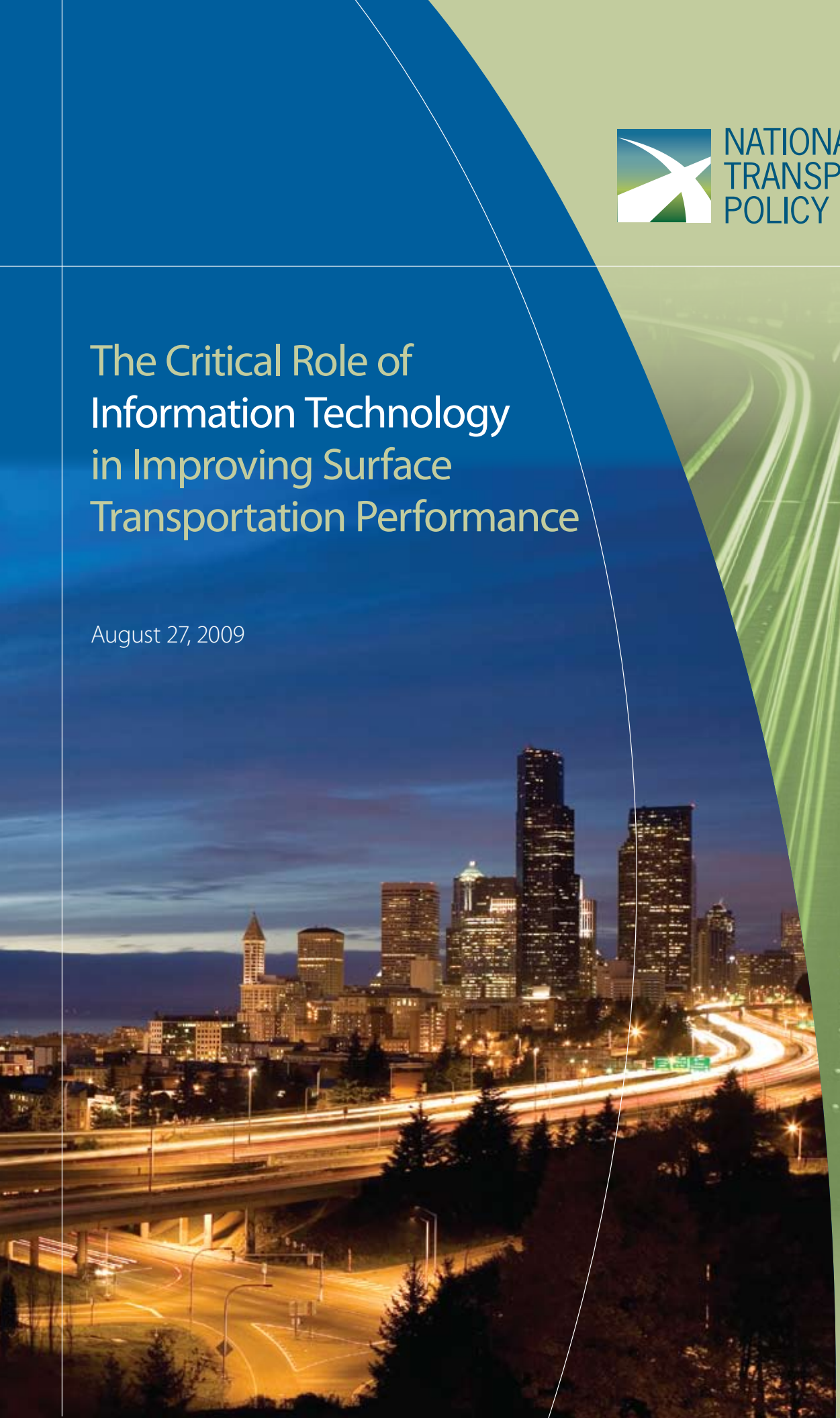
NATIONAL TRANSPORTATION POLICY PROJECT

The Critical Role of Information Technology in Improving Surface Transportation Performance

August 27, 2009



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The Critical Role of Information Technology in Improving Surface Transportation Performance

August 27, 2009

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This paper was prepared by a consultant to the Bipartisan Policy Center's National Transportation Policy Project (NTPP). It was meant to inform the work of NTPP in the production of their report "Performance Driven: A New Vision for U.S. Transportation Policy", which was released June 9, 2009. The opinions and recommendations in this paper are those of the consultant alone, and not of the members of NTPP.

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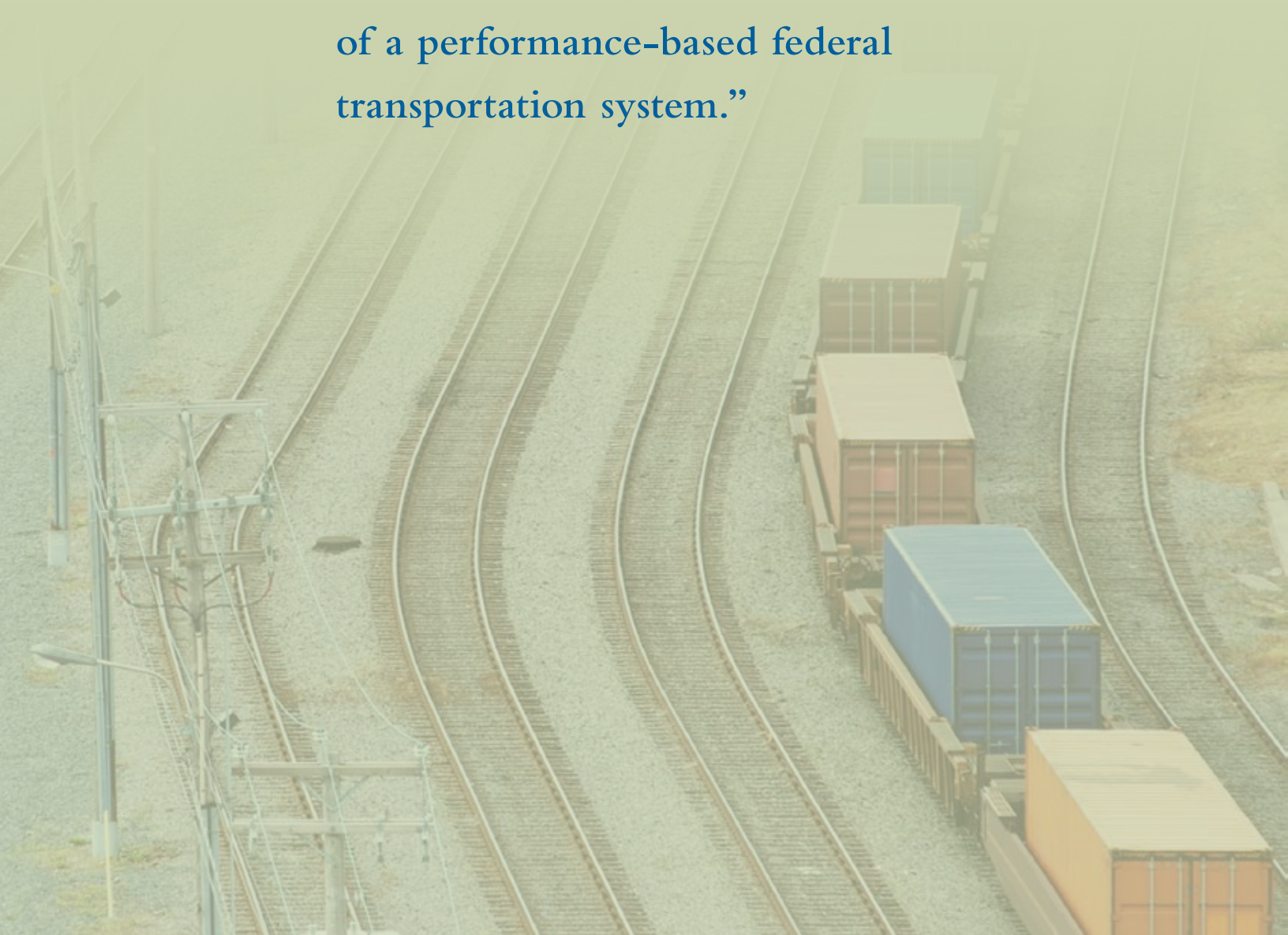


The Critical Role of Information Technology in Improving Surface Transportation Performance

Executive Summary

Purpose of Research

This research outlines the potential of Information Technology (IT) and Intelligent Transportation Systems (ITS) to enhance the monitoring and performance of the surface transportation system. The paper reviews trends and accomplishments of the federal ITS program and then considers the need to accelerate IT and ITS-related innovations in the context of a performance-based system. This acceleration would result in better IT-based performance information that can assist regions, states and localities in devising innovative programs with demonstrable impacts across a range of performance areas, such as access/mobility, safety, economic productivity and environmental impacts.

Findings

- In the last fifteen years of public ITS expenditures, there have been a range of accomplishments in achieving positive traffic management impacts.
- While the ITS program has become integrated as a funded element in the federal aid program, the overall pace of deployment has been modest with less than half (40%) of urban freeways and only 6% of urban arterials being instrumented.
- Given the relative lag in the use of IT to improve transportation system performance and innovation, there is a need for a more sustained focus to accelerate this use, including leveraging private sector innovations and resources.
- Federal policy should facilitate moving towards a systems intelligence capability that facilitates high performance transportation projects and the use of IT and ITS to achieve this high performance.

Policy Implications

Three ideas for federal policy action are outlined for accelerating the use of IT and ITS to help enhance surface transportation performance.

- Develop a credible IT-based system for assessing performance at the state, regional and national level through a function such as National Surface Transportation Performance Monitoring Service.
- Accelerate public and private innovation in IT implementation through the establishment of a Surface Transportation Technology Innovation Foundation, focusing on metropolitan, rural connectivity and consumer-centric innovations.
- Restructure the highly fragmented federal transportation research program to better focus on performance needs and gaps, such as through the creation of Centers of Excellence In Transportation Performance R&D.

"The level of innovation and change in transportation is comparatively low in contrast to other industries."

Introduction

When the Interstate Highway System was initiated during the Eisenhower era, the world was a technologically simpler place. Windows were what you opened to let the summer breeze through. In-vehicle technology consisted mainly of a radio and, if you were lucky, electric windows.

Since that time, the demands of the surface transportation system have increased dramatically. Vehicle miles traveled have risen exponentially, metropolitan congestion has become a major impediment to regional productivity and environmental degradation (including climate change) is now an undeniable force that will affect all sectors of society.

The upcoming transportation authorization provides a timely opportunity to conduct a strategic assessment of existing and emerging transportation issues. NTPP joins a cadre of enterprises that are focusing on policy, programmatic and funding challenges. All these efforts seek to enhance the productivity of the transportation sector in the economy, while addressing a range of fiscal, social, environmental and related systems issues. In this spirit, the goal of NTPP is "to encourage and support the development of a new national transportation policy direction that reflects the nation's values and social and economic vision of the future." [1]

While there is a cacophony of voices about future directions, one dimension that has been generally understated is the role that IT can play in improving the performance of the system. This point has been raised by former NTPP co-chair Mark Warner and NTPP's report provides a vision for a national transportation policy that could potentially foster greater and better use of IT.

Information technology has transformed almost all aspects of business and society, but transportation continues to be left behind. At the end of the 20th century, massive investments were made in information technology and services. On the business front, enterprise IT systems are employed to manage complex worldwide supply chains, bringing globalization to just about every corner of the US. While these systems require complex coordination, they are easily understood and used by consumers and businesses. Office workers can get the status of a FedEx package with a click of a mouse. The most sophisticated of users, teenagers, can leverage various aspects of the Web 2.0 environments to create vibrant social networks.

Somehow the realm of this technology revolution has not taken hold in transportation. Somewhat pejoratively, one IT expert recently referred to the surface transportation sector as a relatively "dumb" sector of the economy—referring to its low use of IT. To be sure, there have been noteworthy initiatives such as the federal effort in ITS. And federal policy pours about a half-billion dollars a year into highway research, testing and deployment support. Yet, as this paper indicates, the level of innovation and change seems to be comparatively low in contrast to other industries, precisely at a time when several factors are combining to place a premium on innovation in the transportation sector.

The time is right to craft a set of policy actions that can accelerate surface transportation performance enhancements through IT. This acceleration can build on the current generation of activities, but not in an incremental fashion. Rather the challenges of the system require a more transformative approach. To do that, the source of innovation needs to move away from public sector procurement and management and toward private sector innovation in service to system goals. That is, this "second generation of IT(S)" must build on the successes of a first generation, but with an eye on the organizational structures needed to ignite widespread utilization in surface transportation.

1 National Transportation Policy Project. "Commentary on the Report of the National Surface Transportation Policy and Revenue Study Commission." February 28, 2008. Washington, DC.

"Near-term ITS improvements have, to date, made modest but cost-effective impacts on transportation operations and services."

The S-Curve of ITS

It is hard to separate the progress of transportation from technological change. The advent of the steam-engine locomotive led to a transcontinental rail system that fueled the development of the US, particularly the western regions. And, of course, the advent of the automobile has played a pivotal role in contemporary transportation—and its problems.

The focus of this paper is on a select class of innovations, namely information technology (IT). Essentially, this paper addresses what the information revolution has meant for surface transportation and what role could it could play in fostering much needed performance improvements.

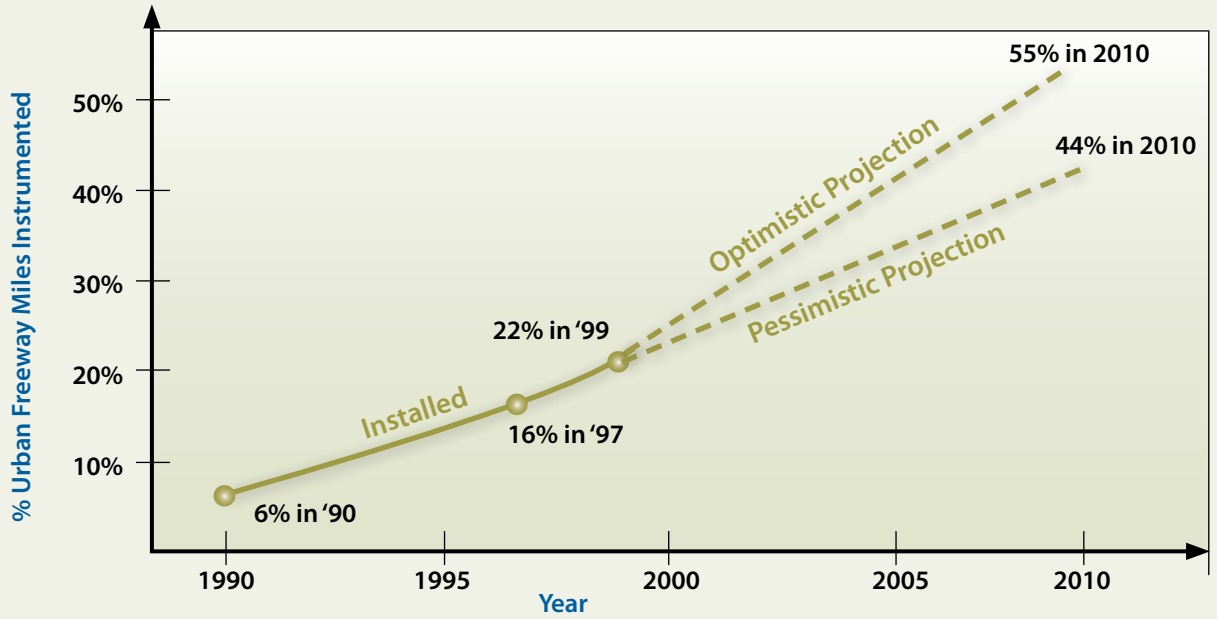
Within surface transportation, this class of technologies has been folded, from a public sector perspective, into the Intelligent Transportation Systems (ITS) program. Having said that, perhaps of greater importance are the technological developments that have occurred in the private sector concurrent to this program. As will be discussed below, a challenge moving forward is aligning limited public sector resources in a manner that best capitalizes on innovations (and capital) in the private sector.

First Part of the S-Curve

In the last fifteen years of public ITS expenditures, there have been a range of accomplishments in facilitating IT implementation to assist with traffic management. In this regard, the program has become integrated as an eligible element in the federal highway program. Most metropolitan regions have IT enabled traffic management and well as basic traffic and transit information.[2] The ambitious goal of the then Secretary Pena to fully equip major

2 U.S. Department of Transportation. "ITS Deployment Statistics Database." November 2008. http://www.itsdeployment.its.dot.gov.

Figure 1: Rate of ITS/Instrumentation Deployment



Source: Tarnoff, 2009

metropolitan areas has, however, not been reached.[3] According to the U.S. Department of Transportation, the top 105 major metropolitan areas have achieved approximately 25-35% of the full ITS capacity.[4] As shown in Table 1, this includes significant coverage of urban freeways, but much less so with regard to arterial management. In terms of overall national impact, out of approximately 160,000 freeway miles, only some 6-8% are fully instrumented, according to transportation experts.[5]

This pace has been described as "incremental" by some and "glacial" by others.[6] At best, given ongoing funding constraints, the growth remains at 2-3% per year, well below the threshold for significant impact (see Figure 1). Aside from the public ITS infrastructure, there have been ITS-related implementations in congestion pricing, commercial vehicle operations, emergency response and the like. These have been more limited in terms of pubic sector investments, but there is considerable and separate private sector investment in these areas.

There have been many worthwhile investments in ITS. In general, ITS has usually proven to be an integral and cost-effective tool in the management of transportation systems. When the federal program was started in 1991, few could have fully predicted the pronounced impact that IT would have on infrastructure services.[7] There is now an abundance of evidence about various significant impacts of ITS (see Table 1). This includes deployment of integrated corridor management programs such as the I-95 coalition, congestion pricing implementations such as in Orange County, California, and online traveler information services such as in Seattle, Washington.[8] Numerous reviews have been conducted at the project level, and the findings are consistent: near-term ITS improvements have, to date, made modest but cost-effective impacts on transportation operations and services[9].

The NaviGAtor system in Atlanta provides an illustration of ITS impacts. This system covers 140 freeway miles in the Atlanta metropolitan area, and includes a traffic management center (TMC), freeway management components, advanced traveler information systems and an incident management program. TMC operators use vehicle detectors, closed circuit television cameras, dynamic message signs and ramp meters to collect traffic data and manage incidents. When TMC operators identify an incident, they dispatch a crew to provide motorist assistance or traffic control. The program also disseminates traveler information through dynamic message signs, their project website and a telephone information service.[10]

A systematic evaluation of NaviGAtor was conducted in 2006,[11] which found that the program resulted in an average 46-minute reduction in incident duration time and reduced incident delay by 7.25 million vehicle-hours. Safety benefits in the NaviGAtor coverage area included a 69 percent reduction in secondary crashes. Researchers estimated that the secondary crash rate was reduced from 676 to 210 crashes annually. In comparing these benefits to the program costs, the evaluators found a 4.1 to 1 benefit-to-cost ratio.[12]

3 Mudge, R. "Using Technology to Manage and Operate 21st Century Transportation Systems." August 2004. NCHPR Project 20-24 (33)B, Transportation Research Board, Washington, DC.

4 U.S. Department of Transportation. 2008.

5 Delcan Corporation and Cisco Systems. "Vehicle Infrastructure Integration Business Model." Submitted to U.S. Department of Transportation May 2, 2008.

6 Tarnoff, P. "Blue Sky Thinking", *Thinking Highways*, Vol 4. No. 1, pp. 34-38, 2009.

7 Zimmerman, R. and Horan, T. "Digital Infrastructure: Enabling Civil and Environmental Systems Through Information Technology." EDS. London: Routledge Press, 2004.

8 U.S. Department of Transportation. 2008.

9 For example, see chapters and reviews in Gillen. D. and Levinson, D., *Assessing the Benefits and Costs of Intelligent Transportation Systems*, Kluwer Academic Publishers 2004.

10 U.S. Department of Transportation. 2008.

11 Guin, A., et al. "Benefits Analysis for the Georgia Department of Transportation, NaviGAtor Program: Final Report." Prepared by URS Corporation for the Georgia DOT August 2006.

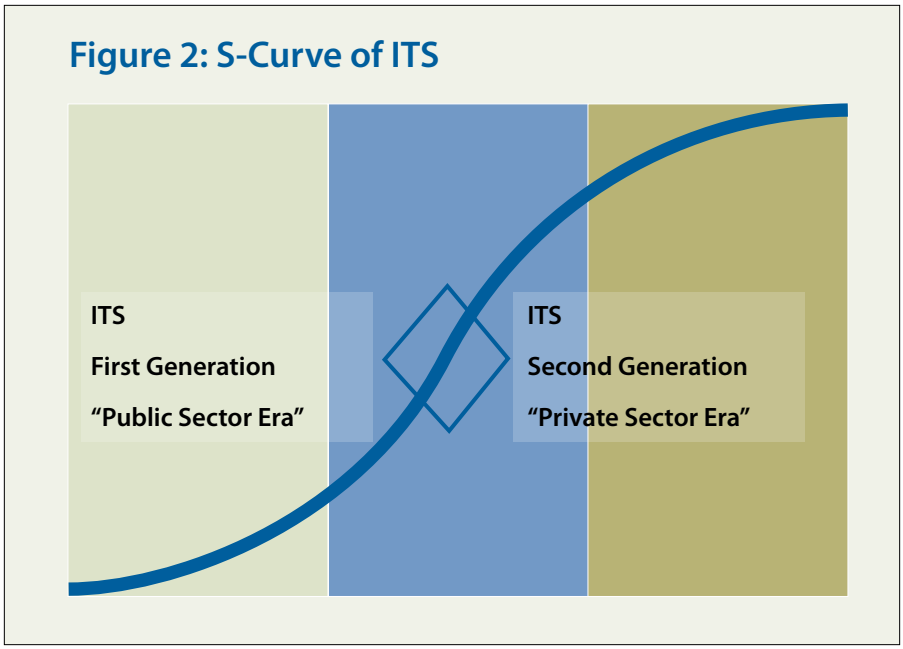
12 Guin, A., et al. 2006.

Table 1: ITS Deployment in Top Metropolitan Areas

National Summary (100 metropolitan areas surveyed)			
Freeway Management	**Reported**	**Total**	**Percent**
Miles under electronic surveillance	7,589	19,370	39%
Ramps controlled by ramp meter	4,197	26,336	16%
Miles under lane control	1,119	19,370	6%
Number of Dynamic Message Signs (DMS)	3,359	N/A**	N/A**
Miles covered by Highway Advisory Radio (HAR)	3,727	19,370	19%
Incident Management			
Freeway miles under incident detection algorithms	2,835	19,370	15%
Freeway miles under free cell phone call to a dedicated number	5,486	19,370	28%
Freeway miles covered by surveillance cameras (CCTV)	6,884	19,370	36%
Freeway miles covered by service patrols	8,057	19,370	42%
Arterial miles under incident detection algorithms	1,297	103,619	1%
Arterial miles under free cell phone call to a dedicated number	4,460	103,619	4%
Arterial miles covered by surveillance cameras (CCTV)	5,863	103,619	6%
Arterial miles covered by service patrols	14,534	103,619	14%
Arterial Management			
Signalized intersections covered by electronic surveillance	48,196	137,320	35%
Signalized intersections under centralized or closed loop control	72,255	137,320	53%
Number of Dynamic Message Signs (DMS)	1,104	N/A**	N/A**
Arterial miles covered by Highway Advisory Radio (HAR)	3,025	103,619	3%
Electronic Toll Collection			
Toll collection plazas with Electronic Toll Collection capabilities	590	612	96%
Toll collection lanes with Electronic Toll Collection capabilities	3,501	4,113	85%
Transit Management			
Fixed route buses equipped with Automatic Vehicle Location (AVL)	26,381	43,233	61%
Fixed route buses with electronic real-time monitoring of system components	14,543	43,233	34%
Demand responsive vehicles that operate under Computer Aided Dispatch (CAD)	6,844	10,938	63%
Bus stops with electronic display of dynamic traveler information to the public	1,893	491,695	0%
Electronic Fare Payment			
Fixed route buses equipped with Magnetic Stripe Readers	29,876	43,233	69%
Fixed route buses equipped with Smart Card Readers	14,183	43,233	33%
Rail Stations equipped with Magnetic Stripe Readers	994	2,497	40%
Rail Stations equipped with Smart Card Readers	601	2,497	24%
Highway Rail Intersections			
Highway rail intersections under electronic surveillance	490	12,028	4%
Emergency Management			
Vehicles under Computer Aided Dispatch (CAD)	89,037	111,493	80%
Vehicles equipped with on-board navigation capabilities	28,399	111,493	25%

*NR=No Response, **N/A=Not Applicable

Source: U.S. Department of Transportation, 2008.



Results such as the NaviGAtor program demonstrate that systematic implementation of ITS can produce cost-effective results. Indeed, looking over the experience of the public sector ITS program since ISTEA, one could conclude that noteworthy strides have been made to facilitate the use of federal-aid highway for deploying IT for use in managing metropolitan operations. Still, given the lag in terms of both full deployment in major metropolitan areas as well as in terms of national coverage, more remains to be done—and done in an accelerated manner—given the nation's transportation problems.

Perhaps the best way to think of the current state of IT in surface transportation is that it has gone through a long first phase of adoption—the lower part of the technology "S-curve" (see Figure 2). This first phase has been characterized by public procurement of traffic operations ITS, targeting implementation of electronic toll technologies and more limited implementation of ITS in other areas. As illustrated above, the cornerstone of this success has been the development of transportation operations centers. Most major metropolitan areas now have some form of a transportation operations center thanks to federal support, initially through a dedicated program and subsequently through eligible federal aid funds. There have been fewer demonstrable gains in the dynamic traffic information and guidance aspects of ITS. Despite widespread expectations for real-time traffic information available to the consumer, only recently have these systems come online and they are still not widely used. One lesson from these systems is that the public sector may not be nimble enough to adapt to evolving customer demands. Indeed, recognition of this limitation is perhaps necessary condition for arriving at the inflection point of the technology adoption S-curve.

Inflection in the S-Curve

Since the onset of the ITS program, there has been the hope that public sector investment would leverage private sector participation. At first this was viewed as occurring via tightly bound forms of public-private partnerships. Rather than the originally conceived notion of joint-ventures (which often disassembled into standard procurements), what has emerged is a rather promising slate of consumer related products on the transportation information side and emerging markets in traffic information/vehicle guidance, pricing, logistics and safety arenas.

In terms of the "traditional" players, the OnStar service is worth noting. The service is now available on most GM vehicles and has over 5 million subscribers. It continues to roll out new services that combine safety, navigation, and most recently, vehicle diagnostics. But the fastest

growing segment of the marketplace is "aftermarket" navigation, through a variety of vendors (Garmin, TomTom, Dash, etc.). These devices provide up-to-date route guidance information, and most recently, traffic information. It is a noteworthy point that consumer demand for traffic information in these devices has led to the rise of innovative traffic sensing services, such as INRIX and Traffic.com. These services provide a wider range of congestion information than typically available through public sector resources. As a demonstration of this value (and moving farther up the S-curve), the I-95 Corridor contracted with a private service for provision of traffic congestion data, representing a sign of this changing era of public versus private sector roles in ITS and related IT provision.

Toward Broad Adoption

The ITS industry is evolving to connect with this broader marketplace, thus moving beyond early adopters. One hybrid attempt is the teaming of Microsoft with Ford in rolling out the "Sync" service. Sync is an in-vehicle information hub that not only integrates mobile phones, texting and MP3 players, but also allows for traffic congestion monitoring and navigational services. Developed with the 57 million generation "Y" users in mind, such a system appropriately locates ITS services within the broader array of mobile services.[13]

Another example of this evolution is the Nokia geo-locational products, which bring the power of location-based services to the consumer, including traffic conditions, travel modes and safety information. Location-based services are a new brand of mobile internet services that provide a detailed geographical stamp to the data being provided[14]. In a forward-looking move, the U.S. Department of Transportation recently announced a major demonstration in San Francisco, which will utilize the 10,000 Nokia phones to act as traffic probes while providing enhanced vehicle services.[15] And in a similar vein, the U.S. DOT's Urban Partnership Agreements (UPA) included technology components that leveraged off of private sector innovations, such as Best Buy's "Results Only Work Environment" telecommuting program. The UPA program also pushed strongly for congestion pricing, which relies heavily on automatic tolling technologies. What connects these federal actions is an explicit recognition that widespread system impact is strongly tied to achieving value in the consumer market place and that the private sector involvement is by definition critical to achieving this goal. There are lessons for public sector agencies as well—create a demonstrable demand for high-quality system information and that will unleash the creative powers of the private sector to meet such demand.

Peter Drucker once said, "I don't predict the future, I merely look out the window and see where the future is happening today".[16] In this spirit, what we see in the above are examples of a future where there are private sector driven innovations to deliver system and performance information to consumers and public organizations. The question then becomes what can or should federal, state and local governments do to enable this future in a manner that improves system performance?

13 E. Piotrowski, "How Ford Sync Works", http://auto.howstuffworks.com/ford-sync.htm

14 B. Rao and L. Minakakis, "Evolution of mobile location-based services," *Communications of the ACM*, vol. 46, pp. 61-65, 2003

15 U.S. Department of Transportation. 2008.

16 Drucker, P. "Drucker on the Future". Spring 2002. The CGU Flame, p 13.

"It is essential that there be a much stronger link between research and development, and system performance innovation."

Performance as a Technology Driver

There is a two-fold answer to this question. First, federal policy must clearly specify that recipients of transportation trust funds demonstrate performance in line with national goals, as recommended by the NTPP. Second, federal policy should accelerate R&D efforts to develop IT services and products that enhance performance of systems and users of those systems. The first creates organizational customers for IT delivered performance information; the second drives continued innovation while riding the broader wave of enhancing citizen experience of and engagement with high performance transportation systems.

Fostering Institutional Demand for System Performance Information

The first part of this answer considers performance of the overall infrastructure and the role that IT can play in monitoring and enhancing this performance. Transportation needs transparent processes for understanding how well the system is performing on a relative basis. On a local level this can be used to devise innovative solutions for overcoming regularly occurring spikes in systems, such as during holiday periods. Given the significant resources invested at all levels of government, it should not be so hard to answer the questions: How is the system performing today compared to this day last year? How utilized are the various modes? How satisfied are businesses and travelers with their travel experiences? How safe are the roadways? What is the carbon footprint of transportation services?

In this vein, it is not surprising that a recent GAO report[17] focusing on the performance issue came to the following conclusion:

> *Data collection is a key tool to give policymakers information on how the transportation system is functioning. Data on the system and its individual facilities and modes are useful in their own right for decision making, but are also essential to enable other effective approaches, such as linking grant disbursements to grantees' performance. As discussed previously, DOT does not have complete data in some crucial areas; the effective use of data in safety programs, despite problems, demonstrates the potential of more comprehensive data gathering to improve evaluations and induce improved performance in the surface transportation system. (p. 46)*

One limitation in the state transportation agencies' ability to monitor performance is the lack of timely information. In terms of traffic conditions, as noted above, there is instrumentation on a subset of the nation's freeway miles but much less so on arterials. There are no ready metrics that summarize across demand reducing activities such as transit usage, off–peak travel, value pricing usage and telecommuting. Furthermore, there are few institutional incentives to monitor system performance and little innovation in bringing these performance data into a visually based, interoperable and near-real time fashion.

As a consequence, the marketplace for performance information is limited and highly fragmented. In light of the increasing federal emphasis on demonstrating system performance, the status quo seems unacceptable. The issue then becomes how to change this in a manner that can leverage the power of information technology to deliver timely and high quality information. A strategy for this will be taken up below.

Of course, the role of technology is not just to monitor, but also to enhance the performance of the system

17 U.S. General Accounting Office. "Surface Transportation: Restructured Federal Approach Needed for More Focused, Performance-Based, and Sustainable Programs." March 6, 2008. Washington, DC. GAO-08-400.

across system objectives, including congestion, safety, economic productivity and environmental dimensions. To do that requires continued innovations in products and services. Federal R&D policy can play a key role in encouraging such innovation, but it must be properly channeled.

Encouraging R&D for Performance Improvement

Federal policy for transportation R&D is guided by the Research Title of Highway Trust Fund. The last authorization bill dramatically increased funding for research. Yet, despite the recent creation of the Research and Innovative Technology Agency (RITA), the federal research program is highly fragmented and without clear direction.[18] From a long term policy perspective, it is essential that there be a much stronger linkage between R&D and system performance innovation and enhancement, with a clear understanding of the role of private sector innovation in achieving these objectives in collaboration with the public sector.

Several policy reviews have cited the need to improvement in the federal R&D function. The Office of Management and Budget (OMB) lists transportation R&D as "Not Performing." OMB notes:[19]

> *The program has developed a coordinated strategic plan covering all Departmental RD&T and tied all RD&T resources to DOT strategic goals; however, the program has not set clear long-term goals and accompanying performance measures, annual objectives and measures that reflect an aggressive program direction, or established an independent program evaluation mechanism. … Some partnerships have been created in pursuit of multi-modal collaborative research; however, the program has not been able to provide a critical view of the Department's overall RD&T portfolio and how best to concentrate limited resources for maximum impact.*

In short, the research program needs significant restructuring. As it is currently organized, it represents a practice-based partnership between the myriad applied research entities and the state and local highway and transit properties. Within DOT, the ITS program is located in the Joint Program Office. This has enhanced the intermodality of its approach, but not necessarily its focus on fostering innovation. There is very little by way of scientific or technology innovation in the program. And, central to the theme of this paper, there is not a laser focus on innovations to enhance system performance across key metrics and with innovative mechanisms for utilizing the private sector in accomplishing this challenge. While several advisory and oversight committees have been created for both transportation research generally and ITS specifically, members of these entities readily admit the task of overcoming fragmentation in the current framework is considerable.

The ITS program does have noteworthy collaborations—such as the Intelligent Vehicle-Infrastructure initiative project involving Nokia (mentioned above). But those aspects relating to development of a nationwide highway short-range communications network will be challenged by the rapid communications developments in the cellular and related wireless industries, the latter being to source of tremendous innovation as noted in the above quotation relating to the Ford program. Still, the vehicle is becoming a major source of information and challenges remain regarding how to best arrange for that information in service to public sector goals.

18 U.S. General Accounting Office. "Transportation Research: Opportunities for Improving the Oversight of DOT's Research Programs and User Satisfaction with Transportation Statistics." August 2006. Washington, DC. GAO-06-917.

19 U.S. Office of Management and Budget. "Expect More, Program Assessment." 2008. The White House. http://www.whitehouse.gov/omb/expectmore/summary/10009006.2007.html

There is an arm's length relationship between the ITS program and innovative segments of the private sector. Despite early attention to public-private partnership, synergistic combinations of resources have been rare. Deployment contracting is rarely a source of innovation; limited state and local funds preclude much by way of experimentation. Yet the private sector is poised for growth. A recent market assessment found that: "World intelligent transportation systems market is forecast to maintain a high CAGR of 11.6% over 2000-2010 and reach US$12.5 billion in 2010. United States constitutes the largest market for intelligent transportation systems, with an estimated share of about 40% in 2007."[20]

A common theme of the R&D critiques is the need to link the research program to key objectives and transportation performance metrics, and that provides an important foundation for thinking about future research directions and organization. Such directions form the final section of this paper.

20 Global Industry Analysts, Intelligent Transportation Systems, San Jose, CA, May, 2008

"Separation of performance analysis from project promotion could be a pivotal decision in creating a program that directly addresses objective performance criteria."

Strategies for Linking Information Technology to Policy Priorities

There are three complementary federal policy ideas that should be pursued to foster innovative use of IT to achieve surface transportation goals. The first idea is to create a public marketplace for surface transportation performance information. The second idea is to create a means to foster private sector ITS innovation in service to public sector goals. And the third idea would create a targeted R&D function aimed at enhancing surface transportation performance through information technology, including ITS.

Idea 1: Build System Intelligence Capacity for Surface Transportation through Performance Monitoring Services

NTPP has placed a high priority on linking federal aid to performance and, as noted, IT is well suited to provide data on this performance. Similarly, the National Policy Commission found that:[21]

> *Given the fundamental importance of good performance data and modeling to all of the plans discussed in this report, the Commission recommends that an important goal for research under the National RD&T plan should be to improve the Nation's ability to measure project performance data, including research into improved traffic, safety, environmental, and energy modeling. (p. 32)*

But the Commission fell short in terms of specifying how that should be done. Performance measurement represents a major opportunity for private sector technological and service innovation, if we have a broader view of performance measurement. We should develop a Systems Intelligence function; much like the private sector utilizes Business Intelligence to guide their planning, business development and management.

Broadly speaking, Business Intelligence is an umbrella term for bringing together data on business performance with analytical capabilities to sort out strategic and tactical business options and decisions.[22] The techniques have been used to support strategic decision-making and investment for interests as diverse as Amazon.com to the Boston Red Sox.[23] A recent survey of technology trends by the Association of Government Accountants confirmed that Business Intelligence capability is considered the number one need among public managers.[24]

Within surface transportation, one way to accomplish this would be create something such as a National Surface Transportation Performance Service. This service would essentially shift the business of developing system performance data (e.g, traffic conditions) to the private sector and position the public sector transportation agencies as purchasers and consumers of these services. Following the general parameters of what Robert Atkinson has dubbed as "turbo-government," this approach would create performance information consumers throughout the U.S. and the service would be a competitive, private sector service for these consumers.[25]

This system would be structured as a service that would perform regional, state level and national level performance monitoring along critical dimensions. The service would be executed by the private sector under contract to federal DOT, state DOTs and others. Perhaps a limited set (e.g., three) of nationally approved competing services would be certified in order to instill competition and

21 National Surface Transportation Policy and Revenue Study Commission, Transportation for Tomorrow, January 2008. Washington, DC.

22 Davenport, T. "Competing on Analytics." January 2006. Harvard Business Review.

23 Davenport, 2006.

24 Association of Government Accountants. "Technology Forecast, 2007." 2007. Mt Vernon, VA.

25 Atkinson, R. "'Turbo Government': A Bold New Vision for E-government." 2006. Information Technology and Innovation Foundation. Washington, DC.

innovation in the development of performance measures the use of IT therein. There would be incentives in the use of federal-aid funds to encourage state usage of the systems, including discounts for data provision into the system.

A major rationale for creation of such a system is to leverage the economies of scale inherent in IT, as it is much more efficient to develop a national system with differing layers of granularity than it is to develop 50-100 separate systems, especially if that latter is under diverse public contracts. Moreover, this approach also recognizes and embraces the business trend in IT toward "service-oriented architectures" that stress the purchase of online services in lieu of developing multiple silo systems.

The mandate for this service would be clear: dramatically increase the availability of local and regional performance data available to localities throughout the nation, while at the same time reducing the overall costs (especially those borne by localities) to produce this data. Such an approach would build on the findings of a recent NCHRP study which found:[26]

> *Based on results from early system deployments and from simulation studies, it can be concluded that WLT (wireless location technology)-based traffic monitoring is a feasible approach to collecting traffic data on heavily traveled roadways. While the research team has concluded that this is feasible approach, it is important to note that there has yet to be a long-term, "production-level" deployment of this technology in the United States. (p.49)*

This strategy would build toward delivering such a production level deployment. Moreover, such performance databanks would set the stage for being able to conduct system level analyses and alternative investments in transportation projects. This capacity would increase the credibility of proposed projects via a third party assessment and, in a related manner, provide decision-makers with defendable data upon which to make decisions. This separation of performance analysis from project promotion could very well be a pivotal decision in creating a long-term transportation investment program that directly and steadfastly addresses objectified system performance criteria.

Idea 2: Accelerate Public and Private Innovation through a Federally-chartered "Intelligent Transportation Systems Foundation"

This strategy would shift aspects of the ITS Program and related programs into a public supported entity, "The ITS Foundation," which would be charged with fostering technological innovation in metropolitan and non-metropolitan areas. Unlike advisory functions such as ITS America, this entity would provide economies of scale to facilitate technological services and improvements at the local, state and regional level. This organization would shift the U.S. DOT ITS Office from staffing, testing and deployments to providing oversight into a public-private collaboration for encouraging deployments at the regional, state and national level. Specific deployment and innovation targets would be set in terms of market penetration and related innovation metrics. The charter would carry a sunset provision based on the ability of the foundation to achieve specific deployment targets with demonstrated ITS system performance results. While an argument could be made that such a function could be carried out within the DOT, the history of ITS suggests that systematic, performance-focused, locally and privately engaged deployments would best be executed through an entity that has effective IT(S) deployment as its sole

26 Smith, B. and Fountaine, M. "Private Sector Provision of Congestion Data." 2007. Transportation Research Board. Washington, DC. NCHRP 70-01.

mission with maximum latitude in forming partnerships to make it happen.

In terms of the substantive focus of the ITS Foundation, the following innovation areas provide a reasonable point of departure: Major Metropolitan, Rural Connectivity, and Consumer-Centric Innovations.

A national view of enhancing transportation system performance must begin with addressing serious system inefficiencies that confront the nation's cities. NTPP has clearly outlined the need for innovation in metropolitan areas. Related analysis shows that three metropolitan areas, Los Angeles, New York and Chicago account for a disproportionate total of total congestion.[27] These three markets represent major opportunities to develop next generation ITS systems and the federal government should funds available for innovative use in these markets. However, this commitment needs to be predicated on a concurrent engagement with localities and the private sector to participate in this drive toward innovation. Specific foundation activities and partnership agreements would solidify this commitment.

A second area would be rural and interconnectivity innovations. While congestion performance is a principal concern of metropolitan areas, rural areas are concerned with safety issues as most fatalities occur in rural areas. Moreover, a range of weather and other circumstances can affect the movement of goods through these regions of the US. However, many rural regions have very limited funds for technology. The foundation would facilitate multi-state cooperative agreements to procure ITS service improvements, such as interoperable, scalable crash notification and emergency response. For example, recent developments such as SafeRoadMaps suggests there is an opportunity to devise IT-based visual performance systems that can be used by states and rural regions to guide policies and innovations aimed at dramatically improving traffic safety "Toward Zero Deaths."[28]

A third area would focus on the user of transportation services. There is a general paucity of information on transportation consumers and a general lack of systematic testing of new approaches with users. Too often transportation performance metrics get translated into internally focused agency agendas. While system level information is important, it is equally important to stay connected with evolving transportation interests and demands of various segments of society.[29]

A significant aspect of this organization would be creation of means for engaging private sector vendors to play a significant role in outlining the nature and shape of the organization. In terms of the private sector, this would include consumer products companies, software companies, major IT service providers as well as automobile manufacturers and systems integrators. A case could be made, for example, to have the foundation located in three locations: East Coast (policy focus and performance services), Midwest (automotive focus), and West Coast (information technology focus). That is, it is essential that the composition and orientation of the foundation be 'beyond the beltway' into regions rich in technological innovation.

This organization would promote the function of creating a series of ITS service functions that use some form of 'web application services.' Such an approach is consistent with broader trends in government performance.

27 INRIX. "National Traffic Scorecard." June 2008. http://scorecard.inrix.com/scorecard.

28 Horan, T and Zietlow, S. "Rural Health, Safety and Emergency Response." October 7, 2008. Luncheon Presentation to the Toward Zero Deaths Annual Meeting. Rochester, MN.

29 Sussman, J. "Intelligent Transportation Systems in a Real-Time, Customer-Oriented Society." Summer 2008. The Bridge, Volume 38, Number 2.

As noted by IBM's Business of Government Center,[30] "market-based" government can be seen as:

> *…a body of tools and incentives that guide public action by embodying some of the beneficial characteristics inherent in private sector markets. These characteristics can be defined from two perspectives: inside and outside government. From the perspective of inside a government organization, these characteristics include competition, focused incentives, flexibility, and the use of contracts. From the outside perspective, the characteristics include voluntary entry/exit, choice, transparency, efficiency, responsiveness, and clearly defined and measurable objectives or services. (p.14)*

This second strategy provides the means for IT to have a transformative impact at the state, local and regional level drawing upon the considerable resources of the public sector with the innovative posture of the private sector. The ITS Foundation would become a force of transforming state and local entities to be consumers of high quality products and services and otherwise working the private sector interests to create economies of scale through pooled acquisition of services. In particular, it would help focus ITS on how to take advantage of the fact that the now ubiquitous cellular system and Internet are two major platforms that have had "game-changing" impacts on many industries and can significantly impact how ITS is deployed in the US. It would also have a consumer element charged with promoting understanding and adoption of consumer services consistent with transportation performance goals.

Idea 3: Create Centers of Excellence Focused on Transportation Performance R&D

There is a paramount need to better target federal research resources to achieve demonstrable innovations. The previous reauthorization bill dramatically increased research funding, but did so in a highly diffuse manner. There should be a set of major Centers of Excellence that combine the national talents in such a way to focus on developing innovations that improve system performance. Similar to the Science and Technology Centers operated by the National Science Foundation, these Centers of Excellence would develop the talents to achieve the above goals. Incentives would be provided for existing research centers to join in Centers of Excellence.

The section above outlined the current problems with the diffuse research infrastructure. This includes but is not limited to the 60 University Transportation Centers, almost all of which have been designated with very little coordination between themes. The creation of a very limited number of Centers of Excellence in Transportation R&D would aim to have the converse effect. Namely, the goal would be to create a highly vibrant ecosystem of innovation in surface transportation.

To appreciate the power of an innovation ecosystem, one can look toward Silicon Valley. Here major research universities (i.e. Stanford) have co-mingled with a strong talent pool, significant venture funding and an embedded professional and social network to create an incredibly powerful source of innovation and entrepreneurship.[31] While surface transportation may never rival the attractiveness of Google or Apple, it represents a significant part of the economy and much more can be done to build a critical mass of talent and solutions.

30 Abramson, Mark A., Breul, J. and Kamensky, J., "Six Trends Transforming Government." 2006. IBM center for The Business of Government. Washington, DC.

31 Saxenian, A.L. "Regional Advantage: Culture and Competition in Silicon Valley and Route 128 Cambridge." MA: Harvard University Press, 1994.

A step in this direction would be to establish major Research and Development Centers in each of the performance areas, such as Centers for Excellence in: 1) Transportation Mobility and Access R&D, 2) Transportation Safety R&D, 3) Environment R&D, 4) Transportation Productivity R&D. Moreover, as a means to reduce duplication across the multitude of University Transportation Centers (UTC), each UTC center could be encouraged to belong to at least one Center of Excellence and to execute part of the overall Center for Excellence research program.

As with the above strategies, metrics would be developed in terms of expected research performance including both traditional measures of research productivity, as well as metrics for commercialization and market acceptance.

"Information technology can provide performance systems in surface transportation, but to do so will require substantially new innovations throughout the country."

Conclusion

The National Transportation Policy Project (NTPP) has rightfully chosen to focus on performance as a key issue for the future of the surface transportation system. As noted by NTPP and other reports, performance metrics are fundamental to ensuring the best use of funds. As the National Policy Commission put it:[32]

> *In addition to putting more money into the system, we also must create a system where investment is subject to benefit-cost analysis and performance-based outcomes. We need a system that ensures each project is designed, approved, and completed quickly; one that provides a fully integrated mobility system that is the best in the world; one that emphasizes modal balance and mobility options; one that dramatically reduces fatalities and injuries; one that is environmentally sensitive and safe; one that minimizes use of our scarce energy resources; one that erases wasteful delays; one that supports just-in-time delivery; and one that allows economic development and output more significant than ever seen before in history. (p.2)*

But as NTPP Co-Chair Martin Sabo stated:[33]

> *We applaud the National Commission's support of a performance-based transportation system, though achieving it will be a great challenge. In order to develop such a system it is vital that we link measurement to funding decisions to ensure money is spent in an efficient and effective manner.*

The question then becomes, "How can you measure these metrics in areas such as congestion, safety, environment, productivity and so forth?" Throughout private sector industries, IT systems have been used to develop enterprise architectures that do precisely that, create executive performance systems. IT can provide such performance systems in surface transportation, but to do so will require substantially new IT innovations throughout the country.

Such an approach can be the tipping point for the transformation of IT and ITS in transportation from the incremental improvements achieved to the transformative impact that it can and should have. As shown in Figure 1, like any technology, there is an S-curve for IT/ITS adoption. Over the last decade and a half, there has been a movement from early adopters to increased market penetration. The question becomes what set of factors can interact to create a transformative impact on system performance. For some, initiatives such as the Vehicle-Infrastructure-Initiative represent such an approach. But rarely does a single government action result in triggering widespread adoption. Rather, the emphasis should be on creating a network of innovative activities and possibilities. As the saying goes, "innovation occurs on a crowded stage."

To return to the beginning, the incremental pace of technological innovation is not going to have the level of impact that is needed given the issues in surface transportation. Moving up the S-curve of technological usage requires a set of transformative policies aimed to reach a broad array of users with innovative approaches that offer system gains and economies of scale. As outlined above, these pivot points include creating strong federal requirements for local government to report performance (demand), while at the same time shifting the means of getting that data more squarely the private sector (supply). It also means creating a series of R&D innovations that will foster an ecosystem of technological innovation in transportation, something that is clearly missing. These activities will transform ITS and broader IT into something that is not just being 'promoted' by federal government but rather something that is occurring throughout government and industry and, in so doing, will have a widespread impact on transportation organizations and the travelers they serve.

32 National Surface Transportation Policy and Revenue Study Commission, Transportation for Tomorrow, January 2008. Washington, DC.

33 National Transportation Policy Project. "Commentary on the Report of the National Surface Transportation Policy and Revenue Study Commission." February 28, 2008. Washington, DC.

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