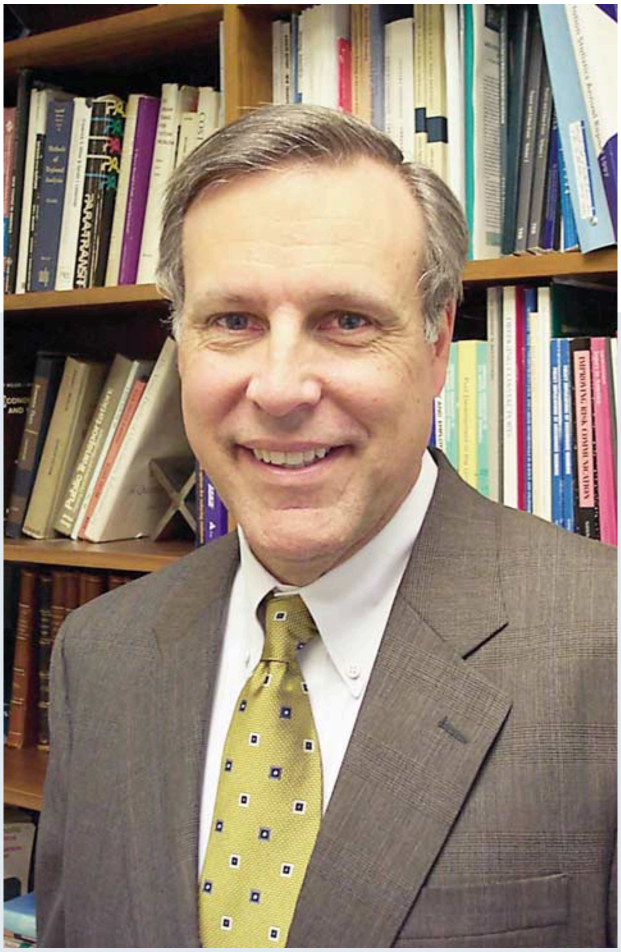

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Mr. Skinner spoke at the Millennial Challenges Colloquium series on 9 June 2000.
The text of "Transportation in the 21st Century" follows.

Transportation in the 21st Century

Robert E. Skinner Jr.

Today I will take on a fairly challenging assignment and speculate about how transportation in the United States may evolve in the first few decades of this new century. Doing this is clearly ambitious; given the scale of our transportation system, it can be approached only partially. Such speculation is also risky because everyone is a transportation expert. This is true not only of this audience of researchers, but of virtually any audience because most of us are not only customers but also operators of the transportation system. My discussion is a bit presumptuous because talking about the future of transportation inevitably takes one well beyond transportation in that it is intertwined with our lifestyles, our economic well-being, and our environment. My comments are not intended to reflect my personal preferences but the probable future of transportation based on what we know now.

First, I'll present an overview of transportation and the changes it causes and those it is affected by. I'll then discuss some important trends and characteristics of transportation that will influence its evolution in the United States, and conclude with some brief comments on specific proposals that have been advanced for transportation.

OVERVIEW

I offer three propositions about transportation as a driver of change and as a reactor to change. First, with due respect to the telephone, computer, and other technologies, the 20th century was the century of transportation technology—aircraft and automobiles changed the way we live, work, recreate, even fight wars. The resulting widespread dramatic increase in mobility across the United States made automobiles and airplanes key drivers of change throughout society.

Second, in the 21st century, at least for the first few decades, no breakthrough transportation technologies like those of the 20th century are on the horizon. We are more concerned with how we will preserve the level of mobility Americans already enjoy in a world of financial and environmental constraints than with expectations of quantum leaps in mobility.

Third, if present trends continue, information technology (including telecommunications) and biotechnology will likely be the breakthrough technologies of the 21st century. Information technology promises to have the most immediate effect on transportation.

Information technology offers substitutes for transportation, e.g., video conferencing. But perhaps more importantly, it reduces the need for critical mass, i.e., for concentrations of employment, especially as the United States increasingly becomes a service economy. It is the great equalizer that allows a person to have the same access to information at home as in the office, and enables companies to operate as well in Des Moines as in New York. **It is a powerful force for dispersal, just as the Industrial Revolution was for concentration.**

As the following statistics indicate, new information technology is being introduced to society quickly:

- U.S. households with PCs: 33 million in 1994, 57 million in 2000; projected 64 million in 2003.[1]
- U.S. households online: 5 million in 1994; 42 million in 2000; projected 60 million in 2003.[1]
- Business-to-consumer commerce on the Internet: $7.5 billion in 1998; $15 billion in 1999.[2]
- Business-to-business commerce on the Internet: $100 billion in 1999; projected $1.3 trillion in 2003.[2]

Four other areas will strongly influence the evolution of transportation: demographics, institutions, capacity of the existing system, and—what I see as a bit of a wild card—human adaptability.

DEMOGRAPHICS

As Alan Pisarski, the author of *Commuting in America*,[3] often comments, "Demographics are destiny." What are our demographics and how are they changing? What will our demographics be 20 or 30 years from now?

Population. Certainly there will be more of us: 20% more by 2020 and 43% more by 2050 according to mid-range census forecasts. But our rate of growth is slowing from an annual rate of 1.9% in the late 1940s to 0.9% in 1996.[4] And we are becoming a nation of immigrants again. The immigrant population nearly doubled between 1950 and 1990[4]; a net population growth of 820,000 per year from immigration is assumed in middle-series census projections through 2035.[5]

Age. More of us will be older: 13% of the U.S. population is now over 65; it is projected to be 19% in 2025.[5] And gerontologists tell us that older Americans of the future will not want to live as older Americans have in the past.

Sex. Women's participation in the labor force will more closely resemble men's, as will their driver's license ownership rates.

- Women's participation in the labor force was 43% in 1970 and 60% in 1998; the ratio of women's to men's rates of participation went from 0.54 in 1970 to 0.80 in 1998.[5]
- Driver's license ownership rates for women were 68% in 1975 and 85% in 1995; rates for men were 88% and 92%, respectively. The ratio of women's rate of driver's license ownership to men's in 1995 was 0.92.[4]

It seems likely that the small remaining gaps in labor force participation and driver's license ownership rates will be effectively closed. One consequence of this trend is that as most adults work, their schedules become very complex. Travel is increasingly organized into "chains" of trips (work, shop, child-related), and such trips are difficult to serve with public transportation.

Affluence. We hope to be more affluent, and that expectation is reasonable based on our recent experience and our prospects.

- 1998 disposable personal per capita income in 1992 dollars was 1.33 times 1980 levels and 2.30 times 1960 levels.[5]
- Leisure travel has increased. Between 1970 and 1990, the population increased by 29%, and passenger-miles traveled increased by 95.3%.[6] Leisure was largely the purpose for trips over 100 miles; the work commute is no longer the dominant determinant of travel demand.

Suburbanization. We have become a nation of suburbs,[4] and it is unknown whether this trend will continue.

- Of the 1940 U.S. population, 15% lived in suburbs; 32% lived in center cities; and 52% were rural dwellers. Of the 1990 population, 47% lived in suburbs; 32% lived in center cities; and 21% were rural dwellers. Rural and suburban population shares nearly flip-flopped from 1940 to 1990.
- About 15% of work trips in 1970 consisted of suburb-to-suburb commuting in metropolitan areas; in 1990, 44% of work trips were suburb-to-suburb commuting.[3] These statistics imply that it is getting harder to serve work trips with conventional public transit.

But ironically, rural areas are now growing as fast as metropolitan regions.[4] A recent U.S. Census study reported that in 1995 more Americans relocated to rural areas than metropolitan areas.[7] Rural Americans of the future will not be like the farmers of the past. They are bringing many of the same values and desires for amenities, activities, etc., as suburban dwellers.

Motor Vehicle Use. If current trends persist, we will probably be "saturated" with motor vehicles. Indeed it looks like we already are.

- Households without automobiles declined from 20% to 8% between 1969 and 1995, while households with two or more motor vehicles increased from 30% to 60%.[4] In nearly the same timeframe, 1970–1995, the average household size declined from 3.14 to 2.65 persons.[5]
- The number of persons per vehicle declined from 2.6 in 1955 to 1.3 in 1995.
- In 1990, 91.4% of trips to work were made by automobile, and 5.5% of those trips were made by public transit.[5]

- In 1995, automobiles were used in 81.3% of intercity trips over 100 miles; 16.1% of these trips were made by air.[5]
- In 1993, trucks carried 72% of freight shipments by value and 24% of ton-miles. Rail carried 4% and 26%, respectively; water carried 4% and 24%, respectively.[6]
- The public transit share of work trips fell from 6.4% in 1980 to 5.3% in 1990 (note: calculated from Ref. 3 to exclude work at home). Given trends noted in the last section, this trend is likely to continue, even though transit ridership has recently increased in absolute terms.

The United States has a growing population that's older, more affluent, and places a greater emphasis on leisure travel. It's highly suburbanized and heavily reliant on motor vehicles for passenger travel and freight. The tendency for dispersal continues, including a return to rural areas.

TRANSPORT INSTITUTIONS

How our nation organizes, regulates, and finances transportation systems plays a big role in determining the availability, cost, and quality of service. The transportation industry is in fact not one industry but rather a collection of industries, a public and private enterprise that is highly decentralized.

- 39,000 governmental units own highways in the United States.
- 6,000 agencies operate transit services.[8]
- Tens of thousands of private companies provide services to transport agencies.
- There are thousands of private trucking firms.

How is our organization of transportation changing, and how will it look in the future? The following comparison of the private and public sectors of the transportation industry can offer some indications.

Private Sector. The private sector has undergone significant transition over the past 20 years. There has been significant consolidation of railroads, airlines, and trucking firms, and it is now occurring in the construction and engineering fields.

- Currently, there are 9 Class I railroads (with only 4 majors), down from 58 in 1977 and 23 in 1985.[9] More mergers are expected, and some believe the United States will have just 2 major railroads, with each providing coast-to-coast service.
- Mergers and acquisitions in construction and engineering tripled between 1996 and 1999; even more mergers have been forecast for 2000.[10]
- In Washington State, 30% of asphalt pavement is now laid by international concerns. In 1964 there were 48 asphalt pavement contractors; today there are 18 (personal communication, D. Spivey, Asphalt Paving Assoc. of Washington, Inc., Jun 2000).
- In 1985, the top 10 aggregate producers had 16% of the market; in 1999 they had 25%.[11]

At the same time, there has been considerable downsizing and streamlining, most dramatically in the railroad industry. In 1977 railroads operated 309,000 track miles; in 1997 the total was down to 173,000 miles.[9] Between 1985 and 1997, Class I railroad employment declined from 302,000 to 178,000,[5] while **ton-miles handled increased by 59% during 1985–1997.**[9]

Economic deregulation starting in the late 1970s, coupled with information technology and the globalization of industry, has prompted a reengineering and reorganization of service delivery and integration of transportation into the supply chain of manufacturers. Just-in-time delivery and airline hub-and-spoke systems are examples of these changes. Companies are increasingly outsourcing their logistics. The World Bank reported that the share of logistical support handled by third parties for a sample of North American and European industry groupings increased by 50% between 1987 and 1995.[12]

Competition, which was encouraged by deregulation, appears healthy despite consolidation. Rail rates (revenue/ton-mile) dropped in constant dollars every year but one in the 1989–1998 period, 30% overall.[13] Airlines' scheduled departures increased by nearly 20% from 1990 to 1999; fares in constant dollars dropped by 25% between 1990 and 1998.[14]

There have been shifts in productivity gains as well. The nation's freight bill was in lockstep with the gross national product (GNP) growth until 1981; since then, the GNP has grown at roughly 6.6% annually and the freight bill at 3.9%.[12]

Public Sector. Organizational changes in transportaion in the public sector have been far more modest. Some devolution of authority to lower levels of government has occurred (with the shorter-term outlook becoming even more dominant). For example, the Intermodal Surface Transportation Efficiency Act of 1991, which reauthorized federal highway and transit programs, gave states greater flexibility in the use of federal aid and metropolitan areas a greater voice in how that aid would be spent in their regions.

There have been other changes in public sector transportation entities: (1) about half of the state departments of transportation have reduced their staff,[15] (2) outsourcing of design and maintenance services is on the rise; there is some experimentation with design-build approaches for new facilities (e.g., I-15 in Salt Lake City), but little true privatization, and (3) little interest has been shown in consolidation, which would face significant barriers.

There is also the continuing problem of financing of publicly provided transport infrastructure and services.

In California, for example, highway operations and maintenance expenditures per 1000 vehicle-miles traveled have declined steadily from $15 in 1956 to $7 in 1995; for capital, from $45 in 1956 to $16 in 1995.[16]

The inflation-adjusted state and federal gas tax at 1.6¢ per vehicle mile in 1995 is near all-time lows. It was 4.5¢ per vehicle mile in 1965 and 2.5¢ in 1985.[16] The average price of gasoline, including taxes and adjusted for inflation, is also near all-time lows, and lower than just before the 1973 oil embargo.[17] This illustrates the irony of recent efforts in Congress to repeal 4.3¢ of the federal gas tax because of recent "spikes" in the price. It makes one wonder about how highways will be financed when hybrid or alternative-fueled vehicles are introduced on a large scale.

Dramatic institutional and organizational changes have occurred in the private sector that have resulted in productivity benefits. In the public sector, change has been more limited—some devolution and increased outsourcing; big revenue questions are looming for the future.

CAPACITY OF EXISTING SYSTEMS

Transport capacity, at least in terms of the physical infrastructure, did not keep pace with demand in the latter part of the 20th century.

Highways. Between 1980 and 1997, lane miles increased by 4%, registered motor vehicles increased by 31%, and vehicle-miles traveled increased by 67% (derived from Ref. 18). The Texas Transportation Institute estimates of the average annual hours of delay per vehicle in the largest U.S. urban areas increased 300% between 1982 and 1997.[19]

Railroads. Whereas the railroads have shed unnecessary assets and employees and have improved productivity, the Bureau of Economic Analysis reports that real net capital stock has declined in value. For railroads, capital spending has not kept pace with depreciation and retirements.[20] Average speeds on Class I railroads increased between 1980 and 1992 and then began to decline.[21]

Waterways and Ports. Capacity problems exist related to aging equipment, mismatches with new technology (container ships, deeper draft ships, double-stack trains), and controversial environmental issues (dredging and disposal of the spoils). Yet, international maritime demand is growing as a result of globalization. For example, containers handled at Los Angeles–Long Beach increased by 80% from 1990 to 1997.

Aviation. Except Denver, no new air carrier airports have been built in the past 25 years. Our air traffic control system still relies on vacuum tube–based technology.

Capacity growth has not kept pace with traffic growth of passengers and freight. Loss of redundancy and "excess" capacity are the flip side of greater efficiency, but they raise concerns about our vulnerability to major system disruptions (such as the Midwest floods several years ago), the cost of routine incidents, and our ability to sustain economic growth. The United States still has plenty of system capacity, but not necessarily where we want it.

THE HUMAN DIMENSION: EXPECTATIONS AND ADAPTABILITY

Transportation systems are operated for and by people, and it is the human dimension of transportation that introduces a great deal of unpredictability about the future—a wild card. How will people's expectations and tastes change, and how will they adapt to new circumstances?

Changing Expectations. Americans want it all: more mobility, more accessibility, more personal space, a better environment, and so on, and in the future there will be more of us wanting these things. Absent a major crisis that galvanizes public opinion and forces a major policy change, we can expect a continuation of current trends—increasingly stringent environmental regulations and a thirst for space and mobility. Our consumer society is increasingly customized, requiring more special orders, more deliveries, and more travel. Almost certainly the transport infrastructures will not keep pace with travel demands. How will Americans reconcile these conflicting desires, deal with congestion, and adapt?

Adaptability. We have all seen dire forecasts of future traffic and gridlock based on extrapolations of current trends that are simply not realistic. Travelers will find ways to avoid regular 2-hour commutes. Indeed, Americans have already demonstrated a remarkable ability to adapt to changes involving their transportation options and to optimize their own happiness and preferences, sometimes in unanticipated ways.

- There have been steady increases in highway capacity as drivers have been willing to tolerate shorter gaps between vehicles when operating at high speeds. Freeway lane capacity was reported to be 2000 passenger cars per hour per lane in the 1985 edition of the *Highway Capacity Manual*, 2200 in the 1994 edition; and 2300 in the 2000 edition. The estimated speed at 1800 passenger cars per hour per lane was 48 mph in the 1985 edition and 59 mph in the 2000 edition.[22]
- Average home-to-work travel times have been surprisingly stable, despite growing highway congestion. The overall average travel time rose from 21.7 minutes in 1980 to 22.3 minutes in 1990,[3] while there was a steady rise in congestion, as measured by the Texas Transportation Institute index.[19] Presumably, the modest growth in travel times is a result of individual adjustments in residential location, employer's location, time of travel, or mode choice.

- After the Northridge earthquake, many commuters in the Los Angeles region were forced to change routes and time of travel. Twenty-five percent said they would stick with their new, mostly arterial, routes after repairs on damaged roads were complete.[23]
- The aviation system has handled growth in airline traffic through the introduction of hub-and-spoke operating systems and the introduction and expansion of service at smaller airports (Burbank, Orange County, and Ontario in the Los Angeles area, and Newburgh in the New York region).

As our options and our expectations change, Americans will reconfigure residential locations, work and travel habits, and lifestyle more broadly in ways that may not be obvious to us today. These changes will alleviate congestion, but this does not mean that no new infrastructure is needed, nor does it mean that the trade-offs and choices individuals make will be desirable for society at large.

PROPOSALS AND ALTERNATIVE VISIONS FOR THE FUTURE

The following proposals, options, and alternative visions have been offered about the future of transportation.

Smart Growth and Other Development Options. Some people envision new land use arrangements as a means of reducing travel demand and at the same time promoting more "livable" communities. Smart growth and similar proposals usually envision more compact, denser residential areas, perhaps mixed with other land uses linked to public transportation. The trends discussed above suggest that Americans will continue to greatly value quality-of-life issues—space, crime avoidance, education, and personal mobility. Certainly these things can be compatible with smart growth, but I suspect that "in-fill" will occur more in regions between major metropolitan areas than within them as employment shifts (with the aid of information technology) to small- and medium-sized metropolitan areas and rural areas. These areas can often accommodate growth with the existing infrastructure or offer a more hospitable environment for infrastructure expansion.

We can and should do a much better job of designing our communities by giving more emphasis and attention to aesthetics, environmental compatibility, and the community impact of roadways. How to implement these improvements is not so clear. The Portland urban growth boundary, for example, has promoted in-fill, increased density, and reduced land consumption. Apparently, as one would expect, it has also increased housing prices and reduced low-end housing availability. Also predictable is the difficulty in determining when and how to extend the boundary as the metropolitan area population increases. Without a market mechanism in place to make adjustments automatically, changes are dependent on regulatory change, which can be politically contentious and erratic.

High-Speed Trains and Maglev. Proposals for new high-speed trains (such as the French TGV or Japanese bullet trains) and magnetically levitated (Maglev) systems in the United States have been advanced many times over the past 15 years. The development of extensive networks of such systems faces significant barriers including the following:

- Dispersed travel patterns.
- A mature air system already providing premium common carrier service.
- Cost—can we afford another network even if it is superior to existing highway and air networks?
- NIMBY ("not in my backyard") is not mode specific. Any transportation system that requires new rights-of-way or that will operate near existing communities will face local opposition.

Yet public interest in high-speed trains and Maglev systems remains strong. When a special Transportation Research Board (TRB) committee looked at this topic, it suggested that selected new rail lines that are integrated with the air system would be more promising than extensive high-speed rail or Maglev networks.[24] Lines in corridors with high air traffic volumes, such as San Francisco to Los Angeles, might be used in lieu of added airport capacity. But these projects would require unprecedented intermodal and public–private partnerships, which pose significant hurdles.

A more promising idea endorsed by the committee is "incremental" passenger rail service using existing tracks with tilt trains, electrification, and selected alignment improvements. We have already seen the application of this less costly approach for high-speed rail service in the Northeast corridor.

Privatization and Outsourcing. Some analysts argue that we will get added highway capacity by privatizing the highways and more transit service by privatizing public transportation agencies.

For highways, increased outsourcing and innovative procurement for construction and maintenance services that transfer risk to the private sector are likely and may be inevitable, given the limits on public agency employment and salaries and the push for greater cost effectiveness. Consolidation in the construction industry would facilitate this shift because larger firms are more likely to embrace innovation for competitive advantage. They have the resources for research and for accepting the added risk of warranties and design-build approaches. But true privatization is unlikely; it requires firms that can adjust supply and prices in response to demand. In the case of highways, government is unlikely (or unable) to relinquish control over decisions regarding capacity and how it impacts the environment and community.

For transit, the possibilities for privatization and a broader array of private sector services are more promising. Various European countries are reporting successful applications. In the United States, labor protections and the difficulty of changing established local institutions might limit creativity in establishing and designing new private sector services.

Intelligent Transportation Systems (ITS). For the past decade, a federally supported effort has been under way to accelerate the development and introduction of systems that use computer, information, and communications technologies to improve the performance of transportation systems. There are a variety of promising applications, two of which are described below.

- Advanced traffic control and management systems, built upon earlier computer-based traffic systems, seem promising in their ability to offer a steady stream of incremental improvements in highway service levels on congested urban roads.
- Real-time performance measurement and information dissemination provide drivers with accurate, real-time information through in-vehicle devices, Internet access, or variable message signs. With these technologies, drivers can stay informed about travel times (or speeds) and accidents. Over time, these devices may produce better informed, more demanding customers who are more supportive of public investments in operational improvements that deliver real benefit.

ITS improvements that can be implemented unilaterally by the private sector are more likely to see widespread use. Many promising applications will require strong, continuing commitments from local governments, which unfortunately are often unable to provide the resources necessary to maintain and operate existing systems. Until such funding commitments are made and local and state governments within the same region can cooperate with seamless systems, it will be difficult to realize the full potential of ITS.

Road Pricing. Under various names such as congestion pricing and value pricing, charging motorists variable fees to use highways based on the level of demand or congestion has been advocated by some economists since the 1920s. More recently, it has been embraced by environmental organizations and policy analysts who see it as an effective way of dealing with congestion. A special TRB study committee concluded that road pricing is technically feasible and could produce net benefits to society, but implementation would require that a complex set of institutional issues be addressed, and even then it would face uncertain political feasibility.[25]

In addition to likely public resistance, institutional and political issues include the details of scope (limited access roadways only, all primary arterials, etc.), collection methods, price-setting algorithms, allowable uses of the revenues collected, and equity across income groups. As a first step in implementing road pricing, the TRB committee supported HOT (high-occupancy and toll) lane experiments such as on State Route 91 in Southern California in which single-occupant vehicles pay variable congestion-based tolls to use high-occupancy lanes.

New Automobile Technology. For the past 30 years, the United States has relied heavily on cleaner engine technology, driven by more stringent regulations to reduce or limit air pollutants. The record has been remarkable as demonstrated by the changes in tons emitted by all sources between 1970 and 1997.[5]

- Nitrogen dioxides: +9%
- Volatile organic compounds: −38%
- Carbon monoxide: −36%
- PM-10: −32%
- Lead: −98%

Nonetheless, more must be done as the increases in traffic growth threaten to overwhelm the gains made through cleaner internal combustion engines. This, in fact, has already happened with fuel consumption. Between 1970 and 1996, average fuel economy increased from 13.5 to 21.3 mpg, respectively, but total fuel consumption for motor vehicles increased 59%.[5] And carbon dioxide emissions, which are linked to global warming, are directly tied to the amount of petroleum fuel burned.

Given the trends discussed above, the most promising way to deal with emissions, including carbon dioxide, still appears to be through the continued evolution of automotive engine technology. Hybrid engines, new battery technology, and hopefully fuel cell technology in the not-too-distant future are all promising. Missing, however, are strong economic or regulatory incentives for the automobile companies to aggressively pursue development and for consumers to purchase the cleaner, more fuel-efficient vehicles.

CONCLUSION

These trends and proposals suggest a future America with a larger, more dispersed population that continues to rely heavily on motor vehicles for transportation. The largest metropolitan areas will continue to grow, but small- and medium-sized cities will also grow and attract service industries. In addition to perceived lifestyle advantages, smaller cities often have underused highway capacity and a greater willingness to increase it if necessary. Information technology will facilitate these trends and will allow people to make other lifestyle adjustments that—along with ITS, creative public transportation services, and modest increases in physical capacity—will help Americans adapt to the choices available without gridlock levels of traffic congestion. "Incremental" high-speed passenger rail will be introduced in selected intercity corridors. As in the past, the nation will rely principally on new automotive technology to address emissions, greenhouse gas, and energy concerns unless a crisis arises and leads to new public policy. More consolidation will occur in private-sector transportation companies, and public agencies will outsource more of their work to the private sector.

REFERENCES AND NOTES

[1] Drezen, R., "A Dot-Com World," *The Washington Post* (17 May 2000). Reporting figures from Forrester Research.

[2] Hayes, D., "E-Commerce and Transportation: A Win-Win Partnership," Presentation to the TRB Executive Committee (Jun 2000). Citing figures developed by Forrester Research.

[3] Pisarski, A., *Commuting in America II*, Eno Foundation, Landsdowne, VA (1996).

[4] Pisarski, A., Presentation to Reason Foundation Seminar, Washington, DC (Oct 1999).

[5] U.S. Census Bureau, *Statistical Abstract of the United States*, Washington, DC (1999).

[6] Bureau of Transportation Statistics, *Transportation in the United States: A Review*, Washington, DC (1997).

[7] "Americans Are Less on the Move," *The Washington Post* (4 Dec 1997). Reporting on U.S. Census report, *Geographical Mobility* (Mar 1995 to Mar 1996).

[8] American Public Transportation Association, *Public Transportation Fact Book*, Washington, DC (Mar 2000).

[9] Larson, P., and Spraggins, H., "The American Railroad Industry: Twenty Years After Staggers," *Transp. Q.* **54**(2), 31–46 (2000).

[10] Korman, R., "Another Day, Another Big Deal," *Engineering News-Record* (15 Nov 1999). Reporting figures from Mergerstat, a division of Houlihan, Lokey, Howard, and Zirkin.

[11] Towe, M., Presentation at Texas Transportation Institute 50th Anniversary Conf. (May 2000). Citing figures from Warburg, Dillon, Reed.

[12] Gwilliam, K., Presentation at the World Bank Symposium, Washington, DC (17 Dec 1998).

[13] Lautsch, S., "Reorganization of U.S. Railway Systems," in *Proc. 5th Regular Conf., Int. Federation of Port Cargo Distributors* (Oct 1999).

[14] Transportation Research Board, *Entry and Competition in the U.S. Airline: Issues and Opportunities*, Special Report 255, Washington, DC (1999).

[15] Lockwood, S., *Factors Affecting the Future of State DOTs As Institutions*, National Cooperative Highway Research Program, Report for Project 8-36 (2000).

[16] Wachs, M., Presentation to Transportation Research Board F-SHRP Committee (Jun 2000). Citing California Revenue Study.

[17] Kessler, G., "Despite the Price, Gasoline Is Still a Bargain," *The Washington Post* (27 May 2000). Citing data from Cambridge Energy Research Associates, DOE, and American Petroleum Institute.

[18] Bureau of Transportation Statistics, *National Transportation Statistics, 1999*, Washington, DC (1999).

[19] Shrank, D., and Lomax, T., *Urban Mobility Studies*, Texas Transportation Institute, College Station, TX, available at http://mobility.tamu.edu (accessed 20 Jul 2000).

[20] Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC (May 1997).

[21] Association of American Railroads, *Railroad Facts*, Washington, DC (1998).

[22] Transportation Research Board, *Highway Capacity Manual*, Special Report 209; 1985, 1994, and 2000 edition (pending), Washington, DC.

[23] Commuter Transportation Services, Inc., *State of the Commute*, Los Angeles, CA (1994) (see also Giuliano et al., *Impacts of the Northridge Earthquake on Transit and Highway Use*, Bureau of Transportation Statistics, Washington, DC, 1996).

[24] Transportation Research Board, *In Pursuit of Speed: New Options for Intercity Passenger Transportation*, Special Report 233, Washington, DC (1991).

[25] Transportation Research Board and Commission on Behavioral and Social Sciences and Education, *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion*, Special Report 242, Vol. 1, Washington, DC (1994).