Symposium On

Challenges and Opportunities For Global Transportation In The 21st Century

Proceedings

U.S. Department of Transportation
Research and Special Programs Administration

Volpe National Transportation Systems Center
Transportation Strategic Planning and Analysis Office

Symposium On
Challenges and Opportunities For Global Transportation In The 21st Century

Cambridge, Massachusetts
October 26-27, 1995

Proceedings

U.S. Department of Transportation
Research and Special Programs Administration

Volpe National Transportation Systems Center
Transportation Strategic Planning and Analysis Office

Executive Summary

Transportation Leaders and Decisionmakers Convene

Over 200 transportation leaders and decisionmakers from around the nation convened in Cambridge, Massachusetts to attend a symposium sponsored by the U.S. DOT Research and Special Program Administration's Volpe National Transportation System Center. The October 26-27, 1995, symposium, entitled *Challenges and Opportunities for Global Transportation in the Twenty-first Century*, was an effort to support effective public and private sector policy decisions by focusing on the core issues that underlie several of the most challenging transportation topics now on the national agenda.

Overview of Major Issues

Many broad forces—some new, some long-standing—have created a world characterized by rising population, ongoing urbanization and the creation of "megacities" and sprawling suburbs. These trends are accompanied by rapidly growing levels of disposable income in many developing nations, ever-closer global economic links and interdependence, and emerging sensitivity to the effects of human activity on the local and global environment. One major result is that demand for both passenger and freight transportation at all distances—city center to international—will call for sustained expansion of overall system capacity at an unprecedented rate—a rate substantially greater than that characterizing the growth of population or economies. This expansion must be accomplished in a manner compatible with environmental concerns ranging from health implications of local air pollution to long-term adverse changes in the global climate. In addition, near-universal fiscal constraints on the public sector limit the options available to increase transportation system capacity at the rate necessary to support economic and quality of life goals, and to assure the level of mobility, access, safety and security the public demands.

Deputy Secretary, RSPA Administrator, Volpe Center Director, Kick-Off Symposium on Global Transportation Issues

> *"We're not going to meet tomorrow's challenges with yesterday's strategies, or the day before yesterday's analytical techniques. If we're going to develop new ways of thinking and doing we can't do it without investing in new analytical tools and new technologies."*
>
> ***The Honorable Mortimer L. Downey***
> *Deputy Secretary of the US Department of Transportation*

Deputy Secretary of the US Department of Transportation Mortimer L. Downey delivered the keynote opening address at the symposium. The Deputy Secretary painted a broad picture of some of the transportation challenges of the coming century: "We have a global economy where reasonable growth could help bring about political and economic stability for generations to come, but it's a world economy whose growth, also, could be choked off by inadequate transportation."

In opening the conference, RSPA Administrator, Dr. D.K. Sharma stated that, "The Federal Government has a major role to play

in providing leadership in research and technology by working in partnership with industry, state and local governments and academia." Dr. Sharma stated that leadership "will be needed on environmental issues as expanding populations and transportation demands place increasing stress on the world ecosystem. It will be needed to deal with safety and security issues. It will be needed in logistics and logistical systems as greater efficiency is required to meet increasing demands with limited resources. And it will be needed in business process design, investment, and financing as we need to find increasingly creative ways to pay for transportation improvements."

Dr. Richard R. John, Volpe Center Director, set the global tone for the event, "In planning this symposium and looking forward to the year 2020 . . . virtually every topic we considered involved global trends, concerns, and solutions." Dr. John continued, "In the next 25 years, the current world population of 5.7 billion people will increase to 8 billion. More than one-half of these people will be living in cities—many in megacities in the developing world...with populations exceeding 25 million. Along with increasing urbanization, the world is becoming motorized...The powerful combination of urbanization and motorization can have dramatic consequences in terms of air quality, transportation safety, and congestion."

Dr. Lester Thurow Delivers Rousing Address to Participants

Dr. Lester C. Thurow, MIT professor and best-selling author, painted a compelling picture of the major forces that are acting now and in the next few decades to affect both the world economy and the global transportation system. Thurow pointed out that the world's growth rate is slowing. Europe, with an economy one-half larger than that of the U.S., has created no net new jobs since 1970, compared to 38 million new American jobs in the same period. The Japanese economy, which until recently has led the world in sustained growth, has essentially been stagnant for the past five years. The Mexican economy recently went through a profound economic shock from which they are still in the process of recovering. Meanwhile, in the United States, gross domestic product has risen by about one-third in the past twenty years. Nearly all of this gain went to the top 25% of the population in income terms, and most of that was concentrated in the top 1%. As this was occurring, the bottom 60% of American workers lost 20% of their wage values in the same twenty year period.

"We have a global economy for the first time in human history where anything can be made anywhere and sold everywhere else on the face of the globe."

Dr. Lester C. Thurow
Jerome and Dorothy Lemelson Professor of Management and Economics, Sloan School of Management, Massachusetts Institute of Technology

---

Thurow discussed how major forces are causing sudden and rapid shifts in economic and political factors which are sufficiently significant to suggest that a revolutionary change in world conditions is now occurring. Five major factors discussed by Thurow include: (1) the collapse of Communism; (2) the shift of the basis of industry from natural resources to brainpower; (3) demographic trends; (4) the creation of a truly global economy; and (5) the absence of a dominating political, economic and military 'superpower' that can impose its will on the world.

Assistant to the President for Science and Technology Stresses Partnerships, Risk-Taking, and Innovation

> *"In this Administration's view, one of the most important roles of the Federal Government is to ensure that private investors have an incentive to take risks and invest in good ideas. This Administration has worked hard to create a pro-business environment."*
>
> ***The Honorable John H. Gibbons***
> *Assistant to the President for Science and Technology*

Dr. John H. Gibbons, Assistant to the President for Science and Technology emphasized transportation's significance to the nation and indeed the world, "The Clinton Administration came into office clearly understanding the enormous direct and indirect importance to the US economy, and the challenges it faces. Transportation issues have played a central role in the Administration's economic and technology policy....In this Administration's view, one of the most important roles of the Federal Government is to ensure that private investors have an incentive to take risks and invest in good new ideas. This Administration has worked hard to create a pro-investment business environment. For the first time since President Truman sat in the White House, we have cut the deficit for the third year in a row, freeing up capital for private investment. We've strengthened university-based research, created new and responsive technology programs to speed the path from laboratory bench to marketplace, opened up world trade, and reinvented existing Federal science and technology programs to make them work better and cost less," said Dr. Gibbons.

National Experts Steer Symposium Sessions

Day one of the symposium included three plenary sessions: Transportation in the Twenty-first Century: A Global Perspective; Contributions of the Emerging Global Transportation System to Environmental Pollution an Petroleum Consumption; and Ensuring a Safe and Secure Transportation System.

Day two of the event included six breakout sessions: Role of Information Technology in the Transportation Enterprise; Investment in the Global Transportation System in An Era of Limited Public Spending; Urban Transportation Trends in the Developed and Developing World: Where are we heading? What are other countries planning?; Outlook for Advanced Vehicle Technology and Reformulated/Alternative Fuels; Opportunities for Reducing Transportation Accidents and Fatalities; and Enhancing Transportation Security. This document provides a detailed summary of these sessions.

Future Volpe Center Events to Follow-up On Symposium

As follow-up to the symposium, the Volpe Center will be conducting a series of seminars on critical issues in transportation for the twenty-first century. The purpose of these meetings will be to examine key issues reflective of strategic change in the Department's operating environment. The Volpe Center will assemble key participants in selected areas to identify issues and trends, discuss emerging technological, financial, and institutional opportunities, and assess future directions. Six seminars will be held over the next year at the Volpe Center. Each seminar will provide in-depth focus on selected topics and educate policymakers on strategic change in the transportation enterprise and its operating environment.

Symposium on Challenges and Opportunities for Global Transportation in the 21st Century

Symposium Background

On October 26-27, 1995, transportation leaders and decisionmakers from around the nation convened in Cambridge, Massachusetts, to attend a symposium sponsored by the U.S. DOT Research and Special Programs Administration's Volpe National Transportation Systems Center. The symposium, entitled *Challenges and Opportunities in Global Transportation in the Twenty-first Century,* had three main objectives: to increase awareness and understanding of the enormous challenges facing the world transportation community; to explore potential technological and institutional responses available to meet changing needs; and to identify opportunities for development of new markets for U.S. transportation-related products and services.

The symposium was an effort to support effective public and private sector policy decisions by focusing on the core issues that underlie several of the most challenging transportation topics now on the national agenda. These issues included transportation in the newly developed and developing world, aviation safety and security, implications of rising motor vehicle use, and aging vehicle operators. Through discussion and interaction between participants and presenters, the symposium helped to develop a better understanding of the transportation challenges of the next century, and to promote collaborative solutions to these challenges. It allowed for participants to consider the progress that has been made in transportation over the past 25 years and to consider how the current political and physical limits will impact where we *can* as well as where we *want* to go. The symposium was one of several events held to commemorate the Volpe Center's twenty-fifth anniversary, and to reflect upon the Volpe Center's history and its contributions to the nation.

(l. to r.) Mr. Noah Rifkin, U.S. DOT Director of Technology Deployment, The Honorable Mortimer Downey, U.S. DOT Deputy Secretary, Dr. Richard R. John, Volpe Center Director, and Dr. D.K. Sharma, RSPA Administrator.

Future Volpe Center Events to Follow-up On Symposium

As follow-up to the symposium, the Volpe Center will be conducting a series of seminars on critical issues in transportation for the twenty-first century. The purpose of these meetings will be to examine key issues that reflect strategic changes in the Department's operating environment. The Volpe Center will assemble key participants in selected areas to identify issues and trends, discuss emerging technological, financial, and institutional opportunities, and assess future directions. Approximately six seminars will be held over

the next year at the Volpe Center. Each seminar will provide in-depth focus on selected topics and educate policymakers on strategic change in the transportation enterprise and its operating environment.

The following seminars will be conducted at the Volpe Center; seminar dates appear in parentheses:

- **Emerging Issues in Transportation Information Infrastructure Security (May 21, 1996):** Recent events in the U.S. and around the world demonstrate that transportation facilities continue to be a major target of terrorists and local violence. What is the nature of the threat to the U.S. public and to U.S. transportation assets? What are the available countermeasures? What role can the Department play in technology deployment and in partnerships with industry to ensure public security and optimal passenger and freight mobility?
- **Current and Future Federal Applications of Tagging and Tracking Technology (June 18, 1996):** The U.S. Government is the world's largest shipper. In managing its shipping activities, the public sector has sought to develop more effective solutions for the logistics of freight movement based largely on innovative applications of information technologies. How well have the technologies been implemented? Can Federal agencies learn from one another in tagging and tracking technology applications? What common institutional barriers need to be addressed?
- **Mesoscale Weather Forecasting: Technological and Institutional Challenges (July 16, 1996):** The transportation community needs weather information on a mesoscale level to improve the efficiency of its operations. The weather service is currently capable of providing this information, but the channels of dissemination are unable to handle the transmission of it. What types of technological and institutional improvements are needed to provide the mesoscale weather information to transportation operators?
- **Spectrum Availability and Digital Communication Links (August 20, 1996):** Space-based satellite navigation systems increasingly are being applied to the transportation industry. Increased reliance on these technologies places a greater need for transportation systems to have access to digital communications. How can the transportation industry better position itself to be represented for the allocation and use of the communications spectrum?
- **Travel and Tourism as the World's Largest Industry: Transportation Challenges and Opportunities (September 18, 1996):** Travel and tourism is one of the fastest growing industries in the world. It is a major source of employment and the nation's leading source of foreign currency. What are the special needs of this growing market? How does its exponential and ubiquitous growth affect the transportation system?
- **Transportation Health Effects: A Current Assessment (October 16, 1996):** Transportation operations and facilities produce many externalities that may affect public health, e.g., air pollution, EMF. How should public health considerations relating to the investment and operation of transportation facilities be integrated into transportation decisionmaking?

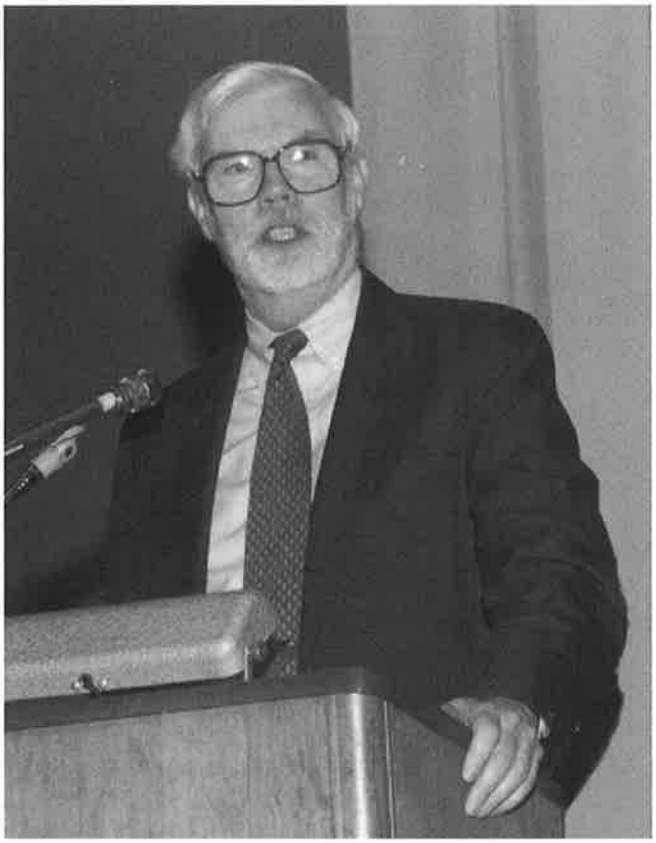
Anyone interested in obtaining information about these workshops should contact Ms. Cynthia Maloney, Volpe Center Transportation Strategic Planning and Analysis Office (phone: 617-494-2283 or fax: 617-494-3688).

Day One Keynote Speakers

Deputy Secretary Highlights Transportation Challenges of the 21st Century

"We have a global economy where reasonable growth would help bring about political and economic stability for generations to come...but it's a world economy whose growth, also, could be choked off by inadequate transportation."

The Honorable Mortimer L. Downey
Deputy Secretary of the
U.S. Department of Transportation



U.S. DOT Deputy Secretary Mortimer Downey

Deputy Secretary of the U.S. Department of Transportation Mortimer L. Downey delivered the keynote opening address at the symposium. Citing the importance of symposium participants listening to key individuals from a broad range of disciplines, Deputy Secretary Downey stated, "Transportation already generates one-sixth of our Gross Domestic Product and employs millions of Americans. Transportation's role in the economy will only increase with time: 400,000 of the 7 million jobs created since President Clinton took office are in transportation...We face unprecedented challenges in the 21st century as we work to fulfill the mobility needs of our growing economy. However, we can't meet tomorrow's challenges with yesterday's tools, and so we need to invest in new technologies to make our transportation systems safer, more efficient, and more environmentally sound. President Clinton has called for the development of these new technologies and strongly supports many of the dynamic new approaches to transportation that this conference will explore."

Deputy Secretary Downey painted a broad picture of some of the transportation challenges of the coming century: "We have a global economy where reasonable growth would help bring about political and economic stability for generations to come, but it's a world economy whose growth, also, could be choked off by inadequate transportation."

He also called attention to increasing travel demand, the need for greater transportation efficiency, and increased security risks faced by our transportation system. "Our teenagers,

our women in the society, and our senior citizens now play more fulfilling roles than they did a generation ago, and each of these groups produces unique sets of transportation needs. [However,] the very openness of our system that has meant such unprecedented mobility is at risk as we seek solutions to safeguard travelers."

"We're not going to meet tomorrow's challenges with yesterday's strategies, or the day before yesterday's analytical techniques. If we're going to develop new ways of thinking and doing we can't do it without investing in new analytical tools and new technologies," the Deputy Secretary stated.

RSPA Administrator Focuses on Federal Leadership in R&T

"The progress we make toward the resolution of these global issues will reflect the economic and technological environment, as well as point to the priorities and values that we have in our society..."

Dr. D.K. Sharma
Administrator
U.S. DOT, Research and Special Programs Administration

In opening the conference, RSPA Administrator Dr. D.K. Sharma stated that, "Transportation research and technology is essential to ensure that America's transportation network is as safe, efficient, and effective as possible. The Federal Government has a major role to play in providing leadership in research and technology by working in partnership with industry, state and local governments, and academia." Dr. Sharma cited examples of the Volpe Center's efforts in response to customer needs across a spectrum of transportation issues and stated that the Center "is an unrivaled resource for transportation technology and systems expertise."

Dr. Sharma focused on the leadership necessary to address the problems of the next century. He stated that leadership "will be needed on environmental issues as expanding populations and transportation demands place increasing stress on the world ecosystem. It will be needed to deal with safety and security issues. It will be needed in logistics and logistical systems as greater efficiency is required to meet increasing demands with limited resources. And it will be needed in business process design, investment, and financing as we need to find increasingly creative ways to pay for transportation improvements."

In closing the first day's plenary sessions, Dr. Sharma stated that, "the progress we make toward the resolution of these global issues will reflect the economic and technological environment, as well as point to the priorities and values that we have in our society...How clean

Dr. D.K. Sharma, RSPA Administrator

should our transportation system be? How safe should our highways and cars be? How secure should we make our airports, subways, and other public transportation facilities? And most important, how much are we willing to

invest to obtain the levels of environmental protection, safety, and security that we, as a society, deem appropriate? These are all the questions that we must continually ask in light of changing technologies, the global economy, and shifting national priorities."

Dr. Sharma highlighted the symposium as an opportunity to renew the dialogue among our transportation partners on these very important issues. "As populations expand and resources become even more scarce, the need for even more intense dialogue increases, and we will need to forge new partnerships to meet our common challenges," Dr. Sharma concluded.

Global Tone Set in Welcome From Volpe Center Director

Dr. Richard R. John, Volpe Center Director

> *"In planning this symposium and looking forward to the year 2020, it was immediately apparent that we would have to take a global perspective. Virtually every topic we considered involved global trends, concerns, and solutions..."*
>
> ***Dr. Richard R. John***
> *Volpe Center Director*

Dr. Richard R. John, Volpe Center Director, welcomed participants and set the global tone for the two-day event. "In planning this symposium and looking forward to the year 2020, it was immediately apparent that we would have to take a global perspective. Virtually every topic we considered involved global trends, concerns, and solutions... Propelled in large part by parallel advances in transportation and communications, the world has become not just a global village, but more a global factory, office and marketplace." Said Dr. John, "A company may find customers, sources of raw materials and components, and competitors virtually anywhere. Transnational corporate thinking and acting has already become essential to economic survival in many businesses and industries."

"As we become ever more closely linked to the rest of the world, we cannot ignore how it is changing," Dr. John continued. "In the next 25 years, the current world population of 5.7 billion people will increase to 8 billion. More than one-half of these people will be living in cities—many in megacities in the developing world...with populations exceeding 25 million. Along with increasing urbanization, the world is becoming motorized...The powerful combination of urbanization and motorization can have dramatic consequences in terms of air quality, transportation safety, and congestion."

Dr. John portrayed a changing world filled with new vistas and new challenges for the transportation community. In addition to the growing world population and the shift toward megacities and a more urbanized society, Dr. John highlighted increasing travel and tourism; the upswing in global trade; the intense

Over 200 transportation leaders and decisionmakers from around the nation convened at the RSPA/Volpe Center-hosted symposium.

projected growth in the world's motor vehicle fleet and the associated upswing in global transportation accidents and fatalities; the increased global demand for petroleum and its implications for balance of trade and global warming; and the resulting need for basic transportation infrastructure and transportation financing.

Professor and Best-Selling Author Addresses Participants

Dr. Lester C. Thurow, MIT professor and best-selling author, painted a compelling picture of the major forces that are acting now and in the next few decades to affect both the world economy and the global transportation system. He compared the predicament transportation planners and decisionmakers confront to that of Christopher Columbus before his fateful voyage: How do you design and provision a ship for a trip into unknown territory?

> *"We have a global economy for the first time in human history where anything can be made anywhere and sold everywhere else on the face of the globe."*
>
> ***Dr. Lester C. Thurow***
> *Jerome and Dorothy Lemelson Professor of Management and Economics, Sloan School of Management, Massachusetts Institute of Technology*

As background, Thurow pointed out that the world's economic growth rate is slowing: from an average of 5% annually during the decade of the 1960s, it has declined continually to 3.6% in the 1970s, only 2.8% over the 1980s, and a mere 2% for the first half of the 1990s. Europe, with an economy one-half larger than that of the U.S., has created no net new jobs since 1970, compared to 38 million new American jobs in the same period. The Japanese economy, which until recently has led the world in sustained growth, has essentially been stagnant for the past five years. The Nikei stock market average has declined by more than one-half; about one-third of the nation's entire wealth has evaporated; and millions of Japanese families are now net debtors due to the drop in real estate values. The Mexican economy recently went through a profound economic shock from which it is still in the process of recovering.

> *"In twenty-five years, capitalism loses 60% of its momentum."*
>
> ***Dr. Lester C. Thurow***
> *Massachusetts Institute of Technology*

Meanwhile, in the United States, the Gross Domestic Product has risen by about one-third in the past twenty years. Nearly all of this

Dr. Lester C. Thurow, MIT professor and a best-selling author, was the keynote dinner speaker.

gain went to the top 25% of the population in income terms, and most of that was concentrated in the top 1%. As this was occurring, the bottom 60% of American workers lost 20% of their wage values in the same twenty-year period.

> *"No country without a revolution or a military defeat and an occupation, has ever had that kind of a shift in the distribution of incomes within that short a period of time."*
>
> ***Dr. Lester C. Thurow***
> *Massachusetts Institute of Technology*

To understand these events, it is important to recognize the underlying forces that affect the world economy. Drawing analogies from the sciences, Thurow discussed how the impact of these events resembles plate tectonics, from physical sciences, and punctuated equilibrium, from evolutionary biology. These major forces are causing sudden and rapid shifts in economic and political factors which are sufficiently significant to suggest that a revolutionary change in world conditions is now occurring. The five major factors that planners and decisionmakers must bear in mind are: (1) the collapse of Communism; (2) the shift of the basis of industry from natural resources to brainpower; (3) demographic trends; (4) the creation of a truly global economy; and (5) the absence of a dominating political, economic, and military 'superpower' that can impose its will on the world.

> *"Where they will be depends on who mobilizes the brainpower and the infrastructure to make it the most desirable places to do these industries; they can be done anywhere."*
>
> ***Dr. Lester C. Thurow***
> *Massachusetts Institute of Technology*

The end of communism means that nearly two billion of the world's population will be shifting from the communist to the capitalist economic system, which will change both them and us. Resources such as oil, aluminum, wheat, and wool are suddenly available at higher quantities and lower prices. There is now a glut of well-educated but under-employed labor in these nations—Cuba, Russia, China, eastern Europe—that can be, and is being, hired at much lower wages than in the developed world. Meanwhile, the economy is shifting away from natural resources toward knowledge as the single most important basis for adding value. Moreover, there used to be five major bases for economic competitiveness: resources, technology, capital, knowledge and skills, and infrastructure. Now, due to the development of global markets for resources, technology and capital, only the latter two differentiate one location from another. And

The symposium was attended by senior officials in industry, government agencies, academia, and other organizations with an interest in the future course of transportation.

these industries have no natural or necessary home.

Demographic changes will distinctly affect future trends. By the year 2030, there may be close to 8 1/2 billion people on the globe, mostly in poor countries. There will be massive migrations—legal, illegal, and refugee—affecting tens of millions. Meanwhile, in developed countries such as the U.S., the elderly are becoming the single most significant demographic group. They are growing in both numbers and wealth, and they vote. The average older American receives 40% of their income from the government, and 40% of the elderly receive 80% of their income that way. The impact of this trend on national budgets and spending patterns is incalculable. Many vital public expenditures directly related to economic competitiveness—items such as education, research and development, and infrastructure—are being squeezed out by this massive transfer of wealth to the elderly.

> *"We are creating a class of human beings never before seen on the face of the earth, called the elderly, people over the age of 65 who don't work, are very affluent, and they get most of their income from the government...the greatest shift in the distribution of purchasing power the world has ever seen. It has created businesses and destroyed businesses."*
>
> ***Dr. Lester C. Thurow***
> *Massachusetts Institute of Technology*

In fact, over the past twenty-five years, the average elderly American has seen a doubling of his/her income, while the average American 18 to 35 years old has had his/her income cut in half.

Modern transportation and communications have made the global economy possible, as businesses relocate continually within and between countries and pare unnecessary expenses. Unfortunately, however, there is no agreed-upon set of rules for this new situation that nations can use to arrange their economic and trade relations and to resolve disputes and disagreements easily. This would not be as much of a problem if it were not for the final trend: the absence of a world superpower that could impose these rules on their reluctant trading partners.

Thus, given these forces at work in the world, governments and individuals must reassess their policies and priorities. Room needs to be made to afford necessary investments in the real contributors to economic success: knowledge and skills, and infrastructure. The public sector has traditionally played a key role in building infrastructure, because it is willing to invest before a viable market has been revealed. It may make sense now to sell off the results of prior investments, such as the Interstate Highway System, and use the earnings to finance building the next infrastructure, which will be the key to economic competitiveness.

"The private sector is very good at building infrastructure behind the market; but it will never build in front of the market."

Dr. Lester Thurow
Massachusetts Institute of Technology

Day Two Keynote Speaker

Assistant to the President for Science and Technology Cites Future Transportation Demands

"The demands made on the nation's transportation system during the next twenty-five years will be enormous. We will demand even greater levels of mobility, faster and more reliable freight shipments. We will demand improved safety, greater reductions in urban pollutants and greenhouse gas emissions. We will be forced to transition from the cheap, convenient petroleum-based fuels that have served us so well for a generation. And we will need to do all of this while reducing the...costs of transportation."

The Honorable John H. Gibbons
Assistant to the President for Science and Technology

Dr. John H. Gibbons, Assistant to the President for Science and Technology

Dr. John H. Gibbons, Assistant to the President for Science and Technology, emphasized transportation's significance to the nation and indeed the world, "The Clinton Administration came into office clearly understanding the enormous direct and indirect importance to the U.S. economy, and the challenges it faces. Transportation issues have played a central role in the Administration's economic and technology policy. We moved rapidly to build research partnerships with industry to ensure a continuing flow of innovations, to provide Federal investment in infrastructure where it is needed, and to provide a regulatory environment that achieves public objectives with the lowest possible burden and inconvenience to citizens."

"In this Administration's view, one of the most important roles of the Federal Government is to ensure that private investors have an incentive to take risks and invest in good new ideas. This Administration has worked hard to create a pro-investment business environment. For the first time since President Truman sat in the White House, we have cut the deficit for the third year in a row, freeing up capital for private investment. We've strengthened university-based research, created new and responsive technology programs to speed the path from laboratory bench to marketplace,

(l. to r.) Dr. Richard R. John, Volpe Center Director, Dr. John H. Gibbons, Assistant to the President for Science and Technology, and Dr. D.K. Sharma, RSPA Administrator.

opened up world trade, and reinvented existing Federal science and technology programs to make them work better and cost less," said Dr. Gibbons.

Dr. Gibbons called attention to the enormous demands that will be placed on the nation's transportation system during the next twenty-five years. "We will demand even greater levels of mobility, faster and more reliable freight shipments," he said. "We will demand improved safety, greater reductions in urban pollutants and greenhouse gas emissions. We will be forced to transition from the cheap, convenient petroleum-based fuels that have served us so well for a generation. And we will need to do all of this while reducing both the public and the private costs of transportation."

Dr. Gibbons closed the conference by reading a message from President Clinton in honor of the occasion:

"I am delighted to commend the men and women of Volpe National Transportation Systems Center as you celebrate your twenty-fifth anniversary. America's tradition of hard work has made our country strong, and you can be proud of your contribution to that legacy. Your dedication to the public is an inspiration to others. On behalf of all those who have benefited from your service, I thank you for a job well done. Best wishes for continued success."

Transportation in the 21st Century: A Global Perspective

Plenary Panel

Dr. Frank L. Hassler, Director of the Office of Transport and Information Resources, Volpe Center

Mr. William B. Johnston, Executive Vice President, Director of Public Affairs/Americas, Burson-Marsteller

Mr. Daniel M. Kasper, Chairman of the Transportation Industry Program, Coopers & Lybrand

Dr. Anthony J. Pellegrini, Director, Transportation, Water, and Urban Development Department, World Bank

Breakout Session #1: Role of Information Technology in the Transportation Enterprise

Mr. Michael P. Huerta, Associate Deputy Secretary of Transportation and Director, Office of Intermodalism, U.S. DOT

Mr. Jack L. Kay, CEO, JHK & Associates and Chairman of the Board, ITS America

Mr. John S. Niles, President, Global Telematics

Mr. Eugene K. Pentimonti, Vice President, Government Services, American Presidents Line

Breakout Session #2: Investment in the Global Transportation System in an Era of Limited Public Spending

Mr. Noah Rifkin, Director of Technology Deployment, U.S. DOT

Dr. Gregory K. Ingram, Administrator, Research Advisory Staff, World Bank

Dr. Don Pickrell, Chief Economist, Volpe Center

Dr. Elizabeth Pinkston, Economist, National Resources and Commerce Division, Congressional Budget Office

Introduction

A number of significant driving forces—including demographic shifts, economic growth, continued urbanization, and the rapid proliferation of motor vehicles—are spurring continued growth in demand for transportation services across the globe. However, these demands are also occurring at a time when the world's stock of resources that can be devoted to transportation are limited, other compelling issues are diverting attention, and environmental concerns are often acting as a damper on the expansion of transportation infrastructure and operations.

Thus, one of the major issues for the next twenty-five years will be to assure that this growing demand for transportation services worldwide can be adequately met within the constraints imposed by resource limitations and competing priorities. This task will be rendered even more difficult by the realization that the global transportation system itself cannot be rationally planned: it is, in fact, the consequence of innumerable, usually uncoordinated and often incompletely planned decisions made daily by private and public individuals and organizations in every corner of the world.

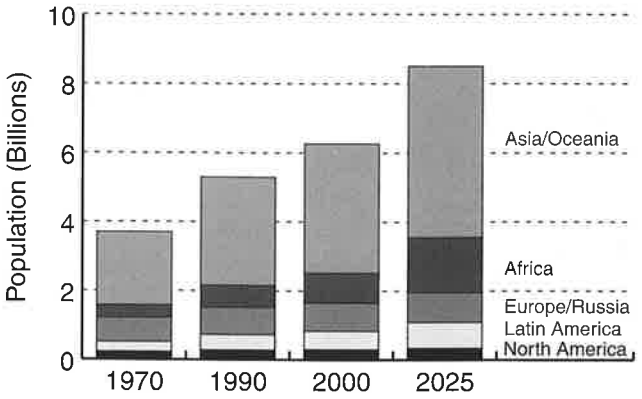
Driving Forces

It is estimated that the world's population could grow by as much as 3 billion people—from 5.5 billion to nearly 8.5 billion—by the year 2025, with the vast majority of that increase occurring in the developing world, particularly Africa and Asia. At the same time, the current trend toward urbanization will continue unabated, as the majority of this population migrates to the world's cities.

Mr. William B. Johnston, Executive Vice President, Burson-Marsteller

> *"If there's a single phenomenon that's shaping the world transportation environment, it is the emergence of the mega-city as the dominant location for people to live in the world."*
>
> ***Mr. William Johnston***
> *Executive Vice President*
> *Burson-Marsteller*

The biggest single consequence of this demographic growth will be the emergence of the 'mega-city' as the dominant site for the world's population and the focal point for national life. By the year 2020 there could be dozens of these cities with 15-25 million people or more, scattered across the globe but especially in the developing world. They will dominate the service sectors of their national economies, which will make them key actors in the world economy as well.



Source: *World Population Prospects 1990* United Nations

Figure 1. World Population Projections

As standards of living in these megacities improve, the middle and upper income groups will inevitably grow in both affluence and numbers. Along with these higher incomes will come a demand for a much higher level of transportation and travel services. One inevitable result will be an expansion in the world's inventory of motor vehicles from about 650 million now to nearly 1.3 billion in 2020. And again, most of this increase will occur in the developing world.

The consequences of these trends, when taken together, are inevitable: increases in congestion, energy consumption—particularly of petroleum—and the accompanying levels of pollution. In an earlier time, these consequences could be handled through increased investment in infrastructure construction and the development of technologies to help mitigate these negative impacts. While these will still be important tools for managing this situation, there are new constraints on their effectiveness.

First, there is mounting evidence that a continually rising demand for transportation cannot be fully addressed by building new infrastructure. Eventually, a saturation level will be reached in which there is literally no more room for new roads in a region, and the existing roads cannot carry any additional traffic. Second, governments, especially in the developing world, are confronted with numerous demands for their limited resources. There are major concerns and unmet needs worldwide over the status of education, public health (clean water supplies, sanitation systems, vaccinations, disease control), housing, agricultural productivity, and economic development. Finally, any improvement to transportation has to be balanced against the perceived negative impacts of that activity on the environment.

This dynamic interaction of major global trends stimulating transportation demand with the inherent constraints to responding to them raises five major issues that decisionmakers must resolve. They are: travel and tourism; global freight transportation; energy efficiency and environmental quality; the application of information technologies; and investing and financing strategies.

Major Theme #1: Increased Travel and Tourism

Few individuals realize the significance of travel and tourism to the world's economy. By some estimates, this may be the single biggest economic activity in the world today, comprising over one-tenth of the total global gross product. The economic well-being of many of the world's smaller nations in such regions as the Caribbean and the Pacific Ocean is dependent on a strong tourism industry. And as population and disposable income both grow, a dramatic increase in international passenger travel can be anticipated.

This trend will particularly stimulate the growth of air travel and the need for new and expanded airport facilities and associated

Mr. Daniel Kasper, Chairman of the Transportation Industry Program, Coopers & Lybrand

surface connections throughout the world. One estimate suggests that world airlines Revenue Passenger Miles (RPMs) will rise at an average of 5% annually over the next 25 years. This growth will be propelled by the expansion of affluent classes across the world with larger disposable incomes, and particularly by leisure travel.

> *"[A]s Pogo said, we have seen the enemy and it is us. We can do it. The resources are there. The demand is there ... at the moment, the biggest problem we have is the ability of our institutions to do that."*
>
> ***Mr. Daniel Kasper***
> *Coopers & Lybrand*

One consequence of this growing demand will be a doubling of the world civil aviation fleet from 10,000 now to about 20,000 in 2020. Although the average size of these aircraft may grow about 10% to about 220 seats, extra

large aircraft are unlikely. There may be new supersonic and hypersonic aircraft, however, in response to high demand in longer routes such as Europe-Asia and North America-Asia. Fortunately, both the demand and the resources will probably exist to build and modernize the air traffic control system and the aircraft inventory to meet these growing markets.

Yet, as has been previously pointed out, there are distinct economic, environmental, and other constraints that will have to be managed if this demand is to be met adequately. For example, expanding airports and ground access connections to them may facilitate greater numbers of tourists while ironically degrading the attractiveness of the destination. Significant international cooperation will be required to standardize and harmonize more effective air traffic control and airport procedures on a global scale.

Mr. Eugene Pentimonti, Vice President, American Presidents Line

Major Theme #2: Global Freight Transportation

Demographic and economic growth will also have a stimulatory impact on the demand for finished goods, which will expand the demand for freight transportation services worldwide. The shift of manufacturing sites to the developing world, as well as the increasing 'outsourcing' of component and parts production, will also necessitate increased freight movements during the manufacturing process itself. Manufacturing strategies such as just-in-time, which is increasingly becoming an industry standard, can also place new strains on the transportation system by increasing truck traffic in the vicinity of a factory.

This growing demand for components and finished goods will require a renewed emphasis on the state of the freight system, with particular focus on seaports, railroads, and intermodal terminals and facilities. Fortunately, the freight sector is already well on the way to achieving the capacity for seamless, global goods movements.

Over the past twenty years, as containerization and intermodalism increasingly replaced the old break-bulk practices, both equipment and procedures have been evolving. Much of the progress in this area has relied heavily on information technologies. Shippers now work closely with customers, often even sharing personnel, to plan integrated origin-to-destination shipments on tight schedules. Electronic

> *"But when we studied it, it became clear that the real value of information technology in our enterprise is what it does to allow you to meet your customers' global logistics demands."*
>
> ***Mr. Eugene Pentimonti***
> *Vice President*
> *American Presidents Line*

Data Interchange (EDI) connections; tracking individual containers in real-time via bar code readers, automatic equipment identification (AEI), and even Global Positioning System (GPS) transponders; and allowing customers to access this data in real time to locate their own shipments are all becoming common practice. The Internet could be even more extensively used as an alternative to private dial-up links to allow customers to do even more of their own self-booking and self-checking.

There are obstacles to the further evolution of these capabilities, however. The cost for installing systems such as these is high. Data and communications standards must be harmonized across the industry. Different countries may restrict access to their national telecommunications systems. In all of these areas there is room for the public sector to assist. The quality of the solution, in fact, depends on all participants giving a full commitment to the effort.

When combined with the travel and tourism trends already discussed, local decisionmakers will need to respond to growing demands for both passenger and freight services. Thus, the entire transportation system—including all modes and the connections between them, both locally and internationally—will have to be considered in any major decision. However, many local planners and decision-makers are not well-versed in either the significance of freight transportation to their region's economic well-being, or to the particular infrastructure and operational needs of that activity. Thus, there is much that both sides can do to inform and educate each other for their mutual benefit.

Major Theme #3: Energy Efficiency and Environmental Quality

As the demand for transportation services rises, it is estimated that the world demand for petroleum—by far the primary fuel source for transportation—could double to as much as 150 million barrels per day. Even if this level of output could be maintained indefinitely, which itself is a subject of controversy, this reliance on a vital natural resource concentrated in only a few nations leads to significant political and economic risks. Critical fuel supplies to a nation could be disrupted over the short or long term, for example, by local conflicts, natural disasters, economic downturns, or conscious political decisions.

> *"What will a sustainable transport system look like? It's necessary to improve operating performance, and I think the way we need to do that is to challenge the boundary between the public and private sectors."*
>
> ***Dr. Anthony Pellegrini***
> *Director of Transportation, Water and Urban Development Department, World Bank*

In addition to concern over energy supplies, the emissions caused by petroleum consumption contribute to both human health problems, particularly in urban areas, and the possibility of global climate changes. And as cities continue to grow and motor vehicles proliferate, the resulting increase in transportation activity places nearly unsustainable pressures on land use, traffic congestion, and air and water quality. If effective responses to these pressures are not found, the economic health of a region could be impaired to the point where productivity and living standards may actually decline. If this occurs, either the megacities projected for the future will be unable to emerge, or they will become places of poverty, social tension, and economic stagnation instead of the dynamic economic drivers and national centers that are envisioned.

Given these concerns, there is justification for pursuing methods of both reducing the pollution associated with petroleum consumption, and finding a substitute source of transporta-

Mr. Michael P. Huerta, U.S. DOT Associate Deputy Secretary and Director of the Office of Intermodalism

tion energy. Included in this debate is also the issue of devising and implementing strategies for managing the demand for transportation services throughout the world in order to manage petroleum usage, including devising means for users to pay more of the full cost of their transportation choices.

One new concept that is increasingly used to frame thinking about this issue is that of sustainable development or sustainable transportation. In general terms, sustainability refers to the ability to meet the basic needs of the current generation without compromising the ability of future generations to meet their needs. There are at least three dimensions to this approach. First, environmental goals such as maintaining bio-diversity, habitats, and natural resources, as well as avoiding pollution, must be included. Second, the approach must incorporate social values such as participation, fairness, and equity for the broadest number of people. Third, the approach must be economically affordable. It may not always be possible to harmonize all three of these goals; in fact, as one speaker commented, "sustainability requires a balance."

Major Theme #4: The Application of Information Technology to Transportation

In a recent report, the Interagency Coordinating Committee on Transportation Research and Development of the National Science and Technology Council (NSTC) established four broad priority areas for transportation R&D. The *physical infrastructure* defines the structure of the system itself. It includes roads, bridges, rail and transit systems, airports, seaports, waterways, pipelines, and terminals. The *vehicles* category covers the units which operate on this physical infrastructure, such as highway, rail and waterborne vehicles, aircraft, and spacecraft. *Transportation system design, planning, management, and operations* captures the overall systems-level considerations of how well transportation is functioning, and incorporates such areas as system assessment, human factors, and human performance. Finally, the category of *information infrastructure* refers to operational control and management systems such as air traffic control, vessel tracking, rail signal and control, weather information collection and dissemination, and highway signaling and traffic monitoring. It also includes the use of information and communications technologies to meet demands that previously could only be satisfied by the transportation system. Telecommuting and tele-conferencing are familiar examples. This replacement of transportation services by information-based services has been termed *tele-substitution.*

"Here we are in the middle of the information age and we're still moving around a lot. What's going on?"

Mr. John Niles
President
Global Telematics

(l. to r.) Mr. John Niles, President, Global Telematics, Mr. Jack Kay, Chief Executive Officer, JHK Associates and Chairman of the Board, ITS America, and Mr. Eugene Pentimonti, Vice President, American Presidents Line

The number of persons in a position to use and benefit from these services is large, and will continue to grow. The U.S. work-at-home population, defined as those working at home 1-2 days per week on average, grew from an estimated 2.2 million in 1988 to over 9 million in 1994. And since about one-half of the national work force consists of 'information workers' who could readily tele-commute, there is plenty of room for this total to grow further. In addition to working at home, telecommunications can substitute for transportation related to other services as well: shopping, education, health care, and banking, among others.

However, there is uncertainty over the specific impact of these trends on transportation demand. Even in the case of tele-substitution, some argue that the extensive use of telecommunications actually acts to stimulate additional demand for transportation. Will tele-commuters compensate for their work-at-home routine by taking more vacations and more weekend social trips? Will the automobile they leave at home be used by other family members for new trips during the day? This phenomenon has been called *tele-stimulation*. It is quite possible that both tele-substitution and tele-stimulation will be occurring at the same time throughout society. Thus, predicting the specific impact of information and communications technologies on transportation demand is speculative at best.

The application of state-of-the-art information and communications technologies to transportation, as well as the indirect effect of these technologies on the demand for transportation services themselves, have both increased sharply in recent years, and promise to continue exerting a profound effect in the future. In fact, information technologies will be a crucial tool in meeting the growing demand

predicted for transportation services. One excellent example of this trend is the *Intelligent Transportation System,* or *ITS,* program.

The ITS program arose in the late 1980s out of an awareness that parallel advances in such fields as electronics, communications, control, and information processing technologies offered a unique opportunity to make profound improvements in the nation's surface transportation system. The ITS program seeks to apply these technologies in a manner that will enable the public to use the nation's surface transportation infrastructure and energy resources to help achieve multiple goals simultaneously, including: improved safety, increased efficiency of transportation operations, reduced environmental and energy impacts of transportation activities, increased economic productivity, and better mobility for transportation users.

ITS, if properly designed and implemented, will significantly mitigate transportation problems in congested urban areas. It will also facilitate the flow of freight on the nation's highways. Incident management applications will play an important role in mitigating congestion by helping to clear accidents quickly from roadways. Freeway and corridor management and region-wide coordinated traffic signal controls will facilitate the flow of vehicles. Crash avoidance applications will reduce the number of accidents. Tolls, fees, and transit fares will be collected electronically. Congestion pricing will enable the application of peak-time pricing to driving.

It is estimated that full implementation of ITS services nationwide will cost about $210 billion over the next twenty-five to thirty years. Of that amount, $170 billion will come from vehicle buyers who choose to pay for on-board electronics. The remaining $40 billion represents the public investment in infrastructure.

There are some potential threats to the successful deployment of ITS. In the words of one participant, "stagnation by investigation" may occur if we focus too much on studying ITS instead of developing and deploying its most beneficial aspects. Standards are still undeveloped, but that process is underway. There is also foreign competition with substantial public and private support in Japan and Europe. Finally, many state and local officials are not yet informed about ITS or enthusiastic about its potential.

"U.S. industry can and should be a significant player in the implementation and development of ITS, not only in the United States, but worldwide."

Mr. Jack Kay
CEO
JHK Associates

There are also a number of actions that DOT and others can take now to stimulate ITS. It should go ahead and deploy the 'core infrastructure' elements of ITS in key metropolitan areas so that the benefits can be proven in real applications. Public-private partnerships can help the U.S. to leap-frog foreign initiatives by looking at the next generation of research opportunities. Above all, it is the right time and the right place for ITS—there is a need to ease congestion and promote more efficient transportation, the technological opportunities are there to do so, and the cost is reasonable.

In applying ITS and other technological advances to transportation, much reliance will be placed on the *National Information Infrastructure,* or *NII.* The NII is a broad effort involving the Federal, state, and local governments; business; labor; academic community; and individuals aimed at increasing the capacity and effectiveness of the nation's many means of communications, including the transmission of voice, data, video, and images. This activity is, therefore, deeply involved in applying new communications and information technologies—including both hardware and software—to this goal. A key aspect of this

Transportation Infrastructure	Telecommunications Infrastructure
Big and heavy	Small and light
Expensive	Cheap
Publicly funded	Privately funded
Changes slowly	Changes rapidly
Fills quickly	Usually has unused capacity
Much peak congestion	Some peak congestion
Air pollution	No air pollution
Not priced by time of day	Prices by time of day
Familiar and easy to use	New and harder to use

Figure 2. Differences Between Transportation and Telecommunications Infrastructures

effort is to expand access to these capabilities to as many Americans as possible.

As can be imagined, many elements of the NII are directly relevant to the provision of transportation services. For example, the NII provides the ability to develop and distribute airline, bus, rail, and transit schedules and fare information; conduct highway traffic monitoring and weather reporting; maintain and update databases on freight movements, including routes and shipment locations; and store and analyze information about traffic flows, patterns, and volumes in order to plan improvements to the system. Information and communications technologies are becoming so vital to transportation that there is already discussion of the concept of a *Transportation Information Infrastructure,* or *TII,* as defining the point at which the NII and the transportation system effectively interlink.

There are a number of significant differences between the traditional transportation and telecommunications infrastructures, however. These differences are worth considering when thinking about how these two activities will merge.

It is also important to keep in mind that neither the NII nor the national transportation system are unitary entities. The public sector, including the Federal Government and the Department of Transportation itself, does have an important role to play in both enterprises. However, neither system is either primarily managed or operated by the Government. In the case of ITS, for example, the Federal Government can play an important role by focusing on designing a truly compatible nationwide system, as well as facilitating and encouraging the development and deployment of effective improvements. The Government also continues its historic emphasis on the safety of transportation activities, including ITS. Most of the actual effort expended on individual ITS components and services, however, must come from individuals, the private sector, and state and local government agencies.

Major Theme #5: Investment Trends and Financing Mechanisms

One of the major responsibilities of national governments around the world is to assure that vital infrastructure elements necessary to sustain a modern society and economy—such as transportation, communications, utilities, water and sanitary systems, housing, and education—are effectively constructed, maintained and operated. Significant needs for these services still exist today. Nearly 1 billion of the world's population lack access to safe drinking water, 1.7 billion lack modern sanitary services, and nearly 2 billion lack electricity.

Although the roles of the public and private sectors may vary widely from nation to nation, few governments can ignore their responsibilities in these areas. At first, countries tend to concentrate this investment in areas such as water and transportation. However, as countries grow richer, they tend to shift the focus of this investment toward electricity and telecommunications. Although the developed world may have a larger accumulated stock of this economic infrastructure, developing countries devote a substantial proportion of their available resources to this area—typically 4% of Gross Domestic Product, or 40-60% of public investment expenditures. This amounts to about $200 billion annually. Less than 10% of this, or about $15 billion, comes from private sources, with the remainder from traditional public sources or developmental aid. And the lowest proportion of private funding was in transportation.

Due to its high initial cost and the large number of users, most countries have viewed transportation infrastructure as a government responsibility. However, there has been a trend recently in both developed and developing economies to stimulate greater private sector involvement in financing infrastructure projects, including transportation. In fact, the proportion of private versus public capital flowing from developed to developing countries over the past ten years has increased from about one-third to over one-half of the total. This is particularly evident in some of the larger and more advanced nations such as China, India, and Indonesia.

The U.S. Transportation Infrastructure

- Highways and roads: 4,000,000+ miles
- Bridges: 575,000+
- Airports: 670 certified, 50 large hubs
- Intercity rail: 240,000+ miles
- Urban rapid rail: 11,000+ miles
- Petroleum and natural gas pipelines: 190,000+ miles
- Navigable inland waterways and canals: 26,000+ miles

Figure 3. U.S. Transportation Infrastructure

In the United States, the existing transportation infrastructure has been estimated to be worth about $2.4 trillion. Each year an additional $120 billion is spent on maintaining this investment. There is disagreement, however, over whether this level of investment is sufficient to fulfill the real need. A number of recent studies, in fact, have suggested increasing this level of investment, in some cases substantially. These studies have also recommended measures that would encourage the flow of private sector capital to this sector. This view was embodied in the President's Executive Order 12893 of January 26, 1994, *"Principles for Federal Infrastructure Investment,"* which called for both cost-benefit studies to prioritize investments and increased private sector participation.

Each major category of transportation infrastructure has its own traditional funding source. For example, railroads typically finance their own infrastructure needs privately; Federal and state fuel taxes fund

major highways; local property taxes maintain and build local streets; and taxes and passenger fees finance the aviation infrastructure. In addition, state and local governments issue tax-exempt bonds as a revenue source for highway and airport construction.

In addition to these sources, there have been numerous suggestions both in the U.S. and overseas to expand the use of toll roads and bridges and other financing devices to fund these infrastructure elements. A spectrum of public and private sector involvement has been seen, from strictly public projects to granting concessions to private operators, including various mechanisms such as build-operate-transfer (B-O-T) and build-transfer-operate (B-T-O). Other innovative concepts currently under consideration include establishing public Infrastructure Banks to borrow, lend, and insure loans and organize the sale of securities; increasing the range of tax-exempt investments; expanding the imposition of user charges to a wider range of transportation services; and innovative public-private partnerships.

"And what we see in developing countries is a tremendous number of policy experiments as new roles are being fashioned for the public and private sectors. We see public-private partnerships of a wide variety."

Dr. Gregory Ingram
Research Advisory Staff
World Bank

In France, for example, road construction contracts include the responsibility to maintain that new road for the first ten years, which acts as an incentive to the contractor to use effective materials and methods. Argentina concessioned off its publicly-owned railroads in 1991 on a line-by-line basis. The result was a cut of $800 million in government subsidies each year with no increased costs to customers, along with service and productivity improvements. Some African countries have established local boards of road users to decide how best to use gas tax revenues to maintain and improve the road system.

Even given these new ideas for expanding transportation investment, significant problems exist. Poor infrastructure maintenance, especially of roads, can be a major obstacle to economic growth in developing countries. The World Bank estimates that $45 billion worth of roads have been lost in the past 20 years due to inadequate maintenance. The new nation of Kazakhstan, for example, once a part of the Soviet Union, is losing an estimated 1,500 kilometers of roads annually for this reason. Yet every dollar invested in maintenance saves about three dollars in re-building costs. In addition, the public sector should maintain an oversight role over transportation decisions in both the public and the private sectors that may adversely affect social groups and the poor by forcing resettlement, cutting jobs, or reducing access to transportation services.

Many economists agree that one of the most promising means of allocating resources fairly is to charge a full and fair price for a service. In the case of transportation, however, many forms of subsidy exist in both developed and developing countries. This means that individuals tend to use more of that service than they are paying for, which shifts some of that cost to others who are not using the service themselves. A more accurate pricing system may help to rectify this situation.

In the U.S., this approach could entail congestion pricing, charging heavy vehicles for their road damage, or taxing the pollution associated with motor vehicle use. Technologies such as electronic toll and fare collection and weigh-in-motion for commercial vehicles could facilitate the introduction of these practices. In the developing world, the World Bank recommends that governments establish a base price for gasoline at about $3 per gallon. This represents about $1 each to pay for: (a) the basic resource cost, (b) road maintenance

fees, and (c) the environmental impacts associated with using the fuel.

> *"One of the major challenges I think we face is, how can we replicate the price system in places where the market fails; that is, where there are externalities or there are other public goods characteristics, such as not being able easily to charge the users for services that they use?"*
>
> ***Dr. Elizabeth Pinkston***
> *Economist*
> *Congressional Budget Office*

Dr. Elizabeth Pinkston, National Resource and Commerce Division, Congressional Budget Office

There can be significant opposition to the introduction of these pricing mechanisms. Many American drivers, for example, would claim that their fuel tax payments are already sufficiently onerous, and they should not be charged additional tolls or fees for using roads, especially those that have already been built with public funds. High gas prices have traditionally been strongly opposed by users in most countries. Existing institutions would also have to reexamine their relationships with each other and their participation in the collection and distribution of transportation-related fees and revenues.

> *"The financial capital markets, particularly in the U.S., are extremely well organized, they're highly diversified, and they operate with extraordinary efficiency . . . and these markets stand ready to capitalize on virtually any stream of revenue that can be generated by investments in public infrastructure."*
>
> ***Dr. Don Pickrell***
> *Chief Economist*
> *Volpe Center*

It is interesting to note that this focus by economists on fair pricing of transportation services based on increased user charges also corresponds with a movement to charge users the 'full costs' of the negative externalities associated with their transportation activities. These externalities are primarily seen as adverse environmental impacts on air and water quality, land use and human health, as well as depletion of energy reserves. In effect, both concepts would raise the cost of transportation to users; however, in one case the motive is to fund an expansion of the quality and quantity of infrastructure, and in the other case, the motive is to limit or control the demand for transportation services itself so that no additional infrastructure is needed.

Contributions of the Emerging Global Transportation System to Environmental Pollution and Petroleum Consumption

Plenary Panel

Dr. Richard R. John, Director, Volpe Center

Dr. Ralph Gakenheimer, Professor and Director of Special Programs for Urban and Regional Studies, Massachusetts Institute of Technology

Dr. David L. Greene, Senior Research Staff Member, Oak Ridge National Laboratory, Center for Transportation Analysis

Mr. James M. Hogarth, Manager of the Electric Transportation Development Department, Boston Edison

Breakout Session #1: Urban Transportation Trends in the Developed and Developing World

Mr. Robert A. Knisely, Deputy Director, Bureau of Transportation Statistics, U.S. DOT

Dr. Daniel Brand, Vice President, Charles River Associates

Ms. Nancy Rutledge Connery, Independent Consultant on Transportation and Urban Development

Dr. Charles L. Wright, Transport Economist, Interamerican Development Bank

Breakout Session #2: Outlook for Advanced Vehicle Technology and Reformulated/Alternative Fuels

Mr. Richard F. Moorer, Associate Deputy Assistant Secretary for Transportation Technologies, Energy Efficiency and Renewable Energy, U.S. Department of Energy

Dr. James J. MacKenzie, Senior Associate, Climate, Energy, and Pollution Program, World Resources Institute

Mr. James D. Shields, Vice President, TASC System Integration Group

Dr. W. Peter Teagan, Vice President, Arthur D.Little, Inc.

Introduction

Worldwide, transportation is becoming the focus of concerns about fossil fuel consumption, global warming, and urban air quality. In particular, motor vehicles account for a third of the world's oil consumption and 14 percent of carbon dioxide emissions from the burning of fossil fuels. Cars, trucks, buses, and other vehicles are also major sources of carbon monoxide and of volatile organic compounds and nitrogen oxides-precursors of ozone and acid rain. Motor vehicles' share of oil consumption and emissions will undoubtedly increase as the world's population grows and becomes increasingly urbanized.

Over the next 30 years, the global population is projected to grow from the current 5.7 billion to almost 8.3 billion people. By far, most of this growth will be in the cities of the developing world. Together with economic development, growth in the world's urban areas has led to a dramatic increase in the number of motor vehicles over the past 25 years. In 1970, there were 246 million vehicles registered in the world, 44 percent of them in the United States. By 1992, the world had 614 million vehicles, two and a half times the number in 1970, with only 31 percent in this country. In fact, the global fleet has been growing linearly since 1970, with each year seeing an additional 16 million vehicles. Should this trend continue, there should be more than 1.1 billion vehicles in the world fleet by 2025.

As the world vehicle population has grown, so has oil consumption. For the most part, the world fleet runs on oil. According to the U.S. Department of Energy (DOE), consumption of oil has risen steadily since the mid-1980s, due primarily to the rapid expansion of transportation in the developing countries. In the United

States, transportation accounts for two-thirds of oil consumption; of this, more than one-half goes to fuel cars, vans, and light trucks. The DOE projects that U.S. oil consumption for transportation will continue to grow by 1.4 percent a year between now and 2010.

Along with growth in the use of oil has come growth in vehicle emissions. For example, according to MacKenzie and Walsh, between 1971 and 1987 vehicular emissions of carbon dioxide increased by 63 percent, at an average rate of 3 percent a year. U.S. emissions rose by 30 percent, and emissions from the remaining OECD countries (those in the Organization for Economic Cooperation and Development) increased by 70 percent. At the same time, carbon dioxide emissions from the non-OECD countries grew by 120 percent. Although its relative role has declined, the United States continues to be the largest single source of fossil-fuel-related carbon dioxide emissions, contributing approximately 38 percent more emissions than the world's second biggest emitter, the former Soviet Union.

Major Theme #1: The Increasing Demand for Oil

> *"The world is consuming about 25 billion barrels of oil per year. It's finding about 8 billion barrels of oil per year ... The end is in view, and it's not a matter of centuries away."*
>
> **Dr. James J. MacKenzie**
> *Senior Associate*
> *World Resources Institute*

According to the DOE, world demand for oil may increase by 9 to 12 million barrels per day by 2000, with total demand reaching between 87 and 95 million barrels, compared with current levels of 67 million barrels a day. To meet this demand, the Organization of Petroleum Exporting Countries (OPEC) is projected to increase oil production by about 21 million barrels a day by 2010. In contrast, the non-OPEC countries will increase production by less than 1 million barrels a day. The DOE projects that, by 2010, OPEC could account for more than half of the world's total oil supply.

> *"It's not a problem of running out of oil. It is a problem of who has this oil and the potential to exercise monopoly power that gives them."*
>
> **Dr. David L. Greene**
> *Senior Research Staff*
> *Oak Ridge National Laboratory*

Although session participants had mixed views about the abundance and longevity of the world's oil supply, they agreed that oil dependence is a serious problem for the United States—with hundreds of billions, if not trillions, of dollars at stake. According to one participant, U.S. imports of oil are within 1 percent of the all-time high, and will surely surpass that level as U.S. reserves continue to be used up and output declines.

> *"If you do an analysis of electric vehicles in Europe, they could look a lot better than here when they're competing against four and five dollar [a gallon] gas."*
>
> **Dr. W. Peter Teagan**
> *Vice President*
> *Arthur D. Little, Inc.*

Another issue raised was the likelihood of adopting alternative transportation fuels and

technologies, given the relative low cost and abundant supply of oil. One participant pointed out that part of the problem is that the price of oil doesn't reflect the true costs of its use. And several felt that oil prices are likely to increase by the end of the decade and continue increasing, making alternatives more acceptable. Finally, participants agreed that, for the United States at least, energy security alone is enough of a reason to pursue alternatives to oil.

Major Theme #2: Advanced Vehicle Technologies

As petroleum use rises, so do greenhouse gas emissions. Among the countries of the developing world, carbon emissions from motor vehicles account for about 45 percent of the world growth in vehicle releases between 1971 and 1987. Nevertheless, the OECD still contributes about 69 percent of motor-vehicle carbon dioxide emissions, with the United States alone generating 38 percent. Although average carbon dioxide emissions per vehicle have fallen internationally (as a result of improved fuel efficiency), these gains have been overcome by increases in the number of vehicles and in miles driven.

> *"We have really seriously got to start moving toward another kind of power plant for vehicles . . . those are electric drive vehicles, with batteries charged in the vehicle or out of the vehicle, or hydrogen fuel cells, powered eventually by renewable energy sources."*
>
> ***Dr. James J. MacKenzie***
> *Senior Associate*
> *World Resources Institute*

Most participants agreed that advanced vehicle technologies have tremendous potential for reducing motor vehicles' harmful environmental effects. One participant felt that only electric drive or hydrogen-powered vehicles can meet the United States' ultimate needs for zero carbon emissions and energy security. Another discussed the government-industry partnerships now under way in the United States, Japan, and Europe to develop a vehicle with significantly improved emissions characteristics and fuel economy, in particular the Clinton Administration's Partnership for a New Generation of Vehicles, or PNGV. To reduce emissions, the PNGV is looking at alternative propulsion technologies, primarily hybrid electric vehicles. The focus for improving fuel economy is on reducing overall vehicle weight by incorporating new materials. According to this participant, similar research is being conducted through government-industry programs in Europe and in Japan.

> *"The bottom line is that we, in the business, really want to develop many of these new technologies, but that there's almost a guarantee that if we're successful there could be major dislocations in other parts of our economic structure. What's really important is to understand what these might be and to plan for them ahead of time."*
>
> ***Dr. W. Peter Teagan***
> *Vice President*
> *Arthur D. Little, Inc.*

Still another participant discussed the economic implications in the United States of a move to alternative vehicle fuels or technologies. He concluded that although advanced vehicle technologies would undoubtedly create new jobs and improve U.S. economic competitiveness, they would also lead to some major structural dislocations in the economy, particularly in the steel, petroleum, and transportation

(l. to r.) Mr. Richard F. Moorer, Associate Deputy Assistant Secretary for Transportation Technologies, Energy Efficiency, and Renewable Energy, U.S. Department of Energy, Dr. James J. MacKenzie, Senior Associate, World Resources Institute, Mr. James D. Shields, Vice President, TASC, and Dr. W. Peter Teagan, Vice President, Arthur D. Little, Inc.

service industries. One major potential problem is the cost of modifying or replacing the existing fuel infrastructure, including our huge pipeline system and the more than 207,000 retail fuel outlets. This participant estimated the cost of replacing these facilities at about $31 billion a year. Nevertheless, most session participants felt that the environmental and energy benefits of new technologies will make their adoption inevitable, and that if U.S. industry fails to lead the way, the industry in Europe or Japan will.

"The momentum has been created . . . if we choose to stop, I don't think that they're going to."

Mr. James D. Shields
Vice President
TASC System Integration Group

Major Theme #3: Congestion in Megacities

United Nations figures show that 45 percent of the world population currently are urban dwellers. By 2025, more than 60 percent of the projected 8.3 billion people in the world will be living in cities-many of them in megacities with populations of 10 million or more. By 2015 most of the largest cities will be in the developing world. After Tokyo, Bombay, Lagos, Shanghai, and Jakarta will lead the world in the number of inhabitants, each with populations of well over 20 million people.

"The important thing is not how many vehicles there are; it's how fast they grow."

Dr. Ralph Gakenheimer
Professor and Director of Special Programs for Urban and Regional Studies
Massachusetts Institute of Technology

Increased auto use has created a level of congestion in the world's cities that is believed

to cost billions of dollars. In the United States, for example, the cost of congestion in major metropolitan areas may exceed $34 billion a year. Congestion on roadways in the developed and developing world is no longer a "peak period" phenomena; in many areas, congested conditions occur throughout the day. For instance, in Lagos, Nigeria, traffic jams often trail for several miles outside the central business district from morning until evening, and in Los Angeles, the average speed on major urban highways is rarely above 35 miles per hour over a 24-hour period.

"We need to do better economic analysis if we're going to understand the impacts of increasing motorization . . . . this means better travel demand modeling and forecasting in the developing world."

Dr. Daniel Brand
Vice President
Charles River Associates

Several participants felt that congestion has become a far worse problem for cities in the less developed world than for industrialized cities. According to one participant, the primary reason is the rate at which developing regions are becoming "motorized." In China, for instance, the number of cars is doubling every two years, while in Korea, the car population increased 460 percent between 1983 and 1990. This participant also felt that congestion is viewed in the developing world as a far more serious problem than air pollution or fuel consumption.

Session participants identified a number of factors that help to explain the greater congestion problems experienced in less industrialized cities. One is the population densities of these cities, which are typically 10 to 20 times those of U.S. cities. Others are limited street space,

"There are people otherwise intelligent who believe that you can have widespread car ownership and get around with no congestion problem in a very densely populated city. It's not possible. With just a very small percentage of trips by car you will clog everything up. And there's no amount of investment in highway space within a 10- or 20-year period that will solve that problem."

Dr. Charles L Wright
Interamerican Development Bank

changing patterns of land use, and inadequate traffic forecasting. But many of these factors, which limit motorization, also make alternatives to automobiles more attractive than they are in industrialized cities—particularly transit and non-motorized transportation. One participant pointed out that residents of cities in the

"The transportation community, the industry, has to push a lot harder to break out of the old modes and to think in more horizontal terms . . . . we are not just solving transportation, but we're essentially enriching our communities."

Ms. Nancy Rutledge Connery
Independent Transportation Consultant

less industrialized countries value quality public transportation and are willing to pay for it. Moreover, because these cities typically

have very high "activity densities" and mixed land use, many trips are accomplished by bicycle or foot. In fact, according to this participant, because of their unique characteristics, for many cities in the developing world, the only truly high-capacity modes, and the ones that make the most sense to invest in, are cycling, walking, and bus transit.

Many participants felt that the principal means for dealing with traffic congestion in the developing world will be some form of demand management. Other solutions include improved mass transit, better transportation and land use planning, and, lastly, construction of new infrastructure. One participant pointed out that transportation problems, such as congestion and pollution, are only part of a series of complex social and economic changes taking place in the world; such problems can not be addressed fully without addressing these larger global changes.

Ensuring a Safe and Secure Global Transportation System

Plenary Panel

Mr. Ronald J. Madigan, Director of the Office of Systems Engineers, Volpe Center

Dr. Leonard Evans, Principal Research Scientist, Automotive Safety and Health Research Department, General Motors Research Center

Mr. John J. Sullivan, Corporate Vice President, Quality Management, ARINC

Dr. Patricia Waller, Director, University of Michigan Transportation Research Institute

Breakout Panel #1: Opportunities for Reducing Transportation Accidents and Fatalities

Mr. Philip R. Recht, Deputy Administrator, National Highway Traffic Safety Administration

Dr. Arnold Barnett, Professor of Operations Research, Sloan School of Management, Massachusetts Institute of Technology

Dr. Clayton Foushee, Vice President, Flight Operations, Northwest Airlines

Dr. Robert Schumacher, Director of Automotive Electronics Development, Delco Electronics Corporation

Breakout Panel #2: Enhancing Transportation Security

Rear Admiral Paul E. Busick, U.S. Coast Guard, Director of the Office of Intelligence and Security, USDOT

Dr. Stephen Cohn, Vice President, Network Security, Bolt, Beranek & Newman, Inc.

Dr. Anthony Fainberg, Independant Consultant

Mr. Richard F. Lally, Independent Consultant on Aviation Security

Introduction

The safety and security of travelers is a major public concern and the principal responsibility of national and state transportation agencies. The measures taken by these bodies to achieve acceptable levels of safety affect not only users of the transportation system, but also the producers of transportation equipment and providers of transportation services. Dramatic increases in air travel and motor vehicle population will be a central theme of transportation-related changes around the world in coming decades, with safety and security a major concern.

While many safety issues are relatively specific to particular localities and situations, most of the primary transportation safety concerns in the U.S. are, to a large degree, global in their relevance. The safety of surface transportation is very much dominated by deaths and injuries associated with the use of highway motor vehicles. In the more-industrial nations with relatively high vehicle populations, safety records are typically good by historical standards. However, even in those countries, the private motor vehicle still ranks as a major public health problem, with the situation likely to worsen as automobile populations grow and drivers age. In newly developing nations, widespread ownership of personal motor vehicles can be expected to bring with it a dramatic rise in road deaths; the developed world may have both strategies and technologies to offer that can minimize the high cost of expanding personal automotive mobility in these countries.

The inherently global nature of air travel, and the extreme sensitivity of the public to aviation accidents, necessitates international cooperation and effort. International factors are important in shaping the means by which safe

and secure air transportation is achieved in the U.S. as well as for U.S. citizens traveling abroad.

The security of travelers can be threatened by terrorist or other malicious actions regardless of means of transportation, but attention has generally focused on aviation. Regardless of mode and the typically very low level of actual risk, public perception and concern make improvement of transportation security a high priority for governments. The need for joint international efforts is especially critical in this sphere. However, it is a very challenging matter to provide a truly high level of security without seriously damaging the convenience and economics of the affected element of the transportation system.

Major Theme #1: A Global Perspective on Highway Safety

Although passenger vehicle registrations in the U.S. continue to increase, such growth in the future is likely to be relatively modest—little greater than the rise in population. This is also true generally in Europe, though with a greater potential for future increase. However, in the developing world there is still the possibility, usually accompanied by a strong popular desire, for a dramatic increase in motor vehicle ownership and use.

Continued and even accelerated growth of passenger vehicle production and use will have many important consequences. Among them is the potential for a dramatic increase in deaths and injury, with the annual toll already estimated at greater than 500,000 fatalities worldwide. It is typically found that highway death rates per vehicle or per vehicle-mile are much higher for countries with relatively few automobiles per capita. As populations adapt to the use of personal motor vehicles, the greater exposure to risk tends to be compensated by improved roads, signage, laws, enforcement, and driver (and pedestrian) behavior.

It is also the case that, throughout the world, young male drivers prove to be the demographic group at the greatest risk for fatalities and injuries as a result of motor vehicle accidents. Thus, traffic safety is going to continue as it is now to be primarily a problem associated with this group. A somewhat atypical but well-documented indication of the dynamics of introducing of large numbers of passenger cars into an already industrialized country is found in Japan.

> *"There are increasing international issues for both cars and aviation, particularly this issue of international harmonization . . . Mercedes Benz and now it appears General Motors are going into China to open plants. And the question becomes what standards will China and other emerging economies adopt to insure safety, but at the same time make sure that the vehicles that are built in these countries . . . are affordable."*
>
> ***Mr. Philip R. Recht***
> *Deputy Administrator*
> *National Highway Traffic Safety Administration*

Among nations, the United States has had the longest and most intense involvement with the private motor vehicle. Recent data indicate that the U.S. has more than one registered passenger vehicle per licensed driver, with almost 600 cars per 1000 population. Automobile registrations in the U.S. have grown more rapidly than population, and vehicle-miles-traveled (VMT) have increased faster still—four-fold since 1950, with no clear sign of slackening. In that same time period, the number of highway fatalities per passenger mile has declined by more than two-thirds. Many factors have contributed to this accomplishment. Through both regulation and private-sector actions, automobiles have improved greatly in crashworthiness and other safety characteristics.

There is a relatively long tradition in the U.S., and most other countries, that state and national governments have an implicit responsibility to protect the citizenry against significant but not readily perceived hazards potentially associated with widely sold products. In the case of the passenger car, this basic principle has been extended to include assurance that private passenger vehicles meet well-founded stringent crashworthiness and other standards fully exploiting current technological understanding. Most of the advances in the safety of motor vehicles since that time have been at least stimulated, if not forced, by NHTSA regulations (and associated research) covering crashworthiness and other safety-relevant topics.

"If anybody in the world wanted to study traffic safety, that person would be well advised to look to the United States because we in the United States have been collecting data for a longer period of time than any other nation. We were motorized earlier. We have more experience in the field . . . "

Dr. Leonard Evans
Principal Research Scientist
General Motors

However, as modern life has grown more complex and public sensitivity to risks in everyday life has expanded, the resulting extensive network of governmental health and safety regulations has increasingly come under attack as being excessive and overly costly to the society. Thus, as the 'easy' motor vehicle improvements—such as restraint systems and basic advances in vehicle structures—were implemented, and as other requirements associated with fuel efficiency and environmental acceptability have been imposed on passenger cars, doubts have been expressed as to the cost-effectiveness or even the legitimacy of further Federal regulations in this area.

The steady recent decline in fatality rate cannot disguise the fact that approximately 40,000 highway deaths and millions of injuries still occur each year, imposing an enormous toll in human suffering and direct and indirect costs. Further advances in highway safety will be hard-won. The most promising technological improvements have already been made and introduced into the fleet. The Interstate Highway System is essentially complete, and seat belt use has become relatively widespread. In spite of a strong public desire for higher levels of automobile safety, Americans typically are not enthusiastic about constraints that limit their choice in the vehicles they buy and the manner in which they use those vehicles. Additional pressures on passenger car design and use, arising from national concerns such as fuel efficiency and environmental quality, must be balanced with the vehicle weight or cost implications of improved crashworthiness.

"The demographic handwriting has been on the wall. Our population is growing and it's clear that with increasing age there is an increased likelihood of problems that are going to interfere with driving performance . . . the crash rate per mile driven begins to go up starting around age 55, and then increases at an accelerating rate..."

Dr. Patricia Waller
Director
University of Michigan Transportation Research Institute

The changing demographics of the U.S. population means that there are going to be no easy answers to meeting the transportation needs of the elderly. A comprehensive

(l. to r.) Dr. Patricia Waller, Director, University of Michigan Transportation Research Institute, Mr. John Sullivan, Corporate Vice President, ARINC, Mr. Ronald Madigan, Director of Systems Engineering, Volpe Center, Dr. Leonard Evans, Principal Research Scientist, General Motors Research Center.

program for older drivers should ideally incorporate three aspects: first, restricting the driving where necessary; second, facilitating the driving task for this population; and finally, improving the performance of older drivers.

"The real challenge, both to the transportation industry and to government, is to work together, develop partnerships, and in particular in enacting regulations and standards so that we can go ahead focusing on collision warning, intelligent cruise control, and ultimately what I'd like to call vehicle dynamic control."

Dr. Robert Schumacher
Director, Automotive Electronics Development
DELCO Electronics Corporation

Unfortunately, the existing human factors and human performance data based on the abilities of older drivers is incomplete. However,

Dr. Robert Schumacher, Director, Automotive Electronics Development, DELCO Electronics Corporation

as was the case with improvement spurred by the Americans with Disabilities Act, measures which are taken to assist the elderly to meet their own transportation needs will probably assist many other population groups as well.

Collision avoidance features such as those found in the Intelligent Transportation Systems (ITS) program provide both an opportunity and a challenge to both industry and government to improve vehicle safety and reduce crashes. The real issues here is what are the specific technologies, how fast can they be rolled out on vehicles, can they be made reliable, and, in particular, how good do they have to be? There are also important questions to answer concerning the cost of these improvements, customer acceptance, the potential product liability risk to manufacturers, and the implementation of government standards and regulations.

Major Theme #2: Aviation Safety

While worldwide air activity has increased, total fatalities have declined and both deaths per passenger mile and fatal accidents per aircraft mile for commercial air transport have been cut sharply. Moving at near supersonic speed six miles or more above the surface of the earth, and bringing a several-hundred thousand pound vehicle back to earth at more than 150 MPH in a wide range of weather conditions is inherently an extraordinarily demanding undertaking. There have been remarkable technical accomplishments and a strong commitment to safety found throughout the commercial aviation community.

Continued expansion in the demand for aviation is likely. For example, one major commercial aircraft manufacturer projects that the seat capacity in China will increase six-fold over the next 20 years. One out of every six new aircraft orders currently comes from China. The International Air Traffic Transport Association estimates that 50 percent of all international aviation traffic will be in Asia by the year 2010, and that aircraft movements to and from Asia will increase by a factor of three.

> *"Safety and growth must remain in balance. And infrastructure and systems improvements are needed to keep safety in the balance as traffic grows. And often a country will decide to hold safety in balance by restricting growth and then they suffer the economic consequences. These restrictions are indeed in place in many areas of the world, but there are always economic pressures to increase that traffic, even if the infrastructure may not be ideal for safety."*
>
> ***Mr. John J. Sullivan***
> *Corporate Vice President*
> *ARINC*

The expansion in commercial aviation around the globe also brings with it the potential for growing concern over the safety of the system. Public perceptions about the risk of commercial travel depend substantially on the way those risks are presented to them. There can be a good debate about how one should measure air safety.

The detailed examinations that follow every major crash almost invariably find that the accident need not have happened: the human errors (in the air or on the ground), technological failures, and miscommunications or misunderstandings could have been avoided, or their consequences mitigated. Governments, air carriers, and manufacturers will continue to be under strong pressure in this regard for the foreseeable future. Improvements in aviation safety will probably be the

"The point is, that when the public rightly or wrongly does perceive a threat to safety, whether it's the type of aircraft . . . or a carrier . . . or an ambient threat like sabotage, it does seem that there is a bigger risk response in the marketplace. You're not dealing with passive individuals who believe solely in fate. Nor does it appear to be purely an American phenomenon."

Dr. Arnold Barnett
Massachusetts Institute of Technology

Dr. Arnold Barnett, Professor of Operations Research, Massachusetts Institute of Technology

"I also agree that Secretary Peña's goal of zero accidents in the transportation system is a laudable one. It really doesn't matter very much whether it's an attainable goal or not, it is probably true that accidents will always happen, no matter how miraculous technology is. Nevertheless, simply striving for a zero accident system does in fact produce, I believe, remarkable results in making sure that all the participants in the system are dedicated to the ultimate safety. It is the gold standard that this profession is based on."

Dr. Clayton Foushee
Northwest Airlines

Dr. Clayton Foushee, Vice President, Flight Operations, Northwest Airlines

result of a mix of advances in standards, training, infrastructure, and aircraft systems themselves.

Major Theme #3: The Security of Our Global Aviation System

Were safety concerns of the type just noted the only risk, the entire aviation community and the traveling public could rest more easily. Unfortunately, in the last few decades the threat of hijacking and deliberate sabotage has come to be a real and highly visible world concern. It is an enormous challenge to keep all weapons and explosive materials off a transport carrying several hundred people and their highly varied luggage. To do so without so lengthening and complicating the boarding process as to threaten the practicality and economic viability of air travel is even more difficult. When there is open concern over terrorism, such as during the Gulf War, international travel does decline. And airlines that are targeted by terrorism can see their business erode in the aftermath of an event.

> *"Is it really worth billions of dollars around the world in security systems to prevent this from occurring ... I think the answer is yes, because ... it has an effect on people's desire to travel and willingness to travel ... World commerce would certainly be disrupted. And I think what's most important is that these attacks are used to gain leverage over policies of major world powers, particularly the United States."*
>
> ***Dr. Anthony Fainberg***
> *Independent Consultant*

Safety and security are both key elements in retaining the public's trust and confidence in public transportation or the nation's transportation network. The U.S. Department of Transportation has always had a really strong focus on safety. Recently, as events have progressed, the Department has begun to have a much stronger focus on security. Recent plots or actual attacks have been made against rail, subway, bus, and highway targets, both domestically and internationally.

> *"We've made a lot of progress in developing good basic procedures, but domestically most of what we have done in terms of increases in security relate to procedural issues, they don't relate to technology issues. And what we are on the verge of, I think, is the implementation of some technology issues, perhaps the most expensive of which is explosives detection systems . . . We need to explore some other technological approaches. We need to think about whether our model is the appropriate model or whether or not there are some better ways to go about it."*
>
> ***Rear Admiral Paul E. Busick***
> *U.S. Coast Guard*

Since the U.S. Government has a responsibility to safeguard travelers throughout trips on all airlines and aircraft serving its cities, the problem is immediately global in scope, and requires international agreement and actions at air terminals throughout the world. At the same time, effective measures are almost invariably expensive to implement, increasing the burden on travelers, shippers, and opera-

tors, and posing additional obstacles to concerted and timely action. There is also concern over the quality of both the equipment and personnel currently assigned to this important task.

Harmony is lacking as national approaches to explosives detection technology evolve differently. The U.S. has chosen a conservative development course based on high technical standards, while Europeans are applying diverse technologies to reach early effectiveness. The troubled state of the world, and the apparent attractiveness of aviation to terrorist attack, make it likely that aviation security, as well as security in other modes of transportation, will be a major and expensive ongoing area of concern as the 21st century begins—possibly eclipsing traditional safety issues.

"There is no free lunch. You have to pay for what you get. And in the airline industry, I would suggest, without going into the airport improvement fund . . . a security surcharge. It has value, it could be mandated by the government or it could be just approved by the government. It could be subject to government audit and accountability. And most of all, it can be adjusted to respond to the threat."

Richard F. Lally
Independent Aviation Security Consultant

Over the next 25 years, many of the mission-critical aspects of transportation operations will increasingly migrate to the National Information Infrastructure. This trend in itself has significant security implications. Just as transportation systems have been targeted in the past and will continue to be targeted, the NII will also have to get safer. Information warfare, or info-war, is a serious concern across many aspects of both government and industry, primarily because the U.S. is so dependent on the efficiency and scope of its information infrastructure to leverage and improve its competitiveness. It will be necessary to incorporate sufficient security measures when developing this Transportation Information Infrastructure; including hardware, software, and human dimensions.

"So what should you do when thinking about transportation? Well, now it's worthwhile thinking about what is your information security policy as you move in these directions . . . You're going to have to expect to live with some level of vulnerability and an active threat and you have to manage some level of compromise."

Dr. Stephen Cohn
Vice President Network Security
Bolt, Beranek & Newman, Inc.

Symposium Attendees

Mr. Paul Abramson
System Resources Corporation
128 Wheeler Road
Burlington MA 01803
Tel. 617-270-9228
FAX 617-272-2589

Mr. William S. Adams
Associate Director, Public Information Division
U.S. Department of Transportation
400 Seventh St., SW
Washington DC 20590
Tel. 202-366-1111
FAX 202-366-7952

Mr. Edward Adelson
V.P., Radio & Industry Services
Aeronautical Radio, Inc.
2551 Riva Road
Annapolis MD 21401
Tel. 410-266-4230
FAX 410-266-2047

Dr. Jeffrey L. Adler
Assistant Professor
Civil & Environmental Engineering
Rensselaer Polytechnic Institute
Troy NY 12180-3590
Tel. 518-276-6938
FAX 518-276-4833

Mr. Joseph A. Ahearn
Sr. Vice President
CH2M HILL, INC.
P.O. Box 4400
Reston VA 22090
Tel. 703-471-1441
FAX 703-481-0980

Dr. David M. Albala
White House Fellow
U.S. Department of Transportation
400 7th Street, SW
Washington DC 20590
Tel. 202-366-5459
FAX 202-366-7952

Mr. John C. Allen
Vice President, Marketing
Transportation Division
Battelle Memorial Laboratories, Suite 204
3 Cambridge Center
Cambridge MA 02142
Tel. 617-577-7250
FAX 617-577-7257

Mr. George Anagnostopoulos
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2087
FAX 617-494-2318

Mr. Kemal Arin
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2066

Mr. James R. Avitabile
Managing Director
Transportation Engineering
Vanasse Hangen Brustlin Inc.
P.O. Box 9151
101 Walnut St.
Watertown MA 02272
Tel. 617-924-1770
FAX 617-924-2282

Mr. Lawrence F. Ayers
Exec. Vice President
Intergraph Corporation
MS-1W17BW
Huntsville AL 35894-0001
Tel. 205-723-7853
FAX 205-730-1263

Mr. Juan Baez
PacifiCorp
825 NE Multinomah, Room 410
Portland OR 97232
Tel. 503-464-5799
FAX 503-275-2650

Dr. Arnold Barnett
Professor of Operations Research/Sloan School
Massachusetts Institute of Technology
50 Memorial Drive
Cambridge MA 02142
Tel. 617-253-2670
FAX 617-258-7579

Mr. Alfred E. Barrington
Chief, DTS-75
Safety & Environmental Technology Div.
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2018

Mr. Daniel F. Beagan
Director
Bureau of Transp. Planning & Dev.
Transportation Bldg.
10 Park Plaza, Room 4550
Boston MA 02116
Tel. 617-973-7877
FAX 617-973-8035

Ms. Laurinda T. Bedingfield
Commissioner
Massachusetts Highway Department
Room 3510
10 Park Plaza
Boston MA 02116
Tel. 617-973-7811

Ms. Chris Bell
Sr. Transportation Planner
DMJM
38 Chauncey Street, Suite 302
Boston MA 02111
Tel. 617-338-1494
FAX 617-338-2791

Ms. Ellen Bell
Management & Program Analyst, DTS-24
Transp. Strategic Plng. & Analysis Office
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3465
FAX 617-494-3688

Mr. William Berman
Director-Environment & Energy
American Automobile Association
1440 New York Ave., NW, Suite 200
Washington DC 20005
Tel. 202-942-2050
FAX 202-783-4788

Dr. William R. Black
Professor
Department of Geography
Indiana University
112 Student Building
Bloomington IN 47405
Tel. 812-855-9414
FAX 812-855-1661

Mr. Eric L. Blair
Technical Staff
Center for Advanced Aviation System Development
7525 Colshire Drive, M/S W281
McLean VA 22102-3481
Tel. 703-883-6082
FAX 703-883-6804

Ms. Carol W. Blair
Project Manager/Central Artery Team
Transportation Department
City of Boston
One City Hall Plaza, Room 811
Boston MA 02201
Tel. 617-635-4880
FAX 617-635-3341

Mr. Bernard E. Blood
Chief, Transportation Strategic
Planning & Analysis Ofc.
U.S. Department of Transportation
Volpe Center, DTS-24
55 Broadway
Cambridge MA 02142
Tel. 617-494-3454
FAX 617-494-3688

Ms. Madeleine S. Bloom
Director, Ofc. of Policy Development
Federal Highway Administration
U.S. Department of Transportation
HPP-1, Nassif Bldg., Room 3317
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-0587
FAX 202-366-9626

Ms. Margaret D. Blum
Associate Administrator for Port, Intermodal & Environmental Auth.
Maritime Administration
U.S. Department of Transportation
MAR-800, Rm 7212
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-4721
FAX 202-366-6988

Mr. Alexander Blumensteil
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2391

Mr. Ashok Boghani
Vice President
Arthur D. Little, Inc.
35/220 Acorn Park
Cambridge MA 02140-2390
Tel. 617-498-5843
FAX 617-498-7173

Ms. Brenda M. Bohlke
Director, Research & Development
Parsons Brinckerhoff
460 Spring Park Place
Herndon VA 22070
Tel. 703-742-5700
FAX 703-742-5800

Ms. Rosemary Booth
Chief, DTS-39
Systems Planning & Integration Div.
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2072
FAX 617-494-3013

Mr. Rick Borchelt
Public Affairs Specialist
Office of Science and Technology Policy
Executive Office of the President
Washington DC 20506
Tel. 202-456-6018
FAX 202-456-6019

Mr. Don Boyd
Manager
Transportation Division
Battelle
Pacific Northwest Laboratory
Richland WA

Dr. Daniel Brand
Vice President
Charles River Associates
200 Clarendon Street
Boston MA 02116-5092
Tel. 617-425-3000
FAX 617-425-3132

Dr. Aviva Brecher
Senior Analyst, DTS-24
Transp. Strategic Plng. & Analysis Office
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3470
FAX 617-494-3688

Mr. John Brewer
Mechanical Engineer
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2554
FAX 617-494-3096

Dr. Michael Bronzini
Director
Center for Transportation Analysis
Oak Ridge National Laboratory
P.O. Box 2008, 45OON, MS6207
Oak Ridge TN 37831
Tel. 615-574-8267
FAX 615-574-3895

Toye L. Brown
Deputy Secretary for Transportation
Programs and Policies
EOTC
10 Park Plaza, Suite 3910
Boston MA 02116
Tel. 617-973-7019

Ms. Judith A. Burrell
Office of the Secretary of Transportation
U.S. Department of Transportation
S-2, Room 10200
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-6524
FAX 202-366-7952

Mr. Paul B. Bushueff Jr.
Chief, DTS-66
Automation Technology Division
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2090

RADM Paul E. Busick
Director, Ofc. of Intelligence & Security
Office of the Secretary
U.S. Department of Transportation
S-60, Room 10401
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-6535
FAX 202-366-7261

Mr. Harry Butler
Technical Director
Environmental Transportation
One Church Street
Rockville MD 20850
Tel. 301-309-0800
FAX 301-309-1579

Mr. Joseph Canha
Volpe Center, DTS-74
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2554

Mr. Cy Caouette
Program Development
Charles Stark Draper Laboratory
555 Technology Square, MS 06
Cambridge MA 02139
Tel. 617-258-1719
FAX 617-258-1333

Mr. Steve Carlton
Transportation Programs Manager
Lockheed Martin
400 Virginia Ave., SW
Suite 300
Washington DC 20024
Tel. 202-646-2089
FAX 202-646-5600

Mr. Wayne Chen
President
WT Chen & Company, Inc.
1000 Winter Street
Suite 2150
Waltham MA 02154
Tel. 617-890-8888
FAX 617-890-8186

Mr. Robert Church
Industry Economist
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2394
FAX 617-494-2787

Mr. Richard Chutter
Computer System Analyst
Volpe Center, DTS-67
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2494
FAX 617-494-2882

Ms. Rebecca Clemans
Orlando Orange Co. Expressway Authority
Orlando FL
Tel. 407-425-8606

Mr. Michael Clifford
Chief, Project Planning & Analysis
Metro. Washington Council of Governments
777 N. Capitol Street, NE
Suite 300
Washington DC 20002-4226
Tel. 202-962-3200
FAX 202-962-3202

Mr. Ralph G. Colello
Vice President & Managing Director
Arthur D. Little, Inc.
35 Acorn Park
Cambridge MA 02140
Tel. 617-498-5444
FAX 617-498-7002

Ms. Nancy Connery
Independent Consultant on Transportation & Urban Development
244 Old Stage Road
RR1, Box 1340
Woolwich ME 04579
Tel. 207-443-2016
FAX 207442-7135

Ms. Nancy Cooney
Operations Research Analyst
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2523
FAX 617-494-3013

Mr. Phillip S. Coonley
Director, DTS-80
Office of Administration
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2331

Dr. James Costantino
Executive Director
ITS America
400 Virginia Avenue, SW
Suite 800
Washington DC 20024-2730
Tel. 202-484-4847
FAX 202-484-3483

Dr. Joseph F. Coughlin
Director
Transportation and Logistics Research
EG&G Dynatrend
Volpe National Transp. Systems Ctr.
55 Broadway DTS-927
Cambridge MA 02142
Tel. 617-494-2193
FAX 617-494-2569

Ms. Elizabeth J. Councilman
Associate Dir., Highway Research Project
U-Mass Transportation Center
University of Massachusetts
Box 35223
Amherst MA 01003
Tel. 413-545-3728
FAX 413-545-9569

Ms. Kelley Coyner
Associate Administrator
Research, Technology and Analysis
Research and Special Programs Administration
U.S. Department of Transportation
400 7th St., SW
Washington DC 20590
Tel. 202-456-4831
FAX 202-456-7436

Mr. Edward. C. Crow
Program Manager
Applied Research Laboratory
The Pennsylvania State University
P.O. Box 30
North Atherton St.
State College PA 16804
Tel. 814-863-9887
FAX 814-863-0006

Mr. Joseph deBlaquiere
Vice President for Advanced Systems
Camber Corporation
635 Discovery Drive
Huntsville AL 35806
Tel. 205-922-0200
FAX 205-922-3599

Mr. John J. DeMeritt
Analyst
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2210

Mr. Gary Des Groseilliers
Daimler Benz
Three Cambridge Center
Cambridge MA 02142
Tel. 617-577-8721
FAX 617-577-9893

Mr. Samir A. Desai
President
System Resources Corp.
128 Wheeler Road
Burlington MA 01803
Tel. 617-270-9228
FAX 617-272-2589

Mr. James Dillard
Partner
Technology and Finance
Coopers & Lybrand
1503 Wilson Blvd.
Arlington VA 22209
Tel. 703-908-1523
FAX 703-908-1695

Mr. Michael G. Dinning
Chief, DTS-38
Safety and Security Systems Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2422
FAX 617-494-2684

Mr. Steven R. Ditmeyer
Director, Office of Research & Development
Federal Railroad Administration
U.S. Department of Transportation
400 7th Street, SW
Washington DC 20590
Tel. 202-366-6980
FAX 202-366-7150

Mr. Robert M. Dorer
Chief, DTS-701
High Speed Ground Transp., Special Proj. Ofc.
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3481
FAX 617-494-2318

Mr. Mortimer L. Downey
Deputy Secretary
U.S. Department of Transportation
S-2, Room 10200
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-2222
FAX 202-366-3937

Mr. Richard H. Doyle
Regional Administrator
Federal Transit Administration
U.S. Department of Transportation
Volpe Center, TRO1
55 Broadway
Cambridge MA 02142
Tel. 617-494-2055
FAX 617-494-2865

Mr. Howard Dugoff
Senior Vice President
ICF Kaiser
9300 Lee Highway
Fairfax VA 22031-1207
Tel. 703-934-3006
FAX 703-934-9740

Dr. Bruce Egan
Vice President, Technical Director Air Services
Environmental Transportation
One Cranberry Hill
Lexington MA 02173
Tel. 617-863-0667
FAX 671-863-0807

Mr. Bowman H. Evans
District Manager
Boston District Office, Ste. 240
TRW Systems Integration Group
20 Mall Road
Burlington MA 01803
Tel. 617-272-1617
FAX 617-272-4753

Dr. Leonard Evans
Principal Research Scientist
Automotive Safety & Health Research Dept.
General Motors Research Center
Bldg I-3, P.O. Box 9055
30500 Mound Rd.
Warren MI 48090-9055
Tel. 810-986-2280
FAX 810-986-0294

Dr. Anthony Fainberg
Consultant
4500 Wetherhill Road
Bethesda MD 20816
Tel. 301-229-5177
FAX 301-229-7572

Mr. Daniel E. Flaherty
Chief, DTS-82
Financial Management Division
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2602

Dr. Clayton F. Foushee
Vice President Flight Operations
Department #N7100
Northwest Airlines
5101 North West Drive
St. Paul MN 55111
Tel. 612-727-6731
FAX 612-726-8292

Mr. Jay R. Frank
Assistant Director
Northwestern University Transportation Center
1936 Sheridan Road
Evanston IL 60208
Tel. 708-491-8350

Ms. Jeanne E. Fuller
Chief, DTS-843
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3475

Dr. Ralph Gakenheimer
Professor and Director of Special Programs for Urban Studies
Massachusetts Institute of Technology
Building 10, Room 402
77 Massachusetts Avenue
Cambridge MA 02142
Tel. 617-253-1932
FAX 617-253-7402

Mr. Lawrence Gallagher
President
Stanley Associates, Inc.
Suite 400
300 North Washington Street
Alexandria VA 22314
Tel. 703-684-1125
FAX 703-548-7169

Mr. James Getzewich
Chief, Highway Funding & Motor Fuel Division
Federal Highway Administration
U.S. Department of Transportation
400 7th Street, SW
HDM-10
Washington DC 20590
Tel. 202-366-0170
FAX 202-366-7742

Dr. John H. Gibbons
Asst to the Pres Sci & Tech/Director
White House Office of Science & Tech
Executive Office of the President
Washington DC 20506
Tel. 202-456-7116
FAX 202-456-6021

Dr. Jonathan L. Gifford
Assistant Professor
Dept. of Public & Intl. Affairs 3F4
George Mason University
4400 University Drive
Fairfax VA 22030-4444
Tel. 703-993-1400
FAX 703-993-1399

Ms. Alicia Goldman
Principal
The Trow & Bridge Group
700 Massachusetts Ave., 3rd fl.
Cambridge MA 02139
Tel. 617-547-2107
FAX 617-547-1928

Mr. Jack Goldstein
Sector Vice President/General Mgr.
Transportation Sector
SAIC, M.S. 1-7-1
1710 Goodridge Drive
McLean VA 22210
Tel. 703-821-4468
FAX 703-790-5267

Ms. Elisabeth Gordon
Chief, DTS-84
Human Resources Mgmt. Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142

Mr. Robert E. Goudey
International Finance Specialist
Raytheon Company
Executive Offices
141 Spring Street
Lexington MA 02173
Tel. 617-860-2797
FAX 617-860-2505

Mr. Herbert H. Gould
Deputy Director, DTS-71
Office of Systems Engineering
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2634
FAX 617-494-3966

Ms. Alice Grant
Management Analysis
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2785

Mr. Denis Granville
Program Manager
System Resources Corporation
128 Wheeler Rd
Burlington MA 01803
Tel. 617-270-9228
FAX 617-272-2589

Mr. George Edward Gray
Consultant
Int'l Institute for Surface Trans. Policy Studies
San Jose State University
9720 Oviedo Street
San Diego CA 92129
Tel. 619-538-3027
FAX 619-538-4929

Mr. Kevin Green
Engineer, DTS-24
Transp. Strategic Plng. & Analysis Ofc.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2106
FAX 617-494-3688

Mr. Melvyn Greenberg
Program Manager
Intermetrics
733 Concord Ave
Cambridge MA 02138
Tel. 617-661-1840
FAX 617-661-4830

Dr. David Greene
Senior Research Staff
Oak Ridge National Laboratory
Bldg 4500; MA MS-6207
PO Box 2008
Oak Ridge TN 37831
Tel. 615-574-5963
FAX 615-574-3895

Mr. Gene Griffin
Director
Upper Great Plains Transp. Institute
North Dakota State University
IACC Building, Room 430
P. O. Box 5074
Fargo ND 58105
Tel. 701-231-8343
FAX 701-231-1945

Ms. Ana Sol Gutierrez
Deputy Administrator
Research & Special Programs Admin.
U.S. Department of Transportation DRP-2
400 7th Street SW, Room 8410
Washington DC 20500
Tel. 202-366-4461
FAX 202-366-3666

Dr. Richard Gutkowski
Professor
Department of Civil Engineering
Colorado State University
Fort Collins CO 80523
Tel. 970-491-8291
FAX 970-491-7727

Mr. Daniel P. Guzowski
General Manager
Federal Systems
Unisys
4 Cambridge Center
Cambridge MA 01810
Tel. 617-374-5810
FAX 617-494-9195

Ms. Patricia K. Hammar
Program Manager
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 202-493-4006

Mr. John A. Harrison
Deputy District Manager for Operations
Parsons Brinckerhoff Quade & Douglas, Inc.
Fourth Floor
120 Boylston Street
Boston MA 02116
Tel. 617-426-7330
FAX 617-482-8487

Mr. Frank L. Hassler
Office Director, Ofc. of Transport and
Information Resources Mgmt.
U.S. Department of Transportation
Volpe Center, DTS-30
55 Broadway
Cambridge MA 02142
Tel. 617-494-2563
FAX 617-494-3633

Mr. Robert J. Hawley
Principal
Booz Allen & Hamilton
8283 Greensboro Drive
McLean VA 22102
Tel. 703-402-4949
FAX 703-402-3631

Ms. Leslie A. Henson
Staff Assistant
Research & Special Programs Admin.
U.S. Department of Transportation
400 7th St, SW
Washington DC 20590
Tel. 202-366-4433
FAX 202-366-3666

Mr. Robert Hicks
Business Director
Public Technology, Inc.
Suite 800
1301 Pennsylvania Ave., NW
Washington DC 20004-1793
Tel. 202-626-2465
FAX 202-626-2498

Prof. William H. Highter
Director
U-Mass Transportation Center
University of Massachusetts
224 Marston Hall, Box 35223
Amherst MA 01003-5223
Tel. 413-545-3728
FAX 413-545-9569

Mr. Paul Hinchcliffe
Director
Systems Research and Applications Corp.
One Kendall Square
Bldg. 200, Suite 2200
Cambridge MA 02142
Tel. 617-621-1507
FAX 617-577-1209

Mr. John S. Hitz
Chief, DTS-73
Accident Prevention Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2400
FAX 617-494-3066

Ms. Vivian J. Hobbs
Director, DTS-50
Ofc. of Operations Engineering & Assessment
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2354

Mr. William J. Hoffman
Manager, New Technology
New Jersey Department of Transportation
225 E. State St.
Trenton NJ 08666
Tel. 609-292-3422

Mr. James M. Hogarth
Manager, Electric Transportation Development
Boston Edison
800 Boylston Street, P173
Boston MA 02199
Tel. 617-424-3304
FAX 617-424-3208

Mr. Hans Hollister
Systems Engineer
Systems Resources Corporation
128 Wheeler Rd
Burlington MA 01803
Tel. 617-270-9228
FAX 617-272-2589

Ms. Nancy L. Homeister
Vehicle Environmental Planning Eng.
Environmental & Safety Engineering
Ford WHO, Rm 255
The American Road
Dearborn MI 48121
Tel. 313-954-3179
FAX 313-390-0382

Mr. Robert B. Honea
Director
Oak Ridge Trans. Technology Center
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge TN 37831-6230
Tel. 423-574-5932
FAX 423-576-8530

Dr. Richard P. Hooper
Chief-Technologist
Rockwell International
3370 Miraloma Avenue
MS AC06
Anaheim CA 92803
Tel. 714-762-3123
FAX 714-762-1755

Dr. John Hopkins
Senior Analyst, DTS-24
Transp. Strategic Plng. & Analysis Office
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3455

Mr. Richard J. Horn
Chief, DTS-401
Motor Vehicle Projects Ofc.
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2265
FAX 617-494-3625

Mr. Edward Howerter
Branch Manager
Volpe Tech Support Services Project
Unisys
4 Cambridge Center
7th floor
Cambridge MA 02142
Tel. 617-494-3906

Mr. Michael P. Huerta
Assoc. Deputy Secretary & Director
Office of Intermodalism
U.S. Department of Transportation
S-3, Room 10200
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-5781
FAX 202-366-7952

Mr. George Humphrey
Deputy Project Manager
Volpe Tech Support Services
Unisys
4 Cambridge Center, 8th Floor
Cambridge MA 02142
Tel. 617-374-5605
FAX 617-494-9195

Mr. Thomas F. Humphrey
Senior Research Associate
Director, New England UTC Program
Massachusetts Institute of Technology
77 Massachusetts Avenue
Room 1-235
Cambridge MA 02139
Tel. 617-253-4978
FAX 617-258-7570

Dr. Gregory K. Ingram
Administrator for the Research Advisory Staff
The World Bank
1818 H Street, NW
Room N-9-033
Washington DC 20433
Tel. 202-473-1052
FAX 202-477-0955

Mr. Saburo Inui
Vice President
Toyota Motor Corporate Services
1850 M Street NW, Suite 600
Washington DC 20036
Tel. 202-463-6820
FAX 202-463-8513

Mr. Maurice Isaac
Program Manager, Technology
GE Automotive
PO Box 5011
Southfield MI 48086-5011
Tel. 810-351-8132
FAX 810-351-8100

Mr. H. George Johannessen, P.E.
Consultant
Vehicle Occupant Safety
OmniSafe, Inc.
757 Redwood Court
Rochester Hills MI 48309
Tel. 810-375-0468
FAX 810-375-9911

Dr. Richard R. John
Director
U.S. Department of Transportation
Volpe Center, DTS-1
55 Broadway
Cambridge MA 02142
Tel. 617-494-2222
FAX 617-494-3731

Mr. Glenn P. Johnson Jr.
Board Member/Chairman Aviation Security Comm.
Victims of Pan Am Flight 103
226 Wren Drive
Greensburg PA 15601
Tel. 412-838-7136

Mr. William B. Johnston
Executive VP; Director of Public Affairs
Burson-Marstleller
850 M Street, NW
Suite 900
Washington DC 20036
Tel. 202-833-8550
FAX 202-833-4228

Mr. Peter J. Jones
Chief, Employment Services
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2360

Ms. Elaine E. Joost
Deputy Director of Research Policy & Tech Transfer
RSPA
U.S. Department of Transportation
400 Seventh St., SW
Washington DC 20590-0001
Tel. 202-366-4993
FAX 202-366-3272

Mr. Rick Jordan
Computer Systems Analyst
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2818
FAX 617-494-3065

Dr. Barry H. Kantrowitz
Director & Chief Scientist
Human Factors Transportation Center
Battelle Seattle Research Center
4000 Northeast 41st Street
Seattle WA 98105
Tel. 206-525-3130
FAX 206-528-3555

Mr. Alan S. Kaprelian
Chief, DTS-63
Computer Center
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2344
FAX 617-494-3633

Mr. Daniel M. Kasper
Partner
Coopers & Lybrand
1 Post Office Square
Boston MA 02109
Tel. 617-478-5000
FAX 617-478-5900

Dr. William Kaufman
Director
Carnegie Mellon Research Institute
700 Technology Drive
P.O. Box 2950
Pittsburgh PA 15230-2950
Tel. 412-268-3190
FAX 412-268-3101

Mr. Jack L. Kay
Chief Executive Officer
JHK & Associates
2000 Powell Street
Suite 1090
Emeryville CA 94608
Tel. 510-428-2550
FAX 510-655-5730

Mr. Daniel R. Kelly
Manager, Marketing Surface Transportation
Raytheon Company
1001 Boston Post Road
Marlborough MA 1752
Tel. 508-490-2657
FAX 508-490-2657

Mr. Shyam Khubchandani
Chief, Planning & Coordination
Research & Development
Transport Canada
Tower C, Place de Ville
330 Sparks Street, 26th floor
Ottawa, Ontario CANADA K1A ON5
Tel. 613-991-6036
FAX 613-991-6045

Mr. William K. Kincaid, Jr.
Director, Transportation Systms
TRW, Inc.
Suite 800
1001 19th Street, N
Arlington VA
Tel. 703-276-5186
FAX 703-276-5029

Ms. Patricia Klinger
Public Affairs
Research and Special Programs Admin
U.S. Department of Transportation
400 7th St., SW
Washington DC 20590
Tel. 202-366-4831

Mr. Robert Knisely
Deputy Director
Bureau of Transportation Statistics
U.S. Department of Transportation
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-3282
FAX 202-366-3640

Mr. Drew Kodjak, Esq.
Program Associate
NE States for Coordinated Air Use Management
129 Portland Street
Boston MA 02114
Tel. 617-367-8540
FAX 617-742-9162

Mr. Evangel Kostojohn
Network Administrator
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2050
FAX 617-494-3262

Dr. George Kovatch
Chief, University Research
Technology Innovation & Progs. Ofc.
U.S. Department of Transportation
Volpe Center, DTS-22
55 Broadway
Cambridge MA 02142
Tel. 617-494-2756
FAX 617-494-2497

Mr. Robert J. Kreklau
Director, Ofc. of R&D and Operations and Support
Federal Highway Administration
U.S. Department of Transportation
6300 Georgetown Pike
Turner Fairbanks Research Ctr.
McLean VA 22102
Tel. 703-285-2104
FAX 703-285-2379

Ms. Annalynn Lacombe
Management & Program Analyst, DTS-24
Transp. Strategic Plng. & Analysis Office
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2161
FAX 617-494-3688

Mr. Richard F. Lally
Independent Consultant on Aviation Security
25 Indian River Drive
Bay Colony
Dagsboro DE 19939
Tel. 302-539-4609
FAX 302-539-4609

Mr. Santo J. LaTores
Chief, DTS-44
Center for Transportation Information
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2429
FAX 617-494-3064

Dr. Charles A. Lave
Professor of Economics
Economics Department
University of California-Irvine
Irvine CA 92717
Tel. 714-824-6502
FAX 714-824-2182

Dr. Douglas B. Lee
Planner
Service Assessment Division
US Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2762

Ms. Olive Lesueur
Operations Research Analyst
Volpe Center, DTS-39
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2541

Mr. David E. Lev
Acting Office Director
Office of Plans & Programs
U.S. Department of Transportation
Volpe Center, DTS-20
55 Broadway
Cambridge MA 02142
Tel. 617-494-2445
FAX 617-494-2370

Mr. David M. Levinsohn
Vice President
Parsons Brinckerhoff Quade & Douglas, Inc.
Orange Commerce Ctr., Suite 900
505 South Main Street
Orange CA 92668
Tel. 714-973-4880
FAX 714-973-4918

Dr. George List
Department Head
Dept. of Civil & Env. Engineering,
Rensselaer Polytechnic Institute
JEC-4052
Troy NY 12180-3950
Tel. 518-276-6362
FAX 518-276-4833

Mr. Gard Little
Director
Coopers & Lybrand
5th Floor
One Main Street
Cambridge MA 02142
Tel. 617-621-3609
FAX 617-621-1497

Mr. Stephen C. Lockwood
Vice President
Farradyne Systems
Parsons Brinckerhoff
3204 Tower Oaks Blvd.
Rockville MD 20852
Tel. 301-816-1848
FAX 301-816-1884

Mr. Lennart E. Long
Security Systems Programs Mgr
Volpe Center
US Department of Transportation
22 Abbott Road
Waltham MA 02154-7840
Tel. 617-494-2251
FAX 617-494-2684

Mr. George A. Luciano
Regional Administrator
National Highway Traffic Safety Admin.
U.S. Department of Transportation
Volpe Center, DTS-903
55 Broadway
Cambridge MA 02142
Tel. 617-494-3427
FAX 617-494-3646

Dr. James J. MacKenzie
Senior Associate
Climate, Energy & Pollution Program
World Resources Institute
1709 New York Avenue
Washington DC 20006
Tel. 202-638-6300
FAX 202-636-0036

Mr. Ronald J. Madigan
Director, DTS-70
Office of Systems Engineering
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 671-494-2489

Dr. Lyle Malotky
Scientific Advisor, Civil Aviation Security
Federal Aviation Administration
U.S. Department of Transportation
800 Independence Ave., SW
Washington DC 20591
Tel. 202-267-3967
FAX 202-367-8496

Mr. Henry Marcus
Professor
Department of Ocean Engineering
Massachusetts Institute of Technology
77 Massachusetts Ave., 5-207
Cambridge MA 02139
Tel. 617-253-5320
FAX 617-253-4560

Mr. Peter C. Markle
Project Administrator
FHWA, Massachusetts Division
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3546
FAX 617-494-2745

Ms. Stephanie Markos
Transportation Safety Specialist
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2165
FAX 617-494-3064

Mr. Norman Martin
Managing Editor
Automotive Industries
One Chilton Way
Radnor PA 19089
Tel. 619-964-4247
FAX 619-964-4381

Mr. Pierre Martin
Director, R&D Program Development
Corporate Research & Development
M/A-COM
Corporate R&D Center
100 Chelmsford Street
Lowell MA 01853-3294
Tel. 508-656-2630
FAX 508-656-2777

Dr. Fred H. Martin
Vice President Software Technologies
Intermetrics, Inc.
733 Concord Ave.
Cambridge MA 02138
Tel. 617-661-1840

Mr. Hector Mesmela
Project Engineer
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-3730

Dr. Stephen V. McBrien
Director, Program Evaluation & Coordination
Ctr. for Advanced Aviation System Dev.
MITRE Corporation
MS-W281
7525 Colshire Drive
McLean VA 22102
Tel. 703-883-7685
FAX 703-883-6809

Mr. Sean K. McDonnell
Rep. Tom Cahir Staff
Chairman of Transportation Committee
State House, Rm. 445
Boston MA 02133
Tel. 617-722-2460
FAX 617-722-2897

Mr. Joseph C. McGann Jr.
Chief, DTS-65
Information Systems Division
U.S. Department of Transportation
Volpe National Transportation Systems Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2031
FAX 617-494-3028

Mr. Michael F. McGrath
Distribution Competency Leader
Safety, Health & Environment
DuPont Co.
D-3076
1007 Market Street
Wilmington DE 19898
Tel. 302-773-0252
FAX 302-773-5484

Ms. Mary Beth Mello
Deputy Regional Administrator
Federal Transit Administration, Reg. I
U.S. Department of Transportation
Volpe Center
55 Broadway, Suite 921
Cambridge MA 02142
Tel. 617-494-2055
FAX 617-494-2865

Dr. Peter Metz
Deputy Director
MIT Center for Transportation Studies
Massachusetts Institute for Technology
MIT 1-235
77 Massachusetts Avenue
Cambridge MA 02139
Tel. 617-253-5322
FAX 617-253-4560

Mr. Edward Meyer
Branch Manager
Unisys
4 Cambridge Center
Cambridge MA 01810
Tel. 617-374-3858
FAX 617-494-9194

Dr. Michael D. Meyer
Chair
School of Civil and Env. Engineering
Georgia Institute of Technology
Mason Building-128
790 Atlantic Drive
Atlanta GA 30332-0355
Tel. 404-894-2236
FAX 404-894-2278

Ms. Helen M. Meyers
Senior Engineer
CTA Incorporated
175 Middlesex Turnpike
Bedford MA 01730
Tel. 617-271-5529
FAX 617-275-1932

Dr. James H. Miller
Director, Univ. Transportation Center Program
Pennsylvania Transportation Institute
Pennsylvania State University
201 Research Office Bldg.
University Park PA 16802
Tel. 814-863-1909
FAX 814-865-3039

Ms. Cynthia M. Mitchell
Information Program Manager
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2271
FAX 617-494-3064

Mr. David Mitchell
Vice President & General Manager
Transportation Division
Battelle Memorial Institute
505 King Avenue
Columbus OH 43201
Tel. 614-424-4929
FAX 614-424-3260

Ms. Leisa Moniz
Volpe Center, DTS-30
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2098
FAX 617-494-3633

Mr. Richard F. Moorer
Assc. Dep. Asst. Secretary for Transportation Technologies
Energy Effncy & Renwble Energy EE-30
U.S. Department of Energy
1000 Independence Avenue, SW
Washington DC 20595
Tel. 202-586-9315
FAX 202-586-1637

Dr. Erik Mortensen
Chief Technology Transfer
Engineering & Applied Sciences
Columbia University
610 SW Mudd Building
New York NY 10027
Tel. 212-854-3151

Mr. David Moskovitz
Associate
The Regulatory Assistance Project
177 Water Street
Gardiner ME 04345
Tel. 207-582-1135
FAX 207-582-1176

Dr. Thomas Mottl
Principal
Strategic Consulting
Suite 200
38 Montvale Ave.
Stoneham MA 02180
Tel. 617-279-7990
FAX 617-279-7990

Ms. Marilyn M. Mullane
Chief, DTS-801
Management Systems Office
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2516

Mr. Peter K. Murphy
Senior Advisor
Stanley Associates
Bldg. 200 / 2200
One Kendall Square
Cambridge MA 02139-1561
Tel. 617-621-7110
FAX 617-577-1209

Dr. Raymond A. Nash, Jr.
Vice President
TASC, Inc.
55 Walkers Brook Drive
Reading MA 01867
Tel. 617-942-2000
FAX `617-942-7100

Mr. George W. Neat
Chief, DTS-74
Vehicle Crashworthiness Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2679
FAX 617-494-3096

Dr. Lance A. Neumann
President
Cambridge Systematics
150 Cambridge Park Dr. #4000
Cambridge MA 02140
Tel. 617-354-0167
FAX 617-354-1542

Mr. John S. Niles
President
Global Telematics
322 NW 74th Street-200
Seattle WA 98117
Tel. 206-781-9493
FAX 206-782-6761

Mr. Eileen Norcott
Chief, DTS-851
Procurement Review & Policy Branch
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2180
FAX 617-494-3649

Mr. John P. O'Donnell
Chief, DTS-42
Economic Analysis Division
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2142
FAX 617-494-2787

Mr. Robert O'Hara
Office of Intermodalism
U.S. Department of Transportation
400 7th St. SW
Washington, DC 20590
Tel. 202-366-8016
FAX 202-366-7952

Ms. Heather Paul
Director
National Safe Kids Campaign
111 Michigan Avenue, NW
Washington DC 20010
Tel. 202-884-4993
FAX 301-650-8038

Dr. Anthony J. Pellegrini
Director
Transportation, Water & Urban Devlpmt Dept
The World Bank
1818 H Street, NW, Room S-4051
Washington DC 20433
Tel. 202-473-6752
FAX 202-522-3227

Mr. Eugene K. Pentimonti
Vice President for Government Service
APL-Government Affairs
American President Companies
1101 17th Street, NW
Suite 400
Washington DC 20036
Tel. 202-331-1424
FAX 202-775-8427

Mr. Richard Pereless
Manager
RMS Technologies, Inc.
305-E
600 Maryland Ave., SW
Washington DC 20024
Tel. 202-863-7370
FAX 202-863-7333

Dr. Joseph C. Perkowski
Manager, Advanced Civil Systems
Research & Development Dept.
Bechtel Corporation
Office 50-17-C35
50 Beale Street
San Francisco CA 94119-3965
Tel. 415-768-0560
FAX 415-768-0503

Ms. Sallye E. Perrin
Director of Environmental Services
DMJM
38 Chauncey Street, Suite 302
Boston MA 02111
Tel. 617-338-1494
FAX 617-338-2791

Dr. Donald H. Pickrell
Chief Economist, DTS-40
Office of Research & Analysis
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2858
FAX 617-494-3064

Dr. Elizabeth Pinkston
Economist
Natural Resource and Commerce Division
Congressional Budget Office
Ford HOB, Room 495
Washington DC 20515
Tel. 202-226-2940
FAX 202-226-4017

Mr. James Poage
Operations Research Analyst
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2371

Mr. Simon Prensky
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2451

Ms. Grace E. Ransom
Governmental Affairs Officer
Philadelphia International Airport
Terminal E, Executive Offices
Philadelphia PA 19153
Tel. 215-937-5499
FAX 215-937-6759

Mr. Philip R. Recht
Deputy Administrator
National Highway Traffic Safety Admin.
U.S. Department of Transportation
NOA-02, Room 5220
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-2775
FAX 202-366-2106

Ms. Isabel Reiff
Vice President
ICF Kaiser
9300 Lee Highway
Fairfax VA 22031-1207
Tel. 703-934-3006
FAX 703-934-9740

Mr. Ted Reuther
Oak Ridge National Laboratory
P.O. Box 2008
4500 N, MS-6207
Oak Ridge TN 37831
Tel. 423-574-8267
FAX 423-574-3895

Mr. Robert C. Ricci
Deputy Director, DTS-41
Office of Research & Analysis
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142

Dr. Herbert H. Richardson
Director
Texas Transportation Institute
Texas A&M University
801 CE/TTI Building
College Station TX 77843-3135
Tel. 409-845-5814
FAX 409-845-9356

Mr. Noah Rifkin
Director of Technology Deployment
Office of the Secretary
U.S. Department of Transportation
S-2, Room 10200
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-9783
FAX 202-366-7952

Mr. Stephen C. Roehrig
Manager, Advanced Transportation Programs
Transportation Systems Center
Sandia National Laboratories
MS-0766, Organization 9600
P.O. Box 5800
Albuquerque NM 87185-0766
Tel. 505-844-6968
FAX 505-844-2193

Mr. Paul Rosenstrach
U.S. Department of Transportation
Volpe Center
55 Broadway, Room 1256
Cambridge MA 02142-1093
Tel. 617-494-3558
FAX 617-494-2370

Mr. Michael Rossetti
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2020

Mr. Richard Sacane
Program Manager
WT Chen & Company, Inc.
1000 Winter Street
Suite 2150
Waltham MA 02154
Tel. 417-494-2439
FAX 617-494-3294

Mr. Mark Safford
Management & Program Analyst, DTS-24
Transp. Planning & Analysis Office
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-3411
FAX 617-494-3688

Mr. Gobal Samavedam
Division Manager
Foster-Miller, Inc.
350 Second Ave.
Waltham MA 02154
Tel. 617-890-3200
FAX 517-890-3389

Mr. John E. Sandorff
Manager, Transportation-Parts & Service Support
Caterpillar, Inc., (MT142)
P.O. Box 474
Morton IL 61550
Tel. 309-266-3654
FAX 309-266-4063

Mr. Clifford M. Sayre
VP DuPont (retired)
Center for Transportation Studies
30 Southridge Dr.
Kennett Square PA 19348
Tel. 610-444-6462
FAX 610-444-2141

Mr. Marc Schoen
Airport Compatibility Group Manager
Douglas Airport Company
3855 Lakewood Blvd.
Long Beach CA 90846-0001
Tel. 310-593-4089
FAX 310-982-6713

Mr. David F. Schulz
Executive Director
Infrastructure Technology Institute
1801 Maple Avenue
Evanston IL 60201-3135
Tel. 708-491-8165
FAX 708-491-4486

Mr. Robert Schumacher
Director, Automotive Electronics Development
Delco Electronics
3011 Malibu Canyon Road
Malibu CA 90265-4799
Tel. 310-317-5439
FAX 310-31`7-5146

Mr. Bob Schwarz
Executive Vice President
Peter Pan Bus Lines
1776 Main Street
Springfield MA 01102
Tel. 413-781-2900

Mr. Damaso Seda
President
Local 100
Transport Workers' Union of Greater NY
80 West End Avenue
New York NY 10023
Tel. 212-873-6000
FAX 212-595-2139

Dr. D. K. Sharma
Administrator
Research & Special Programs Admin.
U.S. Department of Transportation
DRP-1, Room 8410
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-4433
FAX 202-366-3666

Mr. Michael Sheehan
Human Factors Analyst
Volpe Center, DTS-45
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-3412
FAX 617-494-3622

Mr. James D. Shields
Vice President
TASC
55 Walkers Brook Drive
Reading MA 01867
Tel. 617-942-2000
FAX 617-942-7100

Mr. Jeff Shull
Director of Security
Philadelphia International Airport
Terminal E, Executive Offices
Philadelphia PA 19153
Tel. 215-937-5499
FAX 215-937-5499

Mr. Frederick Siems
Vice President
Booz, Allen & Hamilton, Inc.
8283 Greensboro Drive
McClean VA 22102
Tel. 703-902-5650
FAX 703-902-3631

Mr. Albert Skane
Information Systems Analyst
Volpe Center
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-3722
FAX 617-494-3028

Mr. Robert A. Smith
Chief, DTS-68
Information Integration Division
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 202-494-2654

Mr. Guy St. Sauveur
Booz-Allen & Hamilton Inc.
120 Boylston Street
Boston MA 02116
Tel. 617-753-0404
FAX 617-753-0411

Mr. Vladimir A. Starselsky
Operations Research Analyst
Volpe Center, DTS-57
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2653

Dr. Mary D. Stearns
Project Manager, DTS-45
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2617
FAX 617-494-3622

Mr. Lewis M. Stocker
Transportation Analyst
The Gillette Company
30 Burtt Road
Andover MA 01810
Tel. 508-749-5198
FAX 508-749-5917

Ms. Louise F. Stoll
Assistant Sec. for Budget & Programs
U.S. Department of Transportation
B-1, Room 10101
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-9191
FAX 202-366-6031

Mr. John J. Sullivan
Vice President-Quality Management
ARINC Inc.
2551 Riva Road
Annapolis MD 21401
Tel. 410-266-4232
FAX 410-266-4040

Mr. Robert N. Tap
Chief, DTS-37
Strategic Management Division
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142

Dr. Peter Teagan
Vice President
Arthur D. Little, Inc.
25 Acorn Park
Cambridge MA 02140
Tel. 617-498-5000
FAX 617-498-7206

Ms. Susanne Thoring
Daimler Benz
3 Cambridge Center
Cambridge MA 02142
Tel. 617-577-0048
FAX 617-577-5893

Ms. Elizabeth Titus
Senior Analyst
New England Electric System
25 Research Dr.
Westborough MA 01582
Tel. 508-389-2660
FAX 508-366-6551

Mr. Donald Trilling
Director, Office of Env., Energy & Safety
Office of the Secretary #9222
U.S. Department of Transportation P-10
400 7th Street, SW
Washington DC 20590
Tel. 202-366-4220
FAX 202-366-7618

Ms. Pamela Tsang
Engineering Psychologist
Volpe Center, DTS-45
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-3675
FAX 617-494-3622

Dr. Frank F. Tung
Deputy Director
Volpe Center
U.S. Department of Transportation
55 Broadway
Cambridge MA 02142
Tel. 617-494-2333
FAX 617-494-3731

Mr. William Vandersteel
President
Ampower Corporation
Highwood Place
PO Box 417
Alpine NJ 07620-0417
Tel. 201-768-6014
FAX 201-768-6014

Mr. William Vincent
Special Assistant to the Administrator
Research & Special Programs Admin.
U.S. Department of Transportation
DRP-1, Room 8410
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-9777

Mr. Harry Voccola
Senior Vice President
Navigation Technologies
Suite 400
10400 W. Higgins Road
Rosemont IL 60018
Tel. 708-699-7070
FAX 708-699-8667

Mr. Richard L. Walker
Director, Office of Intermodal Development
Maritime Administration
U.S. Department of Transportation
MAR-810, Rm 7209
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-5474
FAX 202-366-6988

Dr. Patricia F. Waller
Director
Transportation Research Institute
University of Michigan
Ann Arbor MI 48109
Tel. 313-936-1046
FAX 313-936-1081

Mr. Robert A. Walter
DTS-72
Environmental Engineering
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2626

Ms. Judith Watten
Project Manager
Volpe Center, DTS-37
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-2120

Mr. George H. Webber
Chief, Plans Office
U.S. Department of Transportation
Volpe Center, DTS-21
55 Broadway
Cambridge MA 02142
Tel. 617-494-2491
FAX 617-494-3062

Mr. Herbert Weinstock
Chief, DTS-76
Structures & Dynamics Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2510

Ms. Cheryl Whetsel
Public Affairs
Research & Special Programs Admin
U.S. Department of Transportation
400 7th St., SW
Room 8414
Washington DC 20590
Tel. 202-366-4831
FAX 202-366-7431

Mr. Ted Williams
Senior Legislative Analyst
EG&G Dynatrend
Suite 1025
1750 N. Moore Stret
Arlington VA 22209
Tel. 703-812-3148
FAX 703-312-9026

Mr. Robert L. Wiseman
Deputy Director, DTS-51
Ofc. of Operations Engineering & Assessment
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142

Mr. John Wojtowicz
Security Tech Progam Manager
Volpe Center, DTS-38
U.S. Department of Transportation
55 Broadway
Kendall Square
Cambridge MA 02142
Tel. 617-494-3100

Mr. William D. Wood
Deputy Director, DTS-61
Office of Information Systems
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2468

Ms. Donna H. Woodman
Chief, DTS-59
Operations Assessment Div.
U.S. Department of Transportation
Volpe Center
55 Broadway
Cambridge MA 02142
Tel. 617-494-2714

Dr. Harold W. Worrall
Executive Director
Orlando-Orange County Expressway Authority
525 South Magnolia Ave.
Orlando FL 32801
Tel. 407-425-8606
FAX 407-649-8304

Mr. Charles L. Wright
Economist
Interamerican Development Bank
1701 New York Avenue
Washington, DC 20854
Tel. 202-623-2121
FAX 202-623-1428

Mr. Charles H. Yelen
Deputy Director
MASSPORT
10 Park Plaza
Boston MA 02116
Tel. 617-973-5560

Ms. Joan B. Yim
Deputy, Maritime Administration
Maritime Administration
U.S. Department of Transportation
MAR-100, Rn. 7206
400 Seventh Street, SW
Washington DC 20590
Tel. 202-366-1719`
FAX 202-366-3890

Mr. Karl-Heinz Ziwica
General Manager
Environmental Engineering
BMW of North America
BMW Plaza
Montvale NJ 07645
Tel. 201-573-2068
FAX 201-930-8401