDATION
INSTITUTIONAL CONSTRAINTS	AGING POPULATION
ENVIRONMENT	EQUITY
ENERGY	IMPACT OF TELECOMMUNICATIONS
AGING INFRASTRUCTURE	BARRIERS TO INNOVATION

The transportation system is vulnerable to attacks by terrorists and saboteurs. The transportation system was designed to serve an open society and a market economy. It does so with an emphasis on efficiency, speed, and reliability. The very features that tie transportation inexorably to the way of life in the United States, however, make the system vulnerable to attack. Because of the redundancies in the system, it is highly unlikely that the physical infrastructure could be rendered inoperable for any length of time. Terrorists, however, are more concerned with causing mayhem and suffering. Transportation becomes a target because it concentrates people in aircraft and terminals and on vehicles that travel through tunnels and over bridges. Following the tragedies of September 11, 2001, it is clear that security will become a much more central goal of transportation in the future. Achieving that goal will be difficult and costly but necessary. New technologies, operations, and deterrence strategies are needed.

Fatalities and injuries from transportation crashes are a major public health problem. Fatality and serious injury rates associated with transportation have been declining steadily. Yet more than 40,000 people still die each year in transportation crashes, 95 percent of which occur on the nation's highways (see Figure 3), and more than 3 million are seriously injured. About 85 percent of highway deaths occur to motor vehicle occupants and 15 percent to pedestrians and cyclists, the latter groups being the most vulnerable to injury from collisions. Although vehicle manufacturers and infrastructure owners continue to introduce safety-enhancing features for vehicle occupants, most of the obvious, politically feasible improvements with major benefit have been made. Even so, thousands of deaths could be averted each year at a low cost if use of safety belts could be increased beyond the seventy percent of motorists who regularly buckle up. Strategies for reaching higher-risk drivers involve enacting stronger state laws or intervening in behavior in ways that lack political support. Behavioral change, however,

may be key to continued reductions in traffic fatalities and injuries, and further improvements will require considerable ingenuity and political will.

The demand for passenger travel and freight movement is straining the capacity of the U.S. transportation system. Congestion in the transportation system is worsening as demand outstrips the ability to provide additional capacity. Travel increases result from both population growth and the greater number of trips per capita. Midrange projections by the Bureau of the Census indicate that in less than 25 years, the U.S. population will increase by some 60 million people--roughly the equivalent of adding double the current population of California. Immigration will account for a substantial share of this growth, and it is the most difficult component to predict. The greatest single challenge will be simply accommodating the resulting housing and transportation demands in the metropolitan areas in which these people are likely to settle. During the last decade of economic prosperity, passenger and freight trips by air, transit, highway, and rail grew at a much greater rate than capacity. The result has been increased frustration and congestion. It is estimated that delays due to air and roadway congestion alone are responsible for more than \$75 billion in lost time and wasted fuel annually.

The physical capacity of the system is growing more slowly than in the past for a variety of reasons, including cost, community resistance, and environmental concerns. Operators of all modes are attempting to increase throughput on existing systems with new intelligent technologies and system management procedures for aviation, rail, road, transit, and maritime operations. New, more integrated technologies and improved approaches for demand management and system operations, as well as additional infrastructure, are needed.

Current institutional arrangements constrain the orderly development, operation, and coordination of the U.S. transportation system, including facilities, modes, and services. Whether capacity-enhancing technologies and new management procedures can be developed and techniques introduced quickly enough to keep pace with escalating demand is an open question. Not only must new approaches be developed, but they must also be applied by institutions that were created in the past to build systems instead of to manage their operations. The transportation system is actually a patchwork of loosely connected modes encompassing 35,000 government owners of roads; tens of thousands of private carriers; and thousands of independent authorities responsible for ports, transit systems, and airports. The funding mechanisms for these entities remain largely unconnected and uncoordinated, despite reforms incorporated in previous federal legislation. Furthermore, in keeping with values of local, democratic decision-making, much of transportation planning, programming, and implementation is conducted at the metropolitan and state levels. These processes are deliberate and time-consuming. The result is a series of disconnects over time and space: slow public planning and implementation on the one hand, and ever-changing demands of private firms and individuals for transportation services on the other. On a regional basis, the major challenge facing transportation agencies is the need to move from a focus on building and maintaining infrastructure to one of operating and managing capital assets for maximum public benefit.

Worthy environmental goals and values pose serious challenges to the operation and expansion of transportation facilities to meet growing demand. Public opinion data reveal that Americans place a high value on clean air and water and are increasingly concerned about

transportation's adverse effects on the quality of life. Individuals and communities oppose noise from operations, and debates about the long-term effects of transportation facilities on sprawling development are contentious. Transportation officials are being asked to address these problems by attempting to balance conflicting demands from the public. Yet the available tools for predicting the consequences of new or expanded facilities or alternative strategies for meeting transportation demand are inadequate. Nor are data or methods for deriving reliable estimates of costs and benefits sufficiently developed. Regulations intended to achieve environmental and transportation objectives can result in lengthy and expensive delays in decision making and in results that are less than satisfying for any of the parties involved. Both government and industry have invested heavily in producing cleaner-burning technologies, and much progress has been made in this regard. Incentives to introduce new technologies that have higher initial costs, however, are lacking. Moreover, the level of public investment in research aimed at exploiting these opportunities, though substantial, pales in significance relative to the importance of protecting and improving the environment. New ways must be found to satisfy public demand for travel while meeting environmental goals.

The U.S. transportation system, which depends on fossil fuels, faces an uncertain future with respect to the availability and cost of energy. Transportation relies heavily on fossil fuels, primarily petroleum, and demand for these fuels is increasing (see Figure 4). The consumption of these fuels results in emissions that are harmful to health and ecosystems and contribute to climate change. Sources of petroleum—including petroleum reserves, tar sands, and shale—appear to be plentiful, but the economic and environmental consequences of their use are increasingly worrisome. Recent dramatic price fluctuations, for example, have hurt the balance sheets of private carriers, for which fuel represents more than 10 percent of costs, and caused budget problems for transit systems, for which energy costs are also significant. Alternative fuels and propulsion systems appear promising, but considerable investment in technology and distribution systems will be needed to make these energy sources competitive with petroleum-based fuels.

The aging transportation infrastructure must be rebuilt, but the costs involved exceed revenues. Major highway and transit assets built in the post–World War II era—including the entire Interstate system and most airports and transit systems—demand constant renewal and upkeep, necessitating large reinvestment expenditures just to maintain current capacity. Public agencies invest more than \$30 billion annually just to maintain the existing highway and transit infrastructure. Even the substantial increases in funding for highway and transit infrastructure incorporated in recent federal legislation are estimated by the U.S. Department of Transportation to fall short of meeting maintenance and upkeep investment needs. Railroads, which provide private financing for capacity enhancements, face the same imbalance of costs and revenues as they attempt to earn their cost of capital. Costs are substantial as well for maintaining waterways, airports, and air traffic control systems. However, the cost of not keeping up with transportation system demand is also substantial: lower productivity, less-competitive U.S. products, and a lower standard of living.

The financing of publicly provided transportation infrastructure is not adequately matched to use or need. The vast majority of major highway and transit facilities have been financed by taxes on fuel. In the longer term, fuel tax revenues are threatened by the growth in

tax-exempt additives (such as ethanol), increased fuel efficiency, and the development of propulsion technologies not based on gasoline. Moreover, the trend toward increased reliance on sales taxes and general taxes in some jurisdictions is eroding the long-established principle of paying for transportation through user fees. These alternative revenue sources are also more sensitive to changes in the economy and political priorities. Despite an almost unparalleled era of prosperity, the public sector is being forced to do more with less on many fronts and is becoming increasingly reliant on less-predictable revenue streams.

Transportation organizations are having difficulty attracting and retaining the technically diverse personnel needed in the 21st century. Changing technology in transportation has created a need for personnel with expanded skills. Transportation agencies are being asked to adopt more-sophisticated technologies for operating systems and vehicles, and are having difficulty attracting the skilled personnel they need because of higher salaries available in private industry. Even private firms that contract with transportation agencies are having difficulty obtaining workers with needed skills. Enrollments in engineering and other technical programs are declining at a time when the demand for individuals with advanced technical training has never been greater. Many questions arise as a result, including how sufficient numbers of persons with the requisite skills can be trained, recruited, and retained in the transportation industry.

Consumer benefits from deregulation are threatened by industry consolidation. Reduced economic regulation of transportation industries has brought great benefits to consumers as firms have been freed to cut costs and expand services. The marketplace has been tumultuous, to say the least, but industry has unquestionably become more productive and service oriented. Even as industry continues to innovate and cut costs to meet customer demands, however, there is concern that further reducing the number of major airlines and railroads could result in insufficient competition. Government intervention in this process is constrained by the failure of venerable firms, the potential widespread impacts on shippers and travelers, and the cost savings that carriers derive from mergers.

An aging population poses special safety and mobility challenges. More than 19 percent of Americans will be age 65 or older by 2025, compared with 13 percent today. The mobility needs of older people change, but the vast majority of their trips are still made by automobile. Yet driving skills decline with age, even as vulnerability to injury from collisions grows. Most people retire in the neighborhoods in which they have resided, but these mainly suburban settings were designed around the automobile and are difficult and costly to serve with alternative modes. Nonetheless, alternatives are needed.

The burden of owning and operating vehicles is increasing for the lowest-income families. Transportation was the third-highest household expense in the 1970s; today it is the second-highest. For affluent households, this change reflects personal preferences. For families with lower incomes, however, particularly those living in automobile-dominated metropolitan areas, costs for transportation compete in magnitude with those for housing. In many lower-income households in low-density suburbs, 25 percent of household income is being spent on transportation.

Telecommunications and information technologies are likely to have significant but uncertain consequences. The merging of telecommunications and information technologies with transportation offers the greatest potential for innovation in transportation today. Not unlike the sweeping changes being made possible by the Internet, the outcomes that will result from merging these three domains cannot be predicted with certainty. Possible outcomes include much smoother traffic flows; greater ease in telecommuting, such as wireless Internet access to drivers and other travelers while in transit; and promising new crash-avoidance technologies for all types of vehicles. At the same time, complex questions arise about system reliability, privacy, and liability; effects on dispersed development; and the risk that additional vehicle services and driver warning systems will detract from rather than enhance driving performance.

Transportation faces formidable barriers to innovation, which are compounded by growing constraints on research investments. Although innovation offers promise in almost all disciplines involved in transportation, the challenges to developing and introducing these innovations are daunting. Whereas private providers of new vehicles exist in an environment that rewards innovation and respond accordingly, the public sector must address multiple social goals, often leading to slow decision-making processes. Moreover, public agencies are reluctant to try new things in the face of uncertainty, conflicting objectives, and low public tolerance for failure.

Research programs are decentralized because operations are decentralized, and needs vary widely across the country. Decentralization, however, leads to programs of modest scale that address only near-term problems. Longer-term, higher-risk research efforts are difficult to sustain. The ability of federal mission agencies to invest in such programs is also increasingly constrained by congressional designations of research and development (R&D) funds. Earmarking of research funding, which has grown with each recent budget cycle, bypasses the quality-control mechanisms of competition, merit review, and peer review. The latter procedures have been central to the remarkable contributions of science and engineering to society during the last few decades, and earmarking threatens to undermine even the modest programs of transportation research that exist.

Potential Opportunities Offered by Transportation Research

The opportunities offered by transportation research hold great promise. The following are examples of the benefits such research may provide:

- New intelligent technologies in all modes have the potential to improve safety and service quality as transportation, information, and telecommunications infrastructures are merged. New traffic operations centers could both help operate traffic more efficiently and provide a more focused response during emergencies.
- Improved materials of many types promise to extend the service life of assets and result in lower maintenance costs.
- New construction techniques can permit replacement and upgrading of congested facilities with less disruption and delay for users.

- Innovative approaches are being developed for purchasing services from the private sector with a better return to the public sector in terms of quality and life-cycle cost.
- Enhanced understanding of public preferences and behavior with regard to safety and trip making can guide better investment decisions.
- Better tools for predicting, managing, and avoiding environmental impacts can improve environmental stewardship.
- Better understanding of complex and long-term side effects, such as sprawl, can improve decisions about development.
- Deeper understanding of the causes of crashes can lead to more cost-effective countermeasures.
- More-efficient, less-polluting vehicles and fuels that are less environmentally disruptive are within reach in terms of both availability and cost.
- Analysis of newly emerging institutional experiments within states and regions can indicate new and better ways to make decisions and manage and operate facilities.

Despite its promise, transportation R&D is out of balance with national needs and the sector's importance. Although transportation's share of GDP is nearly equal to that of health care, the federal R&D investment in health care is 10 times that in transportation (see Figure 5). Moreover, the national investment in science, engineering, and health has increased sharply in recent years, while that in transportation has remained low and unchanging. This under investment makes it more difficult to attract the best minds to work on solving transportation problems and leads to insufficient development of intellectual capital in agencies and universities. Federal investment in highway research as a share of expenditures, for example, is a mere 0.5 percent--a share substantially lower than that of even low-tech industries.

Summary

Transportation is vitally important to individuals, communities, and the nation. The challenges facing the system are changing and have never been greater. Research and innovation hold great promise for addressing these challenges, but face formidable barriers. Moreover, transportation research programs are not being funded or organized optimally. At the national level, the investment in transportation research, a primary source of innovation in the sector, is entirely out of balance with the importance of transportation to society. If the potential benefits of transportation research are to be realized, the nation must invest in such research, and do so wisely.