
Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies

Summary of Proceedings

January 1994



U.S. Department
of Transportation

**Office of the
Secretary of
Transportation**

Research and Special Programs Administration
Volpe National Transportation Systems Center
Transportation Strategic Planning and Analysis Office

Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies

Summary of Proceedings

January 1994

**The Honorable Federico Peña
U.S. Department of Transportation**

ACKNOWLEDGEMENTS

I would like to thank all those who participated and contributed to this outreach series. The facilitators, panelists, participants, and exhibitors, whose names are listed in this document, greatly contributed to making the seminars an extremely useful forum. Special thanks to those at the host universities: Patricia Waller and University of Michigan staff; Daniel Sperling and University of California, Davis, staff; Thomas Humphrey and Massachusetts Institute of Technology staff; and C. Michael Walton and University of Texas, Austin, staff and graduate students. Thanks also to the staff of the Gerald R. Ford Library in Ann Arbor and the Lyndon Baines Johnson Library in Austin. Finally, thanks to the key developers and planners of the series, Judith Burrell, my Special Assistant for Defense Conversion; Richard R. John, Director of the Volpe National Transportation Systems Center in Cambridge, Massachusetts; and the staff of the Volpe Center's Transportation Strategic Planning and Analysis Office.

Federico Peña

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INTRODUCTION AND SUMMARY

A competitive, growing economy requires a transportation system that can move people, goods, and services quickly and efficiently. To meet this challenge, each transport sector must work effectively both by itself and as part of a larger, interconnected whole. Technologies that increase the speed, reliability, and cost-effectiveness of the transportation sector also will increase the economy's competitiveness and ability to create jobs.

President Bill Clinton
Technology for Economic Growth
October 28, 1993

We want to form partnerships with each and every one of you to the extent we can. We think we have the American genius and creativity in this country if only we can find a way to partner with you so that we can put it to wise applications and...eventually export it, so that ten or fifteen years from now we will be the exporters of this new technology in transportation and environment and other areas.

Secretary Federico Peña
Lyndon Baines Johnson Library
Austin, Texas
November 2, 1993

From September–November 1993, U.S. Department of Transportation (DOT) Secretary Federico Peña sponsored a series of meetings, called "Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies," to advance President Bill Clinton's technology policy and to reinforce the Administration's commitment to transportation-related research. Day-long seminars were held in cooperation with four

universities across the country: the University of Michigan, Ann Arbor; the University of California, Davis; the Massachusetts Institute of Technology, Cambridge; and the University of Texas, Austin. About 300 leaders in state and local government, industry, small business, and academia came together with the goal of matching transportation research and development needs with advanced technologies residing in the national



*The Honorable Federico Peña,
U.S. Secretary of Transportation*

laboratories and defense industries. Numerous key transportation research and development needs amenable to current technological solutions were identified, as well as promising advanced technologies. The seminar series was developed and planned by the Office of the Secretary and the Department's Volpe National Trans-



(left to right) Louise Stoll, Assistant Secretary for Budget and Programs, U.S. DOT; Secretary Federico Peña; and Professor Barbara Jordan, University of Texas at Austin

portation Systems Center's Transportation Strategic Planning and Analysis Office.

Promoting the development of new technologies is one of the Clinton-Gore Administration's top priorities. Key speeches at the seminars by senior Federal officials—Secretary Peña; Katherine Gillman, Special Assistant for Defense Conversion at the White House Office of Science and Technology Policy; Louise Stoll, U.S. DOT Assistant Secretary for Budget and Programs; Grace Crunican, U.S. DOT Deputy Administrator for the Federal Transit Administration; Jane Garvey, U.S. DOT Deputy Administrator for the Federal Highway Administration; and Richard John, Director of the U.S. DOT Volpe National Transportation Systems Center—focused on recent Administration defense conversion accomplishments.

Nowhere is the promise of defense conversion greater than in transportation—where we are already witnessing a technological revolution that will transform our economy and our daily lives as much as railroading did in the last century or the automobile and commercial aviation have in the last few generations.

Federico Peña, U.S. Secretary of Transportation

I'm sure that everybody here realizes that we've made a U-turn in transportation policy. Throughout 40 years of Cold War, the main idea in our technology policy in the United States was to build the world's most sophisticated...war machine. Today the biggest challenge we face is economic. It's a tough challenge, and it's one that will take our best efforts to restore the nation's competitiveness and to regain leadership in important industries where we've lost it and to create good, new jobs and raise living standards of all Americans, not just the top echelon of the most educated and the most fortunate, but for everybody.

Katherine Gillman, White House Office of Science and Technology Policy

There is a tremendous amount of support for this defense conversion and for assisting agencies and moving agencies and companies into the 21st century in civilian applications.

Louise Stoll, Assistant Secretary for Budget and Programs

DOT is dedicated to helping mesh the users and the providers of transportation services and equipment with the research and technology community...The importance of the public-private cooperation in the defense conversion cannot be understated. We need all partners at the table.

Grace Crunican, Deputy Administrator, Federal Transit Administration

Investment in technology development can play a fundamental role in stimulating and in sustaining an economy that is competitive, that creates quality jobs and protects the environment and our future. From our perspective at the Department of Transportation, we are aware of the opportunities we now have to achieve these objectives through the application of advanced technologies to transportation functions.

Jane Garvey, Deputy Administrator, Federal Highway Administration

With the growing concerns about defense conversion, economic growth, mobility, environmental quality, and global competitiveness, the transportation community is ideally positioned to receive additional R&D resources. However, with this unique window of opportunity comes a major responsibility. The reason for this and similar seminars around the country is to make sure that we are generating technology that is needed by the markets and by you and me as travelers.

Richard John, Director, Volpe National Transportation Systems Center

Secretary Peña is currently working within the Department, as well as with several Federal agencies, to identify defense conversion and other advanced technology opportunities in transportation.

In addition to this seminar series, the Department is a full partner—along with the Departments of Defense, Commerce, and Energy; the National Science Foundation; and the National Aeronautics and Space Administration—in the Technology Reinvestment Project, or TRP. The TRP is an effort to stimulate the transition of military technologies into competitive, commercial products that will boost U.S. productivity. In October 1993, President Clinton announced that \$140 million in TRP funds would be awarded to 15 grant recipients. Secretary Peña noted that in this first wave of TRP grants, "six of the 15 were direct transportation technologies and another six had indirect applications in the area of transportation." In addition, the Department is engaged in discussions with the Department of Commerce's National Institute of Standards and Technology to include transportation-related activities in future Advanced Technology Program (ATP) solicitations. The ATP is the Department of Commerce's counterpart to the TRP.

The seminar series, "Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies," furthered Secretary Peña's goals for transportation research and technology in three ways:

- Broadened the base of people discussing how to connect defense conversion opportunities with transportation needs to include state

and local officials, entrepreneurs, and small business leaders, in addition to representatives of the traditional high-technology industries, major defense companies, national laboratories, and universities.



Katherine Gillman, Special Assistant for Defense Conversion, the White House

- Stimulated interest in transportation technology through seminar tours and exhibits (see Appendix A) that demonstrated actual applications of advanced technologies to transportation problems, such as Boston's Central Artery/Tunnel Project, electric vehicles produced by corporations and universities, alternative-fueled buses, and advanced technologies related to highway construction and high-speed rail.
- Encouraged participants to identify local transportation needs or problems that can be addressed with

defense-developed or other advanced technologies.

At each of the four seminars, discussions were held on the linkages between transportation and three key areas: the environment, infrastructure rehabilitation and maintenance, and new vehicle technology. Panels were composed of representatives from the private sector, public sector, and academia (see Appendix B). Representatives from the universities facilitated each seminar: *Ann Arbor* - Patricia Waller, Director, University of Michigan Transportation Research Institute;

Davis - Paul Jovanis, Professor, Department of Civil & Environmental Engineering, University of California; *Cambridge* - Yosef Sheffi, Director, Center for Transportation Studies, Massachusetts Institute of Technology; and *Austin* - Barbara Jordan, Lyndon B. Johnson Centennial Chair in National Policy, Lyndon B. Johnson School of Public Affairs, University of Texas, and C. Michael Walton, Ernest H. Cockrell Centennial Chair in Engineering, Chairman of the Department of Civil Engineering, University of Texas. A list of all seminar participants is included in Appendix C.

TRANSPORTATION AND THE ENVIRONMENT

Panel Members

Ann Arbor, Michigan

Garry D. Brewer, Dean of the School of Natural Resources and Environment, University of Michigan, Ann Arbor

Davis, California

Michael J. Gage, President and Chief Executive Officer, CALSTART

Richard S. Napier, Councilmember, City of Sunnyvale, California

Frank J. Tokarz, Acting Transportation Research Program Leader, Lawrence Livermore National Laboratory

Cambridge, Massachusetts

Ann Donner, Executive Director, Move Massachusetts 2000

Stephen J. Karol, Representative, Massachusetts State Legislature

Frederick P. Salvucci, Special Lecturer and Research Associate, Massachusetts Institute of Technology

Austin, Texas

William F. Hayes, President, Defense Systems and Electronics Group, Texas Instruments

Raymond C. Loehr, Professor of Civil Engineering, University of Texas, Austin

William R. Stockton, Director of Public Works and Transportation, City of Austin

Environmental sensitivities have increased dramatically in the last few decades. Technological

"It's not the money that we're concerned about. It's the ability to get this product to market and make money on it after we've made the investment, and we need government cooperation."

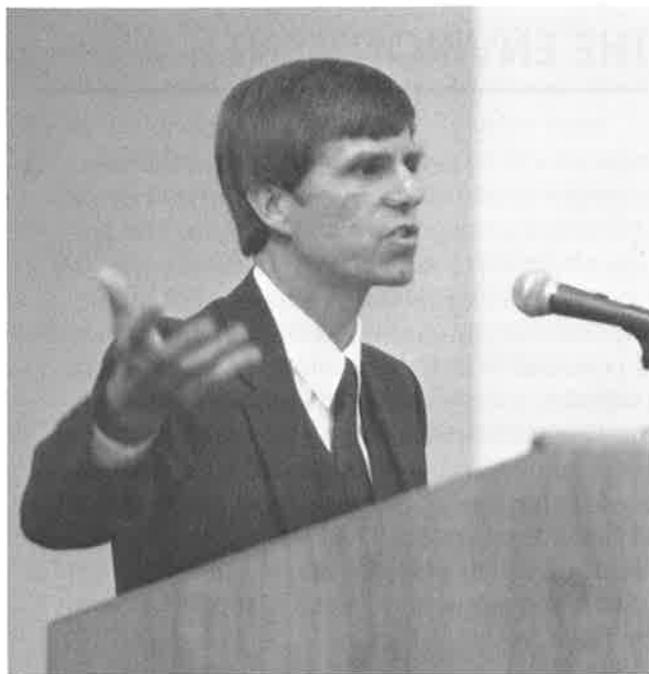
advances will be needed to meet the combined challenges of mobility and environmental needs. Achieving a satisfactory balance among transportation alternatives requires, in addition to national commitment and investment, that each component of the overall system be brought to its full potential in terms of performance, life-cycle economics, energy efficiency, and minimal adverse societal impacts. Major areas in which transportation and environmental concerns are linked include air quality, noise, global warming, and hazardous waste. The views of panel members and seminar participants on transportation and the environment reflected a number of common themes:

The Government's Role Should Be to Facilitate New Technology Applications

State and local transportation agencies and the defense industry are confronted with doing more with less, and with exploring new and effective ways of delivering high-quality products and services. They are faced with incorporating new technologies, reordering priorities, and with the need to be more environmentally sensitive. The Department of Transportation and other Federal agencies should facilitate solutions to environmental problems by matching new technologies with emerging needs through meetings such as these and through other mechanisms as well. In addition to providing funding for the solution of problems, the Federal Government should channel its resources to help plant the seeds of new industries. One participant noted that a promising opportunity for the Government is to establish incentives that create opportunities for the private sector to use defense technologies in new ways.

Yes, there is money from the Government, but I think, maybe more important, especially on this problem, there needs to be the organization and structures to bring all those parties together to focus on a solution to the problem.

Richard S. Napier, City of Sunnyvale, California



Richard Napier, Councilmember, City of Sunnyvale, California

The Nation Can Have Both a Strong Economy and a Healthy Environment

A vigorous economy and transportation system and a healthy environment do not have to be mutually exclusive goals. Environmental concerns have created an area of great potential economic growth, with new opportunities and a worldwide market for advanced technology applications. According to one participant, by the year 2000 the United States alone could spend as much as \$200 billion—or 3 percent of the Gross Domestic Product—just on air pollution control. Environmental standards and regulations need not be negative forces. The regulations are opening up a new industry and presenting new opportunities for automobile manufacturers and others. One panelist noted that because California has responded first and fastest to air pollution through regulations and innovative technologies, California industry is poised to enter into the global market for air pollution control products and services. Another panelist remarked that one way government can provide stable markets for new environmental technologies is by establishing intelligent regulations that get at the heart of environmental problems.

Companies like mine are willing to put up the money. It's not the money that we're concerned about. It's the ability to get this product to market and make money on it after we've made the investment, and we need government cooperation.

Jeffrey Salmon, GenCorp/Aerojet

One thing I think government can do is provide the private sector with some assurance of a steady flow of money so that they know there's a market out there if they can invent a better mouse trap. I don't think you want the Government inventing this mouse trap. I do think you want them providing the incentive.

Frederick P. Salvucci, Massachusetts Institute of Technology

It's very clear we have some of the very worst air pollution in the nation. We have a sustained recession and we have a declining defense and aerospace industry. All of those things are major liabilities, major problems that California faces. If you turn those around, they're also opportunities. We are responding first and fastest to a global problem...and there will be a global market for those responses.

Michael J. Gage, CALSTART

"We are responding first and fastest to a global problem...and there will be a global market for those responses."

The question is not one of either/or—not either a strong economy and adequate jobs or a satisfactory environment. The public believes and the policies of this country are firmly grounded in the recognition that we do not have to choose between a healthy environment and a healthy economy. This nation can have both.

Raymond C. Loehr, University of Texas, Austin

Local Areas Need Integrated Solutions to Environmental Problems

A local official suggested that one of the best things that the Federal and state governments can do is to demonstrate a short-term and long-term commitment to making sure that local public sector leaders are part of the advanced transportation industry. Local areas desperately need integrated transportation solutions that ad-

"Local areas are trying to address a problem that's bigger than us."

dress all aspects of environmental problems—air quality, water quality, noise, congestion, hazardous waste. Too often in the past, the solution to one problem has only exacerbated others. Local governments are today struggling to solve environmental problems that are bigger than they are. One participant suggested that looking at transportation systems from the point of view of a "mobility manager," rather than as discrete modes, may be one way to improve environmental problems. A mobility manager would focus on the best use of a given resource for a particular activity, thus avoiding duplication and taking into consideration environmental and energy factors.

Local areas are trying to address a problem that's bigger than us. It's not a local problem. It's not a state problem. It's not a Federal problem. It's not a private industry problem. It's all of our problems.

Richard S. Napier, City of Sunnyvale, California

I believe there looms an inevitable clash among the environment, personal mobility, and economics.

Whatever the long-term solution, local elected officials...will bear much of the heat associated with that change.

William R. Stockton, City of Austin, Texas

There really has to be a change in the paradigms that we're working with, and rather than the individual modes thinking of themselves as being in competition with each other, we have to begin to think of how can we, together, meet the mobility needs.

Robert J. Foy, Mass Transportation Authority, Flint, Michigan

If there's one message I would like to ask the Department of Transportation to take back to Washington, D.C., it's that we need the Federal Government to engage in the solving of these problems. We need the Federal Government to demonstrate the vision and the funding that resulted in, after the Second World War, the development of the Federal highway system...we at the local level are ready and willing to act in that partnership to solve these problems.

Lois Wolk, Mayor, Davis, California



The Honorable Lois Wolk, Mayor, Davis, California

Transportation Providers and Environmentalists Must Join Forces

Representatives from state and local government, academia, and industry agreed that environmentalists and transportation providers should set aside their "cultural" differences and forge new coalitions. One panelist reminded participants

that the transportation initiatives are part of an ecosystem that has both environmental and economic impacts. It is essential that the nation has a strategy that considers how changes in these patterns and methods affect the ecosystem. Environmentalists and transportation providers in-

"The fact that we're going to rebuild a bridge in Springfield doesn't make everybody in Springfield say, hey, let's go out and buy another car."

deed have common ground. Both share an interest in easing congestion and reducing transportation-related pollution. Highway improvement projects, such as the Boston Central Artery, are as sound an environmental investment as improved transit, because they will allow traffic to flow more smoothly and cars to operate more efficiently. An alliance between transportation providers and environmentalists could be the powerful political force, noted one participant, that is needed to sustain the nation's transition to a post-Cold War economy.

There is no doubt that the defense industry has the technology and has the capability to tremendously impact the transportation industry and the transportation challenge of the future...It still won't be an easy job...It will take partnering with academia, government, and industry that is already in the field, because without that, I think the transition of a defense industry to apply to a commercial sector will always be a failure.

William F. Hayes, Texas Instruments

Every time you talk about highway construction, there will be people who raise a red flag and say, wait a minute, anti-environment—you're putting more pavement down, you're going to put more cars on the road. Well, the fact that we're going to rebuild a bridge in Springfield doesn't make everybody in Springfield say, hey, let's go out and buy another car....there has to be a balance.

Stephen J. Karol, Massachusetts State Legislature

The tie between environment and transportation, which some people think of as an oxymoron, and other people think of as cognitive dissonance, is in fact one of the more powerful political combinations that need to be forged in order to create the political will to sustain the...transition into a new economy and provide jobs in the United States.

Frederick P. Salvucci, Massachusetts Institute of Technology



(left to right) Ann Donner, Executive Director, Move Massachusetts 2000; Stephen J. Karol, Massachusetts State Representative; and Jane Garvey, Deputy Administrator, Federal Highway Administration

Demand Management Is Not Enough—Advanced Technology and Transit Are Crucial

Although many proposed solutions to environmental problems involve drawing people out of their automobiles through market incentives, such as high gasoline prices, several participants felt that driver behavior could not be changed dramatically enough over the short term to make a difference in pollution. What is needed, according to local officials and others, is to bring advanced technology to bear on our transportation-related environmental problems. Key areas that must be pursued are new vehicle technologies, such as alternative fuels, electric vehicles, and advanced materials, and the development of mass transit systems that are efficient, reliable, and comfortable enough to represent a "realistic" alternative to the automobile and appeal to the general public.

Our local experience is that the wily driver will do almost anything to retain the flexibility of their personal automobile.

William R. Stockton, City of Austin, Texas

If you're concerned about the environment, probably one of the best improvements you can make is applying technology to the personal vehicle, in addition to mass transportation.

Richard S. Napier, City of Sunnyvale, California

It doesn't have to happen in the U.S. or in California. There will be clean-fuel vehicles developed in this nation or in this world.

Michael J. Gage, CALSTART

"The wily driver will do almost anything to retain the flexibility of their personal automobile."

Environmental Solutions Must Consider Energy Solutions

Energy and petroleum consumption of automobiles is a key driving force in the long run. The 1990s is a transitional decade, during which we have about a 10-year window of opportunity to think rationally about transportation, the environment, and energy from a "sustainable" point of view. According to one seminar participant, our "business as usual" way of thinking has been defined by oil and nonrenewable petroleum products. Each day, transportation activities consume about 9 million barrels of oil. Because oil is a non-renewable energy source, and because the demand for it is increasing steadily worldwide, we can no longer put off thinking about possible al-

ternatives. Electric propulsion seems to be the key to creating a sustainable, environmentally benign transportation system. However, as two panelists pointed out, there are both macro and micro problems related to electric vehicles that must be overcome, including the question of what type of resources we will use to generate electricity for both transportation and general use, and the issues surrounding the development

"Anything which helps us get off oil imports is of strategic interest to the country."

of an affordable and efficient battery for electric vehicles. One seminar participant raised questions related to the environmental effects of the additional electricity produced for electric vehicles. Participants were cautioned that they must look into broad approaches while considering the future. While one problem is being solved, all must work to assure that other problems are not being created.

Major sections of the economy have got to be transformed into something that they aren't right now, and transportation, just given the sheer weight of it in terms of consumption...has got to figure extremely prominently in whatever that conversion looks like. You have enormous responsibility ahead of you.

Garry D. Brewer, University of Michigan, Ann Arbor

Anything which helps us get off oil imports is of strategic interest to the country.

William Osborn, TravElectric Services Corporation

INFRASTRUCTURE REHABILITATION AND MAINTENANCE

Panel Members

Ann Arbor, Michigan

Robert J. Foy, General Manager, Mass Transportation Authority, Flint, Michigan

Davis, California

Robert Marchbanks, Director of Business Development and Government Coordinator, Morrison Knudsen/Centennial Civil Engineers, Inc.

Frieder Seible, Professor of Structural Engineering, University of California, San Diego

James W. van Loben Sels, Director, California Department of Transportation

Cambridge, Massachusetts

Jay M. Cashman, President, Cashman Associates

Richard R. John, Director, Volpe National Transportation Systems Center

John J. Judge, Director of Operations, Massachusetts Turnpike Authority

Austin, Texas

John E. Breen, Professor of Structural Engineering, University of Texas, Austin

Henry R. Muñoz III, Member, Texas Transportation Commission

Harry W. Voccola, Lockheed IMS

Supporting a sound economy and vigorous international competitiveness are goals of our national transportation system. To achieve this, however, needed levels of system performance must be achieved while meeting high standards of public safety. Until recently, all levels of government

"The transportation community is crying out for new and better ways to increase safety, reduce costs, and prolong the life of our aging infrastructure."

and transportation industries in the United States have placed more emphasis on construction and expansion than on preservation and renewal of infrastructure. With the completion of the interstate highway system and new legislation that restricts expansion of the transportation infrastructure, however, issues of rehabilitation and maintenance have become increasingly important to state and local transportation officials. Seminar participants' views on these issues can be summarized by the following:

There Is a Pressing Need for Infrastructure Applications of Advanced Technologies

As stated in the President's technology policy, one of the nation's greatest challenges is to apply new technologies to the rehabilitation and maintenance of our transportation infrastructure. One participant illustrated the impact of our fragile infrastructure on productivity and economic potential: Of the 575,000 bridge structures in the United States, 118,500 were rated structurally deficient in 1992. As many participants noted, there are many promising advanced technologies, such as nondestructive inspection instruments, advanced retrofit or repair technology for seismic problems, and advanced materials, that can be used to improve the nation's transportation infrastructure.

Whether it's the durability of recycled asphalt or the reliability of new de-icing chemicals, the transportation community is crying out for new and better ways to increase safety, reduce costs, and prolong the life of our aging infrastructure.

John J. Judge, Massachusetts Turnpike Authority

We can set a man on the moon within a hundred yards of where we want him to be...but yet not many city planners or traffic engineers in L.A. would guarantee they could get me across town in thirty minutes.

Robert Marchbanks, Morrison Knudsen

We're dealing with, really, an urban transportation crisis because there are many unmet transportation needs, and they're growing at a very, very significant rate.

**Robert J. Foy, Mass Transportation Authority,
Flint, Michigan**

Citizens told us that what they wanted to look at were ways of managing our transportation without expanding our transportation network, without widening roads, without building new roads; and even though the demand is greater, they wanted to be able to manage within our current infrastructure as much as possible.

**Thais Peterson, Mayor Pro Tem, Ann Arbor,
Michigan**

Whether it's tires being turned into foam or...lightweight concrete being developed, I think there's huge advances that can be made that will make the infrastructure improvements a heck of a lot cheaper to do in the future and we'll all enjoy the benefits.

Jay Cashman, Cashman Associates



*Jay Cashman, President, Cashman Associates
and Dr. Richard R. John, Director, Volpe National
Transportation Systems Center*

Defense Conversion Can Contribute to Solving Infrastructure Problems

U.S. defense companies have an opportunity to apply their strengths and expertise to finding solutions to many of the problems faced by our ag-

ing transportation infrastructure. The national laboratories could bridge the gap between research and development concepts and industrial commercialization, and might be able to bring the technology to the commercial market sooner. De-

"We can use people to come in and bring new ideas."

defense technologies with immediate application to the infrastructure include geographic information systems, command and control centers, fiber optic networks, remote sensors, and advanced composite materials. The combination of the transportation infrastructure and defense technologies will result in positive benefits for both the nation's transportation system and the economy overall. Advanced technologies, when applied to infrastructure maintenance and construction, which are inherently local industries, have the potential to create new, high-quality jobs for U.S. workers.

Given that one of the hallmarks of our nation's defense industry has always been the ability to develop and implement creative solutions to difficult problems, there is an enormous opportunity today to meet some of the traditional needs and transitional needs presented by the defense industry conversion by redirecting the industry's strength and brain power toward finding solutions to many of the problems faced by our nation's aging and deteriorating public highway network.

**John J. Judge, Massachusetts Turnpike
Authority**

We can use people to come in and bring new ideas, especially ideas on noninvasive procedures, nondestructive procedures, corrosion inhibitors, a lot of things that have been big in the space industry and the defense industry. That technology transfer can be made into our market.

John E. Breen, University of Texas, Austin

We think we have a role in transportation...there's a lot of advanced technology at the national laboratories that, if we could find a home for and do some teaming with the industry, might be applicable...We have a

buffet of technology; industry and government has problems, and somehow we have to get together to match the two.

Frank Tokarz, Lawrence Livermore National Laboratory

State and Local DOTs See Value in Applications of Defense Technologies

State and local transportation officials are looking to the defense sector for many of the technologies needed for infrastructure renewal. Specific needs are for high-performance construction materials, instruments for nondestructive infrastructure monitoring and evaluation, new construction methods, and integrated computer, sensor, communication, and display technologies. The principal factor determining whether or not new technologies are implemented at the state and local levels, according to several participants, is af-

"Our job is to understand the cost and benefit of the various technologies, but ultimately let the marketplace decide."

fordability. One participant suggested that "hybrid" solutions—for instance, bridges constructed partly out of composites and partly out of traditional materials—may be more cost-effective and may speed up technology deployment.

Whether it be in areas like the Intelligent Vehicle Highway System types of project, whether it be in the examination of the strength of materials and nondestructive testing, or whether it be surveying and infrared photography, helping us to determine the structural safety of our existing system, we increasingly are going to be looking at you to provide the answers and to be bringing ideas to the Texas Department of Transportation.

Henry R. Muñoz III, Texas Transportation Commission

The key word is affordable. If we cannot show that these new materials are cost-effective in the end, we are not doing our job right. If our bridge across I-5 costs 10 times more than a conventional bridge, then we have built a golden elephant and nobody will ever use it again.

Frieder Seible, University of California, San Diego

I think our job is to understand the cost and benefit of the various technologies, but ultimately let the marketplace decide.

James W. van Loben Sels, California Department of Transportation

There Are Institutional and Political Impediments to Innovation

Because the construction industry tends to be fragmented, with many small companies and few major players, it is hard to generate industrywide awareness and adoption of advanced technologies. It is also difficult for the transit industry to implement advanced technologies, because transit operators are constantly under pressure to control operating costs. Research funds are often limited in the transit industry. As a result, the industry frequently must use spinoffs from other places as its primary source of technological innovations. Other obstacles to the implementation of advanced technologies in transportation include community opposition, pressure to protect transportation workers' jobs, and state and local codes that inhibit change and limit transportation departments' ability to innovate.



Francis Duehay, City Councilor, City of Cambridge, Massachusetts



Jane Garvey, Deputy Administrator, Federal Highway Administration

In the infrastructure area, to a certain extent, we're prisoners of the familiar. We know what we've done in the past. We know it's really not working, but we're comfortable with doing the same thing because we know how to do it.

John E. Breen, University of Texas, Austin

The challenge of this defense conversion into transportation technology is how do we make this conversion transferrable to civilian production so that those most in need will always be able to benefit from the new technology.

Ann Donner, Move Massachusetts 2000

"In the infrastructure area, to a certain extent, we're prisoners of the familiar."

In the transit industry, in general, the research dollars that we've had have been very, very inadequate—very inadequate. We're getting mostly spinoffs from other places as opposed to trying to deal with our problems directly.

Robert J. Foy, Mass Transportation Authority, Flint, Michigan

Technology is more than just components. Technology is truly integration and operation of those complex technologies. It's important in this country that we develop the technologies and own them, but it's also important that we develop the applications that make them work.

Harry W. Voccola, Lockheed IMS

Partnerships Are Key to the Solution

Public-private partnerships can be a valuable mechanism to develop and implement transportation technology advances. If advanced technology solutions are to be pursued, partnerships with private industry will be essential. One participant noted that many state governments are looking to the defense industry to partner with state transportation agencies to help apply technology, thus helping their governments respond

"We are really looking at the decade of the 90s and the next century as a decade and a time of partnership."

to the needs of the citizen as quickly and efficiently as possible. Others pointed out that because states and local areas will continue to spend most of their transportation dollars on maintaining and operating the system, constructing an infrastructure to support Intelligent Vehicle Highway Systems (IVHS), alternative-fueled vehicles, and other new technologies will require heavy outside investment—by private industry, universities, and the traveling public.

We are really looking at the decade of the 90s and the next century as a decade and a time of partnership...in order for us to become a leader in new technologies, a leader in rehabilitation technologies or maintenance technologies, in order to capture some of the dynamic thinking that is taking place in the private sector and in Europe and in other places around the globe, we've got to do it with you.

Henry R. Muñoz III, Texas Transportation Commission

Taking the burden off of the public sector...[will] hopefully provide some additional operational bucks that will allow a lot of the newer technologies that many of you are very familiar with and have served the military very well and now can serve us.

Robert Marchbanks, Morrison Knudsen

Government has a role, but the marketplace ultimately is going to be charged for this service, because there is not enough money, if you add it all up, for government to do all of this...the market is going to have to be there, and market forces and private enterprise are ultimately going to deliver.

**James W. van Loben Sels, California
Department of Transportation**

The Federal Government should play a more active role in developing and diffusing new workplace technologies based on worker judgments and skill. For heightened Federal efforts to be effective, technology, extension services, manufacturing technology enters at Federal laboratories. The full spectrum of existing or proposed Federal technology programs should develop close links with working people and their unions....The development and introduction of new technologies must always be accompanied by increased training for effective workers.

**Albin J. Gruhn, President, California Labor
Federation, AFL-CIO**

NEW VEHICLE TECHNOLOGY

Panel Members

Ann Arbor, Michigan

Robert D. Ervin, Head, Engineering Research Division, University of Michigan Transportation Research Institute

Davis, California

Theodore L. Hullar, Chancellor, University of California, Davis

Steven A. Scott, Manager, New Business Development, Gencorp/Aerojet

Daniel Sperling, Professor of Environmental Studies and Transportation Engineering, University of California, Davis

Cambridge, Massachusetts

Bruce A. Draper, Department of Computer Science, University of Massachusetts, Amherst

Emil Frankel, Commissioner of Transportation, State of Connecticut

William Osborn, General Manager, TravElectric Services Corporation

Austin, Texas

William B. Craven, Vice President, Business Development, Electrosorce, Inc.

N.C. Griswold, Professor of Electrical Engineering, Texas A&M University

Russell H. Pentz, Assistant General Manager, Houston METRO

The flexibility and convenience of the private automobile assure its dominant position for the indefinite future, and thereby focus attention on the need for a new generation of motor vehicle—a "personal transportation system" that represents another major reduction in emissions and fuel consumption, without compromising functionality or safety, and at an acceptable cost. Major advances of this type would be especially beneficial to the world competitive position of the U.S. automobile manufacturing industry. Many of the technological improvements developed for automobiles would also be of value for transit cars, trucks, and buses. The following

themes emerged from the seminar discussions of new vehicle technologies:

DOTs Should Lead the Way in Technology Innovation

Many participants felt that the Federal and state DOTs should guide the development of new vehicle technologies by providing industry and universities with a vision and strategies for realizing



The Honorable Bruce Todd, Mayor, Austin, Texas

it. One participant remarked that the job of government in the development of transportation technologies was to be a catalyst, to take a little bit of the risk, and to create a friendly business environment. Although a virtual "toolbox" of technologies exists, governments need to establish priorities for their development and deployment. One participant felt that governmental priorities are particularly important because many companies take a short-range view. Others emphasized that cooperation among governments, private in-

dustry, and universities should be strengthened and broadened. Businesses and governments need to know what research universities are undertaking, while universities must be aware of business and governmental research needs.

DOT and the State DOT need to play a much more aggressive role in orchestrating and guiding development and deployment process and new technologies.... We need some kind of vision. We need some kind of strategy to guide us.

Daniel Sperling, University of California, Davis

Our approach is not to reinvent Buck Rogers. It's to take advantage of some of the technologies out there that you've already heard today we don't know much about. We've learned a heck of a lot more about it, but we want to know more about it. We do want to partner with you.

Russell H. Pentz, Houston METRO

**"We need some kind of vision.
We need some kind of strategy
to guide us."**

We don't know your problems. You don't know our technology. The only way for us to actually make use of this research that we're doing and for it to see the light of day is for cooperation to happen.

Bruce A. Draper, University of Massachusetts, Amherst

There Is a Range of Opportunities for New Vehicle Technologies

There are today tremendous opportunities for developing and commercializing new vehicle technologies. These opportunities have been generated in part by automobile manufacturers that are looking for new forms of auto electronics, since variations in quality and other forms of product differentiation have become minimal from company to company, and in part by energy and environmental standards. Several participants agreed that, as a strategy, technology offers greater opportunities to reduce congestion, energy use, and pollution than do behavioral ap-



Grace Crunican, Deputy Administrator, Federal Transit Administration

proaches. Many of the key technologies, such as infrared, radar, and digital information displays, are already known. The challenge will be to make these technologies the right size, weight, and price for commercial use. High-priority technologies for new vehicles are electric and hybrid propulsion, advanced lightweight materials, and IVHS.

There are a myriad of opportunities, both for transit and for you folks in here that are looking for opportunities in technology. There's a myriad of opportunities that we have just scratched the surface on.

Russell H. Pentz, Houston METRO

Opportunities to improve our transportation system, to reduce congestion, and especially to reduce energy and environmental impacts, are so large and so much greater with technology than they are with...behavioral-type changes, especially in the near and medium term, that we really have a responsibility to get on with it.

Daniel Sperling, University of California, Davis

**"There's a myriad of
opportunities that we have just
scratched the surface on."**

Since the largest bus manufacturer in the nation only makes 300 buses a year, there's a huge opportunity to move into this marketplace.

Michael J. Gage, CALSTART

That is what the defense industry has done for us: created a new material, re-engineered the battery, and is building a pilot production plant that has zero emissions.

William B. Craven, Electrosorce, Inc.

The Defense Sector's Role Is Unclear

Although many of the innovations being introduced in cars and other vehicles can be traced to the defense sector, the future role of the defense industry in new vehicle technology is unclear. One participant suggested that the level of sophistication of defense technology is far beyond the needs of the automotive marketplace. For automotive technologies, he remarked, the bottom line is their utility and value as perceived by the customer and how much the customer will pay for them. Another issue is the way in which many defense technologies are designed—extremely high quality and often with redundant safety systems for reliability—which makes them

"We've got to be very selective on which things we keep and which things we transfer to the commercial market."

more expensive to produce than typical commercial technologies. Still, participants named several defense technologies with commercial vehicle applications, like night vision enhancement, remote sensing, and active safety systems.

There is a tech push that is coming into automotive transportation from electronics, a very substantial core of which can be traced directly to the achievements in the defense sector. But there's a very pregnant question about the extent to which the defense sector that originated most of this technology will, in fact, become directly involved in implementing

or...actually finding business in the delivery of that technology as it becomes implemented in the motor vehicle.

Robert D. Ervin, University of Michigan Transportation Research Institute

We really want to get some of these technologies out into the marketplace and we need to couple with others like us in this room to make that happen. And I cannot reiterate enough that we've got to be very selective on which things we keep and which things we transfer to the commercial market to make it a success.

Steven A. Scott, GenCorp/Aerojet

The new areas of research...are to look at safety without the redundancy.

N.C. Griswold, Texas A&M University

We Must Focus on the Auto for Solutions to Environmental and Energy Problems

A number of participants felt that because the private automobile appears to be here to stay, advanced technologies leading to development of a "green car" should be the focus of efforts to reduce transportation's environmental impacts. Electric vehicles are one possible option. However, participants raised questions concerning the feasibility and affordability of electric vehicles, including limitations of batteries for energy storage and the projected cost of these and similar innovative vehicles. Although studies generally show electric vehicles to yield overall energy improvement, participants voiced their concern that increased fuel consumption may be required to supply the electricity that powers the vehicles, and questioned the overall efficiency of electric cars in comparison with the traditional internal combustion vehicle. One panelist stated that po-

"Electric propulsion is truly the key to creating a sustainable, more environmentally benign transportation system."

tential solutions to the issues surrounding electric batteries are hybrid vehicles or very small vehicles that do not need a battery. This panelist remarked that a market for electric vehicles as short-range "commuter cars" will exist even if they are never designed to perform like internal combustion cars.

Electric propulsion is truly the key to creating a sustainable, more environmentally benign transportation system.

Daniel Sperling, University of California, Davis

A big problem, of course, for electric vehicles is that the technology has not been there to create a car which is...comparable to internal combustion performance. But the technology is changing very, very fast...the notion that the electric car simply can't perform is going to start disappearing.

William Osborn, TravElectric Services Corporation



William Osborn, General Manager, TravElectric Services Corporation

Although we're driving toward zero-emission vehicles, a hybrid that's 95 percent or 98 percent clean may get us there in the most cost-effective way.

James W. van Loben Sels, California Department of Transportation

IVHS Technologies Are Being Developed and Deployed

Along with electric vehicles, IVHS technologies offer a solution to energy and environmental problems by helping to ease congestion and smooth traffic flows. Many intelligent vehicle

"It's not just conceptual. They are building it, and they are selling it."

technologies are under development or are being site-tested, among them onboard emergency obstacle avoidance, landmark positioning systems, and motorist information systems. One example of a self-sustaining IVHS public/private partnership is Help, Inc., a not-for-profit corporation of state governments and trucking companies with a charter to bring technology to motor carrier operations. However, some participants expressed concern over a variety of aspects of IVHS. One stated that we are not technologically constrained when it comes to the development of an IVHS architecture; we are instead restricted by institutional issues like the needs, interests, and obstacles that differ from community to community. Another felt that IVHS efforts should be re-focused in terms of "smart paratransit," a system that would make real-time information available to transit service providers.

We have to manage our existing system to minimize...congestion as best as we can so people and goods can move efficiently....That's why things like IVHS are so important.

Emil Frankel, State of Connecticut

Some people are already making money. Some people are already moving into new businesses because it's not just conceptual. They are building it, and they are selling it.

**Robert D. Ervin, University of Michigan
Transportation Research Institute**

We want to stress advanced technologies...One of the major advantages we've got in this state is the synergy between IVHS—its concept and systems and electronics and all the other gear—telecommunications, command, control and communications, and electric vehicles.

Theodore L. Hullar, University of California



*James van Loben Sels (standing),
Director, CALTRANS*

RESPONSES TO SECRETARY PEÑA'S SEMINAR QUESTIONS

In conjunction with the seminar series, "Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies," Secretary Peña submitted a series of questions to seminar participants and invitees pertaining to transportation needs in their communities, the advanced transportation technologies that their organizations are currently using and those that

"Our nation's best asset is its people and we waste too much time moving them around the country."

will be used in the future, and the role of defense conversion and partnerships in the development and manufacture of transportation goods and services. The major themes that emerged in the responses have been summarized below.

Transportation Needs

We need to get the various transportation industries' planners involved...in developing new, innovative ways to move people efficiently, both by air and on the ground. There is too much time wasted in the transfer of people from one mode to another....Our nation's best asset is its people and we waste too much time moving them around the country.

Richard Spivey and Ron Reber, Bell Helicopter

Through the seminar questions, meeting participants were asked to describe the most pressing transportation needs in their communities. The range of responses revealed that wherever people are using the transportation system, whether it is the Northeast, Midwest, South, or the West Coast, similar problems exist. Congestion and environmental issues, such as air quality, are not unique to any single region and are the dominant forces behind the call for improved vehicle design, transit systems, and transportation infrastructure. Although the needs expressed in the responses to seminar questions tend to be cross-cutting in nature, they have been categorized in

three major areas: vehicles, infrastructure, and systems modeling and monitoring techniques.

Vehicles

The convenience that the motor vehicle offers has given it great appeal and has led to its extensive use in this country for both passenger and freight transport. The dominance of motor vehicles in our culture has resulted in excessive reliance on and considerable consumption of nonrenewable petroleum products, congestion in urban areas, poor air quality in many regions, and extensive use of natural resources for vehicle manufacturing. Nancy Worst of the Texas Natural Resource Conservation Commission commented, "Future air quality in several metropolitan areas of Texas is directly tied to reducing emissions from mobile sources. Any technologies which can reduce vehicle emissions and/or reduce vehicle miles will



*The Honorable Federico Peña,
U.S. Secretary of Transportation*

be beneficial. We would like to see research and development efforts focused in this area." Most of the vehicle-related needs expressed in the seminar questions address ways in which adverse environmental impacts can be reduced through the redesign of cars, trucks, and buses. The bullets that follow are the vehicle-related needs identified in the answers to seminar questions:

- Improved fuel efficiency through: lighter vehicles, improved internal combustion engines, and alternative propulsion systems.
- Reduced vehicle emissions, which cause adverse health effects or contribute to global warming, through: improved internal combustion engines and alternative methods of propulsion.
- More "environmentally friendly" vehicles that are recyclable.
- Improved safety through vehicle control systems that reduce the incidence of accidents.

Infrastructure

Congestion has reduced the overall efficiency of the transportation system and has stressed the transportation infrastructure. Seminar participants identified numerous ways in which the existing transportation infrastructure could be used more effectively through the application of advanced technologies, and ways to improve infrastructure maintenance and rehabilitation processes. Many remarked that improved techniques for infrastructure construction and maintenance, for example, are needed to reduce costs, improve the reliability of structures, minimize construction-related congestion delays, and improve the safety of highway workers and the traveling public. **Steven Velinsky** of the **University of California, Davis**, commented, "Currently, highway work in California is recognized to be more dangerous than work for the California Highway Patrol!" The following are infrastructure-related needs expressed in the answers to seminar questions:

Reducing Congestion by Using the Existing Infrastructure More Effectively

- Improved traffic flow and control, including incident management.
- Better real-time information for travelers.
- A systemwide management perspective.
- Intermodal transfer and linkage management.

Transportation Infrastructure Construction, Rehabilitation, and Maintenance Needs

- Improved techniques for inspecting, maintaining, and managing transportation infrastructure.
- Improved methods for designing and constructing transportation infrastructure.
- New ways of financing infrastructure maintenance.

The Transit Infrastructure

- Viable alternatives to personal cars and light trucks for transportation needs, such as convenient, nonlinear commuting systems (a network, rather than a corridor solution); interconnected rail and bus networks; and rapid mass transit between local population centers.
- Reduced transit system operating and maintenance costs.
- Improved transit station access.

Systems Modeling and Monitoring Techniques

A pressing need mentioned by seminar participants was better modeling and monitoring techniques. The environment, again, was an important driving force behind these needs. One of the major challenges facing the transportation community is enhancing the abilities to monitor the behavior of the transportation system and its

interaction with the environment for noise levels, air and water quality, and the presence of pollutants. A similar need is for the monitoring of the performance of the transportation system to assess how well its various elements are working, and to compare alternatives. Information of this type, and associated management tools, are essential for rational and efficient resource allocation. The bullets that follow are the needs relating to systems modeling and monitoring that were identified in the answers to seminar questions:

- Improved methods for monitoring/measuring mobile source emissions.
- Improved modeling/simulation capabilities related to vehicle safety, manufacturing, and environmental issues.
- Expanded trip-reduction programs, especially those advancing technologies that allow work at home.
- Methods for tracking hazardous cargo.

Applying Advanced Technologies to Transportation—Matching Needs with Opportunities

The range of applications is already very broad with technology available to address many of the problems.

Primary concern is how to make the technology applications cost-effective, i.e., develop methods by which the known techniques are affordable to the public and private sectors.

Dale Ausherman, Environmental Research Institute of Michigan (ERIM)

Realization of a sustainable transportation system, and of our national and global transportation goals, will be a difficult, long-term undertaking. Technology, however, can offer some productive avenues for achieving this vision. **Ron Koopman** of **Lawrence Livermore National Laboratory** commented that the application of a variety of technologies will be necessary to improve our transportation-related congestion and environmental problems. He stated, "Clean, safe, ultra-low emission vehicles

will still not solve the congestion problems faced in California cities and many other cities in the U.S., [they] will just keep us from choking on our exhaust. Sensors and communications for automated traffic management would help. Telecommuting, working at home would help. Getting more people out of cars and onto bicycles would help. Improvements in mass transit are needed—

"Primary concern is how to make the technology applications cost-effective."

trains, subways,...buses." Seminar participants described a wide array of advanced technologies that have the potential to fulfill a range of transportation needs. These technologies are categorized below in three areas: motor vehicles, infrastructure, and environmental monitoring and measurement techniques.

Motor Vehicles

Although motor vehicles have improved significantly in the past 25 years in terms of safety, emissions, efficiency, comfort, and cost, a number of issues remain. Societal goals of environmental quality, transportation safety, and energy conservation often conflict with the desire for personal mobility. The technologies identified by seminar participants are possible solutions to a number of motor-vehicle-related drawbacks. Electric vehicles, for example, are a potential means of improving air quality, as well as employment in this country. A group of **participants from the Los Angeles Metropolitan Transportation Authority** noted, "A recent UCLA report indicated that the electric vehicles industry has a potential to create in excess of 24,000 jobs. This industry presents an opportunity for small researchers, small manufacturers and small business organizations to produce jobs for the State of California. Furthermore, the potential of expanding EV industry to global market is unlimited." The bullets listed below are the technologies which have the potential to fulfill vehicle-related needs. The technologies are divided into three groups: structures, propulsion, and electronics. Additional technologies which are applicable to rail and transit vehicles, and to aircraft, follow.



New vehicles display at University of California, Davis

Structures

- Lightweight, recyclable thermoplastics and composites.
- "Smart" materials for vibration dampening and structural integrity monitoring.

Propulsion

- Advanced batteries, such as a zinc/air battery or electromechanical flywheel battery, for electric and hybrid personal vehicles and buses.
- "Lean burn" internal combustion engines which put forth fewer emissions.
- Flywheel energy storage systems.
- Regenerative braking in advanced or lightweight hybrid vehicles to reduce pollution.
- Advanced-technology centrifugal compressor systems for refueling natural gas vehicles.
- Ultracapacitors for hybrid vehicles.

Electronics

- Improved solid-state electronics for vehicle radar sensors and all-weather passive vehicle detection sensors.

- Satellite systems engineering skills combined with high-volume/high-quality automotive manufacturing to develop automotive emergency communication systems.
- Micromechanical inertial sensors for vehicle location systems.

Rail and Transit Vehicles

- Advanced composite structures.
- Alternative fuels for buses: methanol, compressed natural gas, liquified natural gas.
- Advanced automatic train control systems.
- Superconducting magnetic energy storage.

Aircraft

- Tiltrotor aircraft to provide high-speed, point-to-point transportation.

Infrastructure

Much of the nation's transportation infrastructure is in need of rehabilitation and renewal to maintain transportation efficiency, access, and mobility. Given the size of the initial investment and the costs of maintaining our infrastructure, obtaining the best life-cycle performance is of great importance to users and to government at all levels. At the same time, the methods, tools,



Dr. Paul Jovanis discusses driver simulation research at the University of California, Davis

and materials used in infrastructure construction and maintenance change slowly.

According to seminar participants, improved infrastructure inspection procedures will provide data that is critical for highway agencies' planning, prioritizing, and budgeting of rehabilitation projects, as well as for detailed design of the projects. Automated pavement inspection systems, for example, will alleviate the need for dangerous lane closures and will provide information that is necessary for the formation of pavement management systems. IVHS was mentioned as a key technology cluster needed for more effective use of our existing transportation infrastructure. One participant saw two primary benefits that could be derived from IVHS: more efficient movement of people and goods, and improved traffic management in construction zones. The following are technologies that could meet transportation infrastructure needs. These technologies are grouped into four categories: ways to reduce congestion by using the existing infrastructure more effectively; transportation infrastructure construction, rehabilitation, and maintenance; the transit infrastructure; and the rail infrastructure.

Reducing Congestion by Using the Existing Infrastructure More Effectively

- Improved, low-cost video surveillance, traffic count, speed and vehicle identification, congestion management, incident management, and control engineering.
- Electronic toll collection systems using automatic vehicle identification, automatic vehicle classification, lane control, system management, system audit, and maintenance management.
- Advanced software for networkwide optimization for signal control on urban street systems.
- Sensors and communications for automated traffic management, including the application of neural networks to traffic monitoring and classification to improve accuracy.

- Countywide road network for computer modeling of traffic using geographic information systems.
- Laser devices and advanced processing technology to provide measurements of the dynamic environment of vehicles in motion.
- Software engineering and design for data fusion, and database design for traveler information systems.

Transportation Infrastructure Construction, Rehabilitation, and Maintenance

Construction

- Composites for use in pavements and bridge components.
- Improved bridge fabrication methods, such as improved welding processes, to lower the cost of bridge repairs and replacement.
- Recycled plastic and paper fibers to control cracks from shrinkage of concrete pavements.
- High-volume coal fly ash concrete for use in rigid pavements.
- Bridge designs where components are easily accessible and that incorporate tracks for robotics for automatic inspection.

Inspection

- Advanced nondestructive inspection systems to inspect bridges and pavements using acoustic emission, ultrasound, and infrared thermography technologies.
- Ground-penetrating radar for highway speed inspection of subsurface conditions of bridge decks and pavements.
- Advanced sensors to determine paint condition on bridges.

Maintenance

- Advanced automation and robotics technologies for the purposes of automating highway maintenance and construction activities.

Management

- Infrastructure mapping in real time using global positioning system (GPS), image processing, and stereo video.
- Electronic database for facilities management integrated with 3-dimensional modeling for visual references to be used during design, construction, and maintenance of bridges.

The Transit Infrastructure

- Develop transit security systems.

The Rail Infrastructure

- Explore magnetic levitation technology for high-speed rail transportation.

Environmental Monitoring and Measurement Techniques

The development of improved models, simulations, and other analytical tools can support both long-term planning and real-time management of transportation systems and resource allocation within and among transportation alternatives and modes. More sophisticated tools have the potential to improve our understanding of environmental problems, transportation activity, vehicle emission characteristics, atmospheric chemistry, and diffusion of pollutants. In their responses to the seminar questions, participants noted that the application of technologies for sensing chemical and physical phenomena could improve both the quality and reliability of the data being collected. The following bullets illustrate the monitoring and measurement technologies identified by seminar participants:

- Pulsed power NOx removal.

- Air quality surveys using LIDAR to evaluate mobile sources of air pollution.

Defense Conversion—How Can It Help in the Development and Promotion of Advanced Transportation Technologies?

The defense industry can address any number of transportation issues....If the defense industry can make concrete last longer, make a road surface last longer, eliminate pot holes, build better or cheaper bridges through new technologies, then those would be significant contributions to the improvement of the transportation industry in this country. Regarding public transportation, the defense industry may well have the ability of building a bus that is functional and economical to use and that would attract more ridership. I think the defense industry needs to understand that the markets are here and they have to find ways to exploit those markets.

Robert K. Morris, Wayne County Government, Michigan

The opportunity that we have, as a nation, to redirect our resources from defense to civilian priorities represents both a challenge for the defense industry and a chance to explore and expand applications of advanced technologies to the trans-

"If the defense industry can make concrete last longer, make a road surface last longer, eliminate pot holes, build better or cheaper bridges through new technologies, then those would be significant contributions to the improvement of the transportation industry in this country."

portation community. The defense industrial sector is the origin of many of the technologies described earlier, such as advanced sensor and control technology and advanced materials. Defense conversion, while complex and difficult, can be a win-win situation for the defense industry, as well as for transportation suppliers, operators, and users.

In their responses to the seminar questions, meeting participants expressed their enthusiasm for transportation applications of advanced technologies that could be developed by the defense industries and the national laboratories. For example, U.S. auto manufacturers have examined Department of Defense and Department of Energy laboratories and have found synergy between the labs' work and their own for the next generation motor vehicle. They believe defense technologies can be focused to benefit new automobiles. Transit operators feel that there are many technologies that were developed using defense dollars that could be adapted and applied to transit in the areas of advanced automatic train controls, advanced energy storage technologies (superconducting magnetic energy storage, flywheels, advanced batteries), advanced facility maintenance technologies using artificial intelligence, as well as others. A local government participant noted that his organization is excited about the potential of defense technologies for improving highway technology and maintenance and airport operations. While budgetary limitations make it difficult for local government to be on the cutting edge of transportation technologies, it is interested in working with the defense industry on experimental, high-technology ideas.

The Role of Partnerships in the Development of Advanced Transportation Technologies

Through partnerships with private industry the national laboratory can make new technologies available for commercialization anywhere in the country depending on the industrial partner's location.

Larry S. Blair, Los Alamos National Laboratory

Yielding the necessary innovations in transportation will require productive collaboration among all levels of government, private industry, the na-

tional laboratories, and universities. Such partnerships have the potential to accelerate innovation, yielding a more flexible and responsive transportation system and a stronger position in global markets for U.S. industry.

Many of the seminar participants stated that they had partnered with organizations from the public and private sectors, as well as with academia, to develop transportation-related proposals for the first round of the Technology Reinvestment Project, or TRP. **Eugene Nishinaga of Bay Area Rapid Transit (BART)** described how BART, along with Hughes and Morrison Knudsen "ap-

"Through partnerships with private industry the national laboratory can make new technologies available for commercialization anywhere in the country."

plied to the ARPA Technology Reinvestment Project for funding to develop an advanced automatic train control (AATC) system using proven military communication and vehicle location technology....the system to be developed will double the passenger carrying capacity of the BART system without requiring the installation of additional rail lines." Several other participants indicated that they would like to be involved in the initiative again in the future.

In addition to their work with the TRP, numerous respondents discussed their interest and involvement in a variety of collaborative arrangements that have supported the development of advanced transportation technologies. Several organizations have developed Cooperative Research and Development Agreements (CRADAs) with Federal Government agencies, such as the Departments of Energy and Defense and the National Institute of Standards and Technology. **Jack Simon of General Motors R&D Center** commented that GM's "Engine Support System Technology Program has over 100 CRADA projects identified at Government Labs in U.S. Benefit will be engines that run lean with reduced emissions."

Partnerships and collaboration are crucial to "non-zero-sum" relationships, in which everyone gains. This kind of partnering is illustrated by a group of U.S. automobile manufacturers that have joined together through organizations like the United States Council for Automotive Research and the National Center for Manufacturing Sciences to establish a technical infrastructure that will bolster international competitiveness for the U.S. auto industry as a whole. Partnerships with private-sector firms can help to bring advanced transportation technologies to transit operators. BART, for example, has agreed with private industry to participate as a technology demonstration site for advanced-technology products. If funding for such products becomes available, BART will be involved in the test and demonstration of technologies such as superconducting magnetic energy storage and military surveillance technology.

Other firms have found that collaboration with states, Federal agencies, and academic organizations are key to the successful development of technologies. Through partnerships, both future users and customers can provide input into the design of transportation technologies, thus helping to create useful, usable, and expandable products and systems.

What Does the Future Hold for Advanced Transportation Technologies? Development, Manufacturing, "Conversion," and Employment Issues

Advanced technologies and defense industry conversion efforts, more specifically, marketing and distribution of the products and sources, would not only create more job opportunities; strategic research would have an impact in propelling the United States toward a global economy.

David Dimaline, Department of Planning, City of San Antonio, Texas

There is no question that the advanced technologies identified through the responses to seminar questions have the potential to improve our transportation systems and generate employment opportunities. As participants looked to the future,

they commented on the positive aspects of defense conversion and advanced transportation technologies, as well as on the hurdles which must be addressed if defense conversion to advance transportation technologies is to succeed.

One participant remarked that conversion opportunities exist in *all* areas of transportation, but in order to identify and develop transportation technologies successfully, the needs of travelers and freight shippers must be considered instead of the "needs" of vehicles and individual modes. Infrastructure inspection, in particular, was identified as a promising, untapped technology. The



Michael Walton, University of Texas at Austin, and Secretary Federico Peña

needs of our extensive highway system spur infrastructure technology development in this country; therefore, this is an area in which the United States is well-positioned to take the lead. There is a strong market overseas for much of the infrastructure inspection equipment we develop here. The momentum in the United States to develop the "electronic superhighway" was identified as another driver of commercial demand for new products.

While the future looks bright for advanced transportation technologies, a smooth transition to civilian markets for the defense industry is crucial to their successful development and deployment. **Lyn Pozzi of Mirage Systems** stated, "Defense products offer the United States a technology edge over the rest of the world; however, this technology needs to be converted into commercial products, manufactured in quantities and

marketed at low prices." These are all monumental tasks that are unfamiliar to the defense industry. This participant indicated that research and development funding is essential for defense conversion, so that the United States can remain competitive and lead the way in this era of globalization. **Russell Steele** of TRW commented that in the short term, the greatest market opportunities for advanced transportation technologies and associated employment will be in areas with the highest levels of traffic congestion

"Strategic research would have an impact in propelling the United States toward a global economy."

and the poorest air quality. In the long term, however, "major investment in advanced programs such as advanced traffic management systems and automated highway systems" will be necessary to replace lost aerospace engineering and technical jobs with equivalent positions in the transportation sector.

As we examine what steps need to be taken to promote transportation technologies, one participant stated that emphasis should be placed on manufacturing, rather than on service industries, because it is our most important job and wealth-producing base. The focus on advanced research and development should continue, but more emphasis should be given to applying technology and to short-term technology assistance. Another commented that advanced, sophisticated transportation technology is being procured from abroad; defense conversion efforts need to be focused on basic transportation technologies, so that the benefits that spring from the ownership, manufacture, and distribution of these technologies can be reaped by the United States. **Robert Morris** of **Wayne County Government, Michigan**, stated, "It is hoped that the defense industry could contribute in such a manner that in 10, 15 or 20 years it is the Europeans and Asians who come to the United States to see how a transportation network should function."

FINAL OBSERVATION

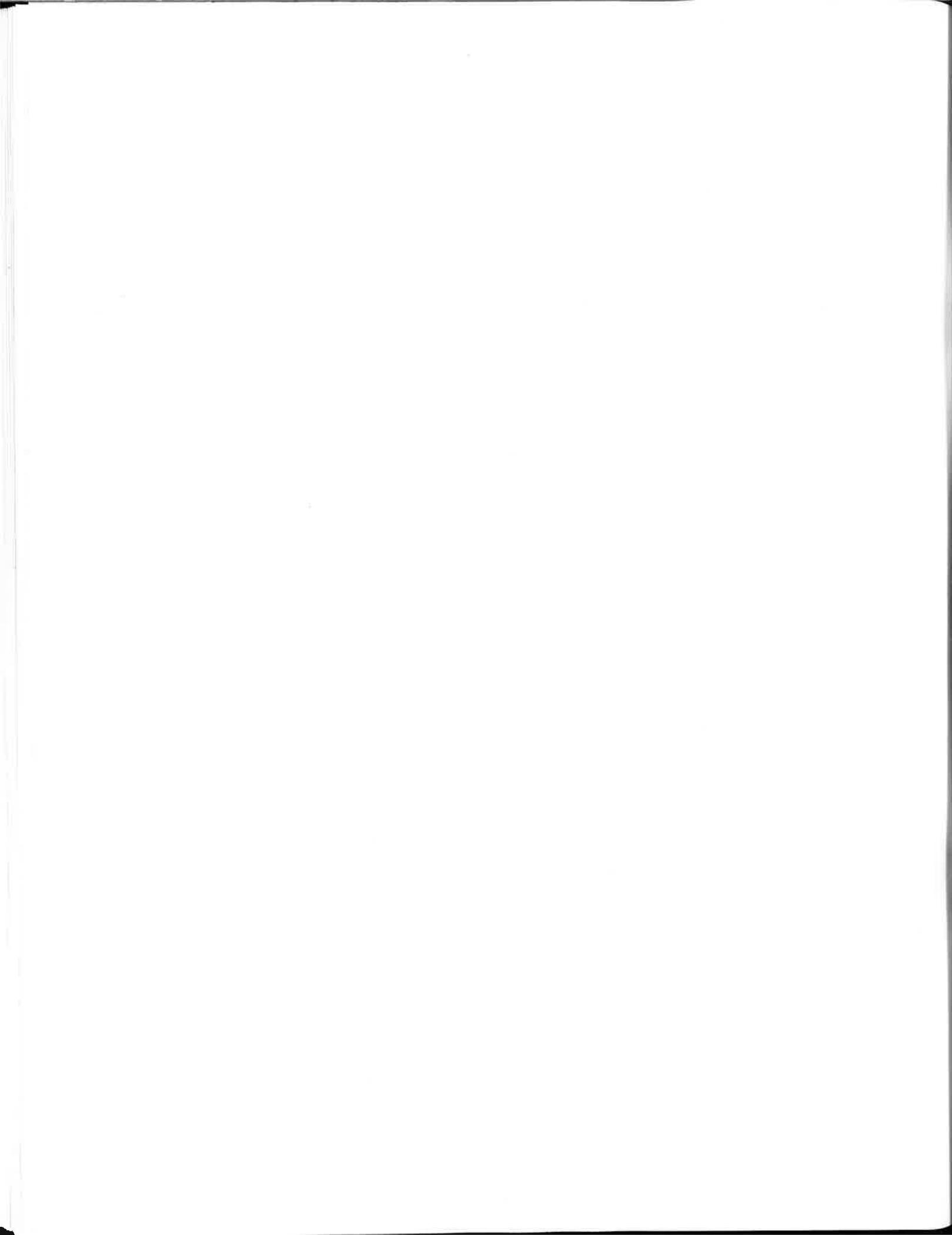
I am excited by the idea of being able to bring technological innovations into the transportation arena with the prospect of improving transportation safety and efficiency as well as productivity in the global marketplace. Beyond the benefits to the economy, the environment and the traveling public, promoting these new technologies will help with the transition for defense-related companies and workers to a peacetime economy.

Federico Peña, U.S. Secretary of Transportation

This seminar series provided the forum for the U.S. Department of Transportation to listen closely to the views of users and providers of transportation services, public officials, technologists, university and industry representatives, and small business men and women as they discussed transportation needs and opportunities. The meetings were successful in acquainting participants with the promise that defense conversion holds for transportation. Soon, for example, the global positioning system based on satellites in outer space will be able to guide airliners to within a few feet of perfect landings in all types of weather. Night vision devices used in Desert Storm are already helping truckers avoid crashes on dark highways. A company in California is using lightweight composite materials developed for the Stealth fighter to produce strong, fuel-efficient, lightweight buses. Another is using advanced composites for earthquake-proof bridges. Many more such "dual-use" innovations are on the way.

Secretary Peña has stated, "Foreigners—and skeptics here at home—who think that America is a military superpower, able to make cruise missiles—but no longer able to invent new toasters or TV's—are in for a very big surprise. The 'Yankee ingenuity' that took the first men to the moon is about to turn its attention to the needs of consumers here on earth. And in the technological and industrial battles of the post-Cold War world, we are only now beginning to fight...The pay-offs—in terms of new American jobs, greater global competitiveness, a cleaner environment, better traffic and cargo flows, reduced dependence on foreign oil—will be huge."

PLEASE NOTE: This summary of proceedings represents the views of the seminar participants and not necessarily those of the U.S. Department of Transportation.



APPENDIX A LIST OF EXHIBITORS

University of Michigan, Ann Arbor— Tuesday, September 28, 1993

Ann Arbor Transit Authority
Argonne National Laboratory
*Environmental Research Institute of Michigan
(ERIM)*
Ford Motor Company
General Motors
*Northwestern University Basic Industrial
Research Laboratory (BIRL)*
Peaker Services, Inc.
Perceptron
Siemens Automotive
Trinova
*University of Michigan Transportation
Research Institute (UMTRI) Human Factors
Research Vehicle*
UMTRI Autonomous Intelligent Cruise Control

University of California, Davis— Tuesday, October 26, 1993

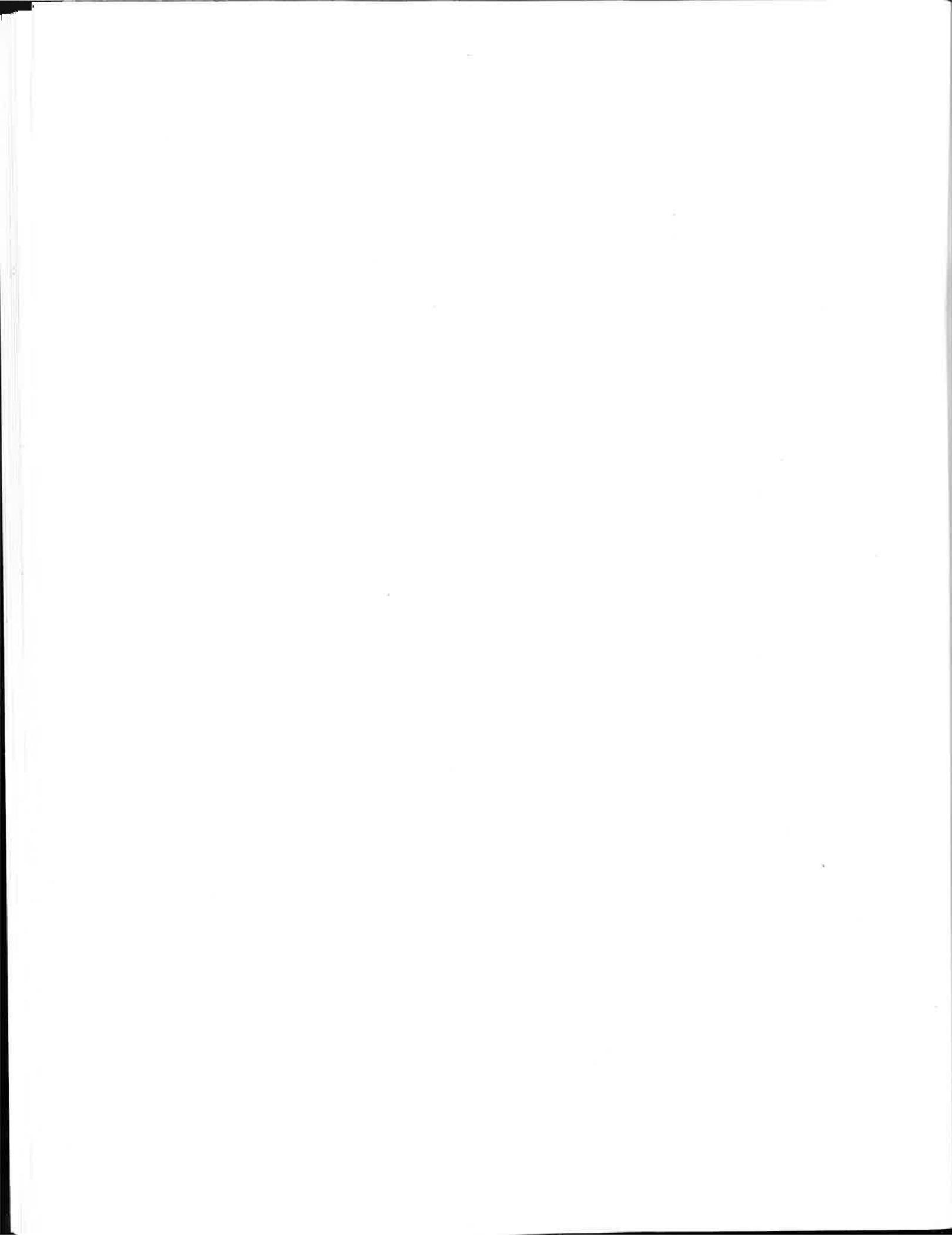
Aerojet
Allied Signal Aerospace Company
Business Spectrum Associates
Doran Motor Company
Electricar
Sacramento Municipal Utility District
U.S. Air Force Electric Vehicle Program
*University of California, Davis, Fuel Cell
Laboratory*
*University of California, Davis, Neighborhood
Electric Vehicle Team*
*University of California, Davis, ATIS Driver
Simulation Laboratory and Telecenters Project*

Massachusetts Institute of Technology— Thursday, October 28, 1993

*Central Artery/Tunnel Project, Boston,
Massachusetts*

University of Texas, Austin— Tuesday, November 2, 1993

Applied Research Laboratories
Amtech Corporation
AT&T
Bell Helicopter Textron Inc.
*Center for Electromechanics/Center for
Energy Studies*
Center for Transportation Research
IBM
Lockheed IMS
Natural Gas Vehicle Technology Center
Parker Kinetic Designs
Pulse Radar Corporation
S.A. Garza Engineering Corporation
*Southwestern Engineering and Equipment
Corporation*
Starlink Corporation
Texas Department of Transportation
Texas Transportation Institute



APPENDIX B

BIOGRAPHIES OF SPEAKERS

University of Michigan at Ann Arbor— Tuesday, September 28, 1993

Speakers

Homer A. Neal *Vice President of Research, University of Michigan*

Homer A. Neal has served as Vice President for Research at the University of Michigan since September 1, 1993. The University of Michigan has the largest sponsored research program of any public university in the nation. In addition to his responsibilities as Vice President for Research, Neal is Professor of Physics and Chairman of the Physics Department. He is actively involved in professional activities. Neal is a Regent of the Smithsonian Institution and a member of the Board of Overseers of the Superconducting Super Collider. He is a member of the MIT Visiting Committee on Sponsored Research, a Fellow of the American Physical Society, and a member of the Board of Trustees of the Center for Strategic and International Studies. In the past, Neal has served on the Board of Trustees of Argonne National Laboratory and the Fermi National Accelerator Laboratory. Neal's research area is experimental high-energy physics and has delivered testimony on numerous occasions to Congress on matters ranging from the funding of national laboratories to the state of undergraduate science education.

Thais Anne Peterson *Mayor Pro Tem, City of Ann Arbor, Michigan*

Thais Anne Peterson is Mayor Pro Tem of the City of Ann Arbor, Michigan. She is a second-term Councilmember from the Fifth Ward. She was elected to her first term in 1990 and re-elected in 1992. As a Councilmember, Peterson approved the City of Ann Arbor Planning Commission's comprehensive transportation plan for the city. The Plan was developed by a wide-rang-

ing group of planning officials, representatives of the University of Michigan, the Ann Arbor Transportation Authority, and interested citizens. Peterson has served on the Solid Waste Commission and Police Chief Selection Committee, among others. She currently serves on the Parks Advisory Commission, City-Schools Committee, Energy Commission, and various advisory boards. Peterson, who has worked and lived in the Soviet Union, worked for many years at Ardis Publishers, a well-known local publisher of books by and about Russians. She and her husband, John, own a small cabinetmaking business.

Grace Crunican *Deputy Administrator, Federal Transit Administration*

Grace Crunican is the Deputy Administrator of the Federal Transit Administration. Crunican came to FTA after serving as Director of the Surface Transportation Policy Project (STPP) since March 1992. STPP is a coalition of organizations working to ensure that Federal transportation policies promote critical national objectives in several areas: economic competitiveness and sustainability, the environment, energy conservation, and community enhancement. For 8 years prior to working with STPP, Crunican was with the Portland, Oregon, Transportation Department, where she was appointed Deputy Director. Crunican previously worked in Washington, D.C., as a Presidential Management Intern at the Department of Transportation and as a senior staffer on the U.S. Senate Appropriations Subcommittee on Transportation.

Facilitator

Patricia F. Waller *Director, University of Michigan Transportation Research Institute*

Patricia F. Waller has been the Director of the University of Michigan Transportation Research Institute since 1989. In addition to this position, she holds appointments in the University of Michi-

gan School of Medicine, School of Public Health, and Department of Psychology. Waller's primary interests lie in injury control and motor-vehicle-related injury. At a national level, she is working to insure that injury control and the human dimension are incorporated into the emerging national transportation agenda. Waller's professional activities are numerous and diverse. She currently chairs the Transportation Research Board's 5 Council, Intergroup Resources and Issues, and is a member of the Research and Technology Coordinating Committee established to assist the Federal Highway Administration with their expanded research program. She is currently on the Board of Directors of the Intelligent Vehicle Highway Society (IVHS) of America, which is overseeing the development of the IVHS program, as well as on the Motor Vehicle Safety Research Advisory Committee of the U.S. Department of Transportation. Waller is also on the Executive Committee of the Council of University Transportation Centers, the Board of Directors of the Traffic Safety Association of Michigan, and the Executive Board of the Michigan Council on Injury Control.

Transportation and the Environment

Garry D. Brewer
Professor of Resource Policy and Management, Business Administration, and Public Policy Studies, and Dean of the School of Natural Resources and Environment, University of Michigan

Garry D. Brewer is Professor and Dean of Natural Resources and Environment at the University of Michigan. He assumed these positions and duties in September 1991. In addition to his primary responsibilities at the University of Michigan, Brewer is a member of the Executive Committee of the Institute of Social Research, the Policy Committee for Michigan Sea Grant, the Vice President's Research Advisory Group, and Chair of the Deans' Council directing the University's Global Change Program. Brewer is the author, coauthor, or editor of nine books and over 175 other professional publications on a wide range of topics, including organizational complexity and behavior, computer applications to social and national security problems, political and economic development, forecasting and stra-

tegic planning, and several forms of environmental management and resource policy matters.

Infrastructure Rehabilitation and Maintenance

Robert J. Foy
General Manager, Mass Transportation Authority, Flint, Michigan

Robert J. Foy is the General Manager of the Mass Transportation Authority in Flint, Michigan. Foy has worked at the Mass Transportation Authority in a variety of positions since 1977, and is involved actively in several professional organizations. Foy is the past president of both the Public Transportation Association and the Michigan Public Transit Association. He is currently the Vice President of the Michigan Public Transit Association, a member of the Association's State Program Committee, and a member of the American Public Transit Association's Management Systems and Legislative Committees. Prior to joining the Mass Transportation Authority, Foy was Deputy of the Budget Management Division of the United States Air Force at the Pentagon in Washington, D.C.

New Vehicle Technology

Robert D. Ervin
Head, Engineering Research Division, University of Michigan Transportation Research Institute (UMTRI)

Robert D. Ervin's 23-year career at UMTRI has focused upon the mechanical performance of motor vehicles operating on road and, more recently, on the development of IVHS. The major emphasis of his research on motor vehicle performance has addressed heavy commercial vehicles, especially in the area of vehicle control. Over 90 reports and technical papers document this vehicle dynamics research. Since 1987, Ervin has worked to develop, as Co-Director, the Program on Intelligent Vehicle-Highway Systems at U of M—a coalition of 17 corporations and 5 public agencies supporting research, education, and field testing for the advancement of IVHS. Ervin has served on the Steering Group of Mobility 2000, forerunner to the national body, IVHS America, and has

conducted research, developed treatises on the IVHS concept, and taught graduate and continuing education courses on IVHS. He has served as Expert Advisor on IVHS issues to the U.S. General Accounting Office and the Office of Technology Assessment of the U.S. Congress. In 1991, he led an International Study Mission to Japan on IVHS. In 1992, he coauthored the IVHS Plan for the National Highway Traffic Safety Administration.

University of California at Davis— Tuesday, October 26, 1993

Speakers

Robert N. Shelton
Vice Chancellor for Research, University of California, Davis

Effective July 1, 1990, Robert N. Shelton was appointed to the newly created position of Vice Chancellor for Research. This position was created when responsibilities once vested in the dean for graduate studies and research were divided to give greater emphasis to each area. Shelton is responsible for increasing and managing extramural financial support, including support for large, long-term, and interdisciplinary projects; furthering research relationships with government and industry; and assisting faculty in developing their research and scholarly studies. Shelton's research has focused on understanding the fundamental properties of such materials as superconductors, heavy fermion compounds, and permanent magnets under extreme conditions such as low temperature, high pressure, and high magnetic fields.

Lois Wolk
Mayor, City of Davis, California

Lois Wolk was elected Mayor of Davis, California, on June 9, 1992. Prior to serving as Mayor, Wolk was active in Davis City Council activities. She was elected to Davis City Council on June 5, 1990, and has worked on numerous committees and commissions, such as the Open Space Element Community Advisory Committee. In addition, she has served as Vice Chair for the Water Resources Association of Yolo County and as

Yolo County Cities' Representative to the Local Agency Formation Commission (LAFCO). Wolk is on the Board of Directors for the California Elected Women's Association, a Founding Board Member of the Yolo Basin Foundation and TREE Davis, as well as an active participant in many other community activities.

Grace Crunican
Deputy Administrator, Federal Transit Administration

Facilitator

Paul P. Jovanis
Professor, Department of Civil & Environmental Engineering, University of California, Davis

Paul P. Jovanis is a Professor in the Department of Civil & Environmental Engineering at the University of California, Davis. Jovanis is actively involved in numerous professional activities. He is chairman of the Transportation Research Board Committee on Traffic Records and Accident Analysis and is a member of the Committees on Highway Capacity and Traffic Signal Systems. Jovanis has served as a consultant and advisor on traffic control and safety measures to a variety of organizations, including the General Accounting Office, U.S. Office of Technology Assessment, National Transportation Safety Board, and numerous state and local agencies. He currently heads the California Safety Forum (a group of researchers and practitioners who meet quarterly to discuss topics and share experiences in contemporary safety issues), chairs the Traveller Technology Focus Group within California's PATH Program, and is a part of the University of California Transportation Center.

Transportation and the Environment

Frank J. Tokarz
Acting Transportation Research Program Leader, Lawrence Livermore National Laboratory

Frank J. Tokarz is currently the Acting Transportation Research Program Leader and Deputy Manager of Energy, Manufacturing and Transportation Technology Program at Lawrence Livermore National Laboratory (LLNL). In these positions, Tokarz is responsible for program de-

velopment and execution of all projects in the areas of transportation, energy, and manufacturing. Focus areas in transportation research include IVHS, advanced vehicles, energy storage, and infrastructure. Projects are currently being performed for the Federal Highway Administration, the National Highway Traffic Safety Administration, the Federal Aviation Administration, as well as the U.S. Departments of Commerce, Energy, Defense, NASA, Caltrans, and industry. Tokarz has over 30 years of engineering experience that includes program development, project management, and technical/functional management of large engineering analysis, design and construction organizations, and consulting.

Michael J. Gage
President and Chief Executive Officer,
CALSTART

Michael J. Gage is currently President and Chief Executive Officer of CALSTART, a nonprofit consortium of California companies formed to develop an advanced transportation technologies industry in California. CALSTART's initial focus has been clean fuel vehicles powered by electricity and natural gas. A former state legislator from the Napa-Sonoma area of Northern California (1976-1980) and the Deputy Mayor and Chief of Staff for Los Angeles Mayor Tom Bradley (1987-1990), Gage has also served in key executive roles in real estate and development firms in Southern California. His own business, the Gage Group, specialized in marketing and public affairs consulting. Gage has also served as the President of the Los Angeles Board of Water and Power Commissions, Chairman of the Metropolitan Water District of Southern California, and Co-Chairman and Co-Founder of the national Electric Transportation Coalition.

Richard S. Napier
Councilmember, City of Sunnyvale, California

Richard S. Napier has been a Councilmember in Sunnyvale, California, since 1991, and is currently a member of the Sunnyvale Redevelopment Agency. Before becoming Councilmember, he served as Mayor of Sunnyvale from September 1990 to November 1991, and prior to that position, served as Planning Commissioner and on the Law Enforcement Sub-Element Advisory

Committee. In addition to his work for the city of Sunnyvale, Napier has been a member of the Santa Clara County Transportation Commission and Commuter Network Council, the U.S. Conference of Mayors Energy and Environment Committee, and is currently the Vice Chair of the Santa Clara County Congestion Management Agency. Napier is the author of several articles on city planning and is employed by Watkins Johnson Company as the manager of the Antenna Department.

Infrastructure Rehabilitation and Maintenance

Frieder Seible
Professor of Structural Engineering, University of California, San Diego

Frieder Seible is a Professor of Structural Engineering at the University of California, San Diego, and the Associate Director of the University's Charles Lee Powell Structural Systems Laboratory. His primary research interests include the analysis and design of reinforced/prestressed concrete bridges; evaluation and rehabilitation of existing bridge structures and buildings; seismic assessment and retrofit of bridges; and application of Polymer Matrix Composites (PMC) in civil structures. In addition to his duties at the university, Seible is a consultant to Caltrans on seismic design and retrofit of bridges and is a member of several professional organizations, including the Earthquake Engineering Research Institute, the International Association for Bridge and Structural Engineering, and the American Society of Civil Engineers.

Robert Marchbanks
Director of Business Development and Government Coordinator, Morrison Knudsen/Centennial Civil Engineers, Inc.

Robert Marchbanks is the Director of Business Development and Government Coordinator for Morrison Knudsen/Centennial Civil Engineers, Inc. As Director of Business Development, he is responsible for marketing, business development, project exploration, and proposals. Marchbanks has over 25 years of experience in the development of capital improvement plans, special assessments, improvement districts, and other

special financing programs directed at public improvement and growth projects. He has directed combined, multidisciplinary public/private engineering, architectural, and construction teams to plan, design, and build large-scale redevelopment projects frequently necessitating complete re-evaluation and subsequent reconstruction of entire municipal infrastructure networks. He has served as President and CEO of the Kankakee County Economic Development Council, the Executive Director of the Arvada Urban Renewal Authority, and the Director of Community and Economic Development for the City of Pontiac.

James W. van Loben Sels
Director, California Department of
Transportation

James W. van Loben Sels was appointed the Director of Transportation for the State of California in October 1991 by Governor Pete Wilson. As Director of Caltrans, van Loben Sels directs the work of more than 20,000 state employees engaged in planning, design, supervision, and management of California's key transportation infrastructure. California is spending about \$12 billion a year to develop, operate, and maintain the State's surface transportation systems, with Caltrans' direct responsibility being about 43 percent of the total. Under van Loben Sels' leadership, Caltrans is building partnerships among various levels of government and private enterprise so essential to the fulfillment of Caltrans' purpose: to promote economic vitality and enhance quality of life for the people of California by providing for mobility of people, goods, services, and information. In addition to his duties as Caltrans Director, van Loben Sels is a member of the Boards of Directors of the American Association of State Highway and Transportation Officials, the United States Transportation Research Board, and the Intelligent Vehicle Highway Society of America.

New Vehicle Technology

Daniel Sperling
Professor of Environmental Studies and
Transportation Engineering, University of
California, Davis

Daniel Sperling is Professor of Environmental Studies and Transportation Engineering at the University of California, Davis, and is founding Director of the campus's Institute of Transportation Studies (ITS-Davis). He is residing in Washington, D.C., during fall 1993 as a recipient of the Gilbert F. White Fellowship, awarded by Resources for the Future. Sperling manages a million dollar research program on "Assessment of Electric and Natural Gas Vehicles" (funded by California government and industry), and manages two similar-sized research programs: "The Future of Motor Vehicles in an Environmentally-Constrained World" (funded by international automotive and oil companies and the U.S. Department of Transportation), and "Neighborhood Electric Vehicles" (for CALSTART, a California-based public-private consortium). In addition to these activities, Sperling is the current and founding chair of the Alternative Fuels committee of the Transportation Research Board and a member of many advisory and steering committees.

Steven A. Scott
Manager, New Business Development,
GenCorp/Aerojet

Steven A. Scott is currently the Manager for New Business Development at GenCorp/Aerojet. He has 15 years' experience in the management, development, and deployment of large, complex space electronics and ground telemetry systems. Scott is currently responsible for securing commercially advanced technology business that exploits the strengths of Aerojet's core competencies and provides for profitable growth.

Theodore L. Hullar
Chancellor, University of California, Davis

On July 1, 1987, Theodore L. Hullar became the fourth chancellor of the University of California, Davis, and was appointed professor of environmental toxicology. As chancellor, he has overall responsibility for the leadership, management,

and administration of the campus. The Davis campus has over 23,300 students and 1,500 faculty and senior scientists. On May 1, 1993, he accepted a special assignment to be coordinator of the University of California's Economic Development Initiative. This involves leadership and coordination of the systemwide program for enhancing technology transfer, for making University expertise available for addressing social and public policy issues, and for accelerating the University's involvement in defense and base conversion throughout California. Hullar conceived of, helped found, and served as first chair of the California Council on Science and Technology, and chaired the state government task force which lead to a two-volume report on Tonics, Waste, and Technology. In addition to these accomplishments, Hullar was a participant in the initial conception of Project California and was a member of its steering committee. He was recently appointed to serve as a member of a new National Research Council study committee to examine Federal coordination and support of environmental research in the United States.

Massachusetts Institute of Technology— Thursday, October 28, 1993

Speakers

Ronald P. Suduiko
Assistant to the President for Government & Community Relations, Massachusetts Institute of Technology

Ronald P. Suduiko was appointed Assistant to the President for Government and Community Relations by former MIT President Paul E. Gray in 1989, and now serves in the same capacity under President Charles M. Vest. Suduiko has been at MIT since December 1982, serving in the Office of the Chairman and representing MIT in government and community relations locally. In his current position, he is responsible for coordinating MIT's relationships with Cambridge, other local communities, and the Commonwealth of Massa-

chusetts. He also supports, with the MIT Washington Office, the president, other senior officers, and the faculty of the Institute in a broad range of activities and contacts with the Federal Government.

Francis H. Duehay
City Councilor, City of Cambridge

Francis H. Duehay has served 11 terms on the Cambridge City Council and has been twice elected mayor of Cambridge. He is a member of the Committee on Community and Economic Development, the National League of Cities, and the Committee on University-City Relations. Duehay serves on the Board of Directors of the Environmental Lobby of Massachusetts and is a former fellow of the Institute of Politics at Harvard University's John F. Kennedy School of Government.

Jane Garvey
Deputy Administrator, Federal Highway Administration

Jane Garvey was appointed by Secretary of Transportation Federico Peña to the position of Deputy Administrator of the Federal Highway Administration (FHWA) in April 1993. She comes to the FHWA with a wealth of transportation experience. Prior to coming to the FHWA, Garvey was director of Logan International Airport, where she was responsible for airport management and capital planning, including the modernization program for the airport. She also developed innovative public-private financing and environmental programs. Her transportation experience also includes serving as Commissioner of the Massachusetts Department of Public Works from 1988 to 1991, where she directly controlled a \$500 million budget and directed the activities of close to 3,000 employees. Her familiarity and involvement with the Central Artery/Third Harbor Tunnel project goes as far back as her position as Associate Commissioner with the Massachusetts Department of Public Works, where she monitored and reviewed all maintenance and construction activities of the department.

Facilitator

Yosef Sheffi

*Director, Center for Transportation Studies,
Massachusetts Institute of Technology*

Yosef Sheffi is a professor at the Massachusetts Institute of Technology, where he leads the School of Engineering's Center for Transportation Studies. He also heads the Transportation Systems Division of the Civil Engineering Department and the joint MIT School of Engineering/Sloan School of Management double degree program in logistics, which he launched in 1990. Sheffi has conducted extensive research in the applications of operations research and computer science to transportation and logistics. He has developed computerized decision support systems for LTL and TL motor carrier operations, as well as for rail-car distribution, rail and intermodal pricing, vehicle routing and scheduling, container positioning, terminal location, and other carrier problems. Sheffi has also worked on shipper issues, including inventory/transportation trade-offs, mode and carrier selection, distribution planning, and third party logistics.

Transportation and the Environment

Frederick P. Salvucci

*Special Lecturer and Research Associate,
Massachusetts Institute of Technology*

Fred Salvucci is a Civil Engineer, specializing in transportation with particular interest in infrastructure, urban transportation, public transportation, and institutional development in decision making. Salvucci currently teaches courses in Urban Transportation Planning, Institutional and Policy Analysis, and Public Transportation at MIT. Most of his career has been in the public sector, having served between 1975 and 1978, and again from 1983 to 1990, as Secretary of Transportation of the Commonwealth of Massachusetts under Governor Michael Dukakis, and prior to that as transportation advisor to Boston Mayor Kevin White. In those roles, Salvucci has participated in much of the transportation planning and policy formulation in the Boston urbanized area and the Commonwealth of Massachusetts over the past 20 years, with particular emphasis on the expansion of the transit system, the development

of the financial and political support for the Central Artery/Tunnel Project, and the design of implementation strategies to comply with the Clean Air Act consistent with economic growth.

Ann Donner

Executive Director, Move Massachusetts 2000

Ann Donner is the Executive Director of Move Massachusetts, an advocacy coalition of business, labor, environmental, professional, and community organizations convened to promote the timely completion of the Central Artery/Third Harbor Tunnel (CA/T) Project. The organization seeks to ensure that the CA/T Project is an integrated element of an intermodal regional transportation system for the 21st century—and to assure the full realization of the related employment, environmental, development, parkland, and urban design benefits of the Project. In the 2 1/2 years since Move Massachusetts 2000's founding, the organization has grown from 20 to over 40 member organizations, representing one of the most diverse coalitions in the Boston area. Donner has worked in the public sector as assistant to Mayor Raymond L. Flynn, and then later as the Deputy Director of the Mayor's Office of Jobs and Community Services, where she helped to establish the City of Boston's Permanent Jobs Initiative.

Stephen J. Karol

Massachusetts State Representative

Stephen J. Karol, a Democrat from Attleboro, is presently serving his eighth term as a member of the Massachusetts House of Representatives, having first been elected in 1978. Karol has been House chairman of the Legislature's Joint Committee on Transportation since January 1985, and has served as a member of the committee since 1981. He has also served as chairman of the Special Committee on Marine Transit and the Second Major Airport Advisory Committee appointed by the Massachusetts Aeronautics Commission to study the need for a second major airport in Massachusetts, and vice chairman of both the Special Commission on Tourism and the John F. Kennedy Memorial Commission. Karol currently serves as Chairman of the Council of State Governments Eastern Regional Conference (CSG-ERC), overseeing the organization's activities in

foreign trade, transportation, environment, and State-Federal relations in the 10 northeastern states, Quebec, Puerto Rico, and the U.S. Virgin Islands. He also sits on CSG's national Committee on Intergovernmental Affairs and its Executive, Budget, and International Committees.

Infrastructure Rehabilitation and Maintenance

Richard R. John
Director, Volpe National Transportation Systems Center

Richard R. John is currently the Director of the U.S. Department of Transportation's John A. Volpe National Transportation Systems Center. The Volpe Center, located in Cambridge, Massachusetts, supports both the Department of Transportation and other Federal agencies—including the Environmental Protection Agency and the Departments of Energy, Defense, and Justice—by providing technical and management support to leading-edge technology development efforts in transportation, logistics, information systems, and related fields. As the Director of the Volpe Center, John served as the Department's representative on the Source Evaluation Board for the Technology Reinvestment Project, administered by the Advanced Research Projects Agency. He also directly supported the Secretary of Transportation's National Transportation Policy Initiative. In the late 1970s, he completed a series of groundbreaking studies on the international competitiveness of the American automobile industry. His contributions to the Department have been recognized by three Secretarial and one Presidential Rank Meritorious Executive Awards. In addition, John received the Federal Government's highest civil service award, the Distinguished Presidential Rank Award, from President Bush in a White House ceremony in January 1991. Prior to his government service, which started at the Volpe Center in 1970, John was the Director of the AVCO Applied Research Laboratory in Wilmington, Massachusetts.

Jay M. Cashman
President, Cashman Associates

Jay M. Cashman, president of Cashman Associates, founded J.M. Cashman, Inc., in 1974. J.M. Cashman is a general construction company which specializes in marine construction, bridge construction, and construction of nonresidential buildings. J.M. Cashman, as general contractor or as partner in joint ventures, has been at the forefront of the Deer Island Sewage Treatment Facility and the Central Artery/Third Harbor Tunnel Project, two of the largest construction projects ever undertaken in New England. In addition to his work at J.M. Cashman, Cashman is the current chairman of Construction Industries of Massachusetts and a past chairman of Shawmut Bank.

John J. Judge
Director of Operations, Massachusetts Turnpike Authority

John J. Judge was appointed Director of Operations of the Massachusetts Turnpike Authority by the Authority's Board of Directors in July of 1989. Prior to 1989, Judge held positions as Deputy Director of Economic Development for the Commonwealth of Massachusetts, Assistant Secretary of the Executive Office of Communities and Development, and Director of Projects for the North Shore Economic Development Council. In his current capacity as Director of Operations, Judge is responsible for the operation, maintenance, and reconstruction of the Massachusetts Turnpike Authority's 135-mile turnpike system, as well as the Sumner and Callahan tunnels.

New Vehicle Technology

Bruce A. Draper
Senior Post-doctoral Research Scientist, Department of Computer Science, University of Massachusetts at Amherst

Bruce A. Draper is a Senior Post-doctoral Research Scientist with the Department of Computer Science, University of Massachusetts at Amherst. He directs graduate students working on the Advanced Research Projects Agency Unmanned Ground Vehicle (UGV) project. Draper is also an expert in the subfield of Machine Learn-

ing for Computer Vision, the area in which he did his thesis, and is currently directing a research project in that area as well.

William Osborn
General Manager, TravElectric Services Corporation

William Osborn is General Manager of TravElectric Services Corporation, a new unregulated subsidiary of Boston Edison Company that is focusing on distributing, selling, and servicing electric vehicle technologies. Prior to joining TravElectric Services, he was President of Environmental Technologies, a business development firm bringing to market environmentally sound products. Osborn has served as manager of BMW Technologies, a U.S.-based venture capital and corporate development arm of the German automaker, which invested in small, high-tech companies with products and processes appropriate to increased automation in the design, manufacture, and use of automobiles.

Emil Frankel
Commissioner of Transportation, State of Connecticut

Emil H. Frankel was appointed Commissioner of the Connecticut Department of Transportation by Governor Lowell P. Weicker, Jr. on February 1, 1991. Frankel is the eighth Transportation Commissioner since the Connecticut DOT was created in 1969 and the fifteenth department head since the former Connecticut Highway Department was organized in 1895. As Commissioner, Frankel is responsible for administering the programs and activities of a department that employs approximately 3,555 people and has a combined operating and capital improvement budget of nearly \$1.5 billion for Fiscal Year 1994. In addition to being responsible for the maintenance and modernization of approximately 5,000 two-lane miles of state highways and 3,600 state bridges, Frankel also administers operations and improvement programs involving Bradley International Airport—New England's second largest commercial airport—and five other state-owned aviation facilities; the Connecticut Transit bus service in Hartford, New Haven, and Stamford regions; the Metro-North Commuter Railroad's New Haven Line and the Shore Line East rail

commuter service; regulation of truck, bus, livery, and taxicab operations; a statewide "Ride Together Connecticut" rideshare program; as well as the Connecticut River ferries and the State Pier in New London.

University of Texas at Austin — Tuesday, November 2, 1993

Speakers

Robert M. Berdahl
President, The University of Texas at Austin

Robert M. Berdahl was appointed the President of the University of Texas at Austin in 1993. In this position, Berdahl is responsible for a flagship university with over 49,000 students, 2,355 faculty, almost 15,000 staff members, 14 colleges and schools, and an academic budget of \$348 million. Before serving as President, he was Vice Chancellor for Academic Affairs and Professor of History at the University of Illinois at Urbana-Champaign. Berdahl is on the Board of Directors of the Association of American Colleges, and is a member of the Executive Committee, Council of Chief Academic Officers, National Association of State and Land Grant Universities and Colleges. He is the author of numerous articles and the recipient of several honors and awards.

Martha Whitehead
Treasurer, State of Texas

Martha Whitehead was appointed Texas Treasurer by Governor Ann Richards in June 1993. She is the former Mayor of Longview, Texas, and was elected twice to the Longview City Council. As Mayor, Whitehead dramatically reduced waste and duplication in the Longview municipal government. She is actively involved in organizations such as the Board of Regents of East Texas State University, the Board of Directors of the Texas Municipal League, and the Executive Committee of the Greater Longview Economic Development Foundation.

The Honorable Bruce M. Todd
Mayor, City of Austin

Bruce M. Todd has served as Mayor of Austin since June 15, 1991. Before being elected Mayor, Todd served as Commissioner for Travis County from January 1987 through December 1990, and was re-elected for term of office January 1991 through December 1994. Todd participates in numerous national and state activities. He is a member of the Energy, Environment and Natural Resources Policy Committee and the Youth, Education, and Family Committee of the National League of Cities; Chair of the Standing Committee on Education, Jobs and Family, and a member of the Advisory Board, the Legislative Action Committee, and the National Unfunded Mandates Task Force of the U.S. Conference of Mayors; a board member of the Austin Transportation Study Committee; and is active in many other groups. Todd is a Presidential appointee to the Advisory Commission on Intergovernmental Affairs and serves as City of Austin Chair on several committees and subcommittees.

Katherine Gillman
Special Assistant for Defense Conversion, White House Office of Science and Technology Policy

Katherine Gillman is Special Assistant for Defense Conversion at the White House Office of Science and Technology Policy. Her responsibilities also include manufacturing technology policy and the potential for cooperation between the Federal laboratories and industry. Until recently, Ms. Gillman was a Senior Associate at the Congressional Office of Technology Assessment, where she directed two studies on defense conversion. The first, published last year, looked at the effects of deep, sustained cuts in defense spending on workers, communities, and defense companies, and discussed government policies to ease the transition to a peacetime economy. The second report, released in June, is on opportunities to redirect government research and development from strictly military goals to civilian purposes.

The Honorable Federico F. Peña
Secretary, U.S. Department of Transportation

Federico F. Peña was nominated by President-elect Clinton on December 24, 1992, to head the United States Department of Transportation. He was confirmed by the Senate and sworn in as the 12th Secretary of Transportation on January 21, 1993. Secretary Peña has spent the past 12 years dealing with transportation issues on a regular basis. He is a ground-breaking political leader who combines the vision and ideology of a one-time civil rights attorney with the everyday skills of a city administrator, while always directing his career towards concrete accomplishments. As Mayor of Denver, one of his most visible accomplishments was gaining approval for construction of one of the largest airports in the world. The new Denver International Airport will serve both as a regional transportation center and as a driving force in a growing Denver-area economy. Secretary Peña is a pragmatic visionary who combines tremendous administrative talents with an ability to foresee future demands. During his tenure as mayor, Denver experienced a general reversal of its declining economic fortunes as he focused on long-term development in the area. In addition to the airport, Peña oversaw construction of a downtown Convention Center—on schedule, on budget—and the issue of over \$330 million in infrastructure bonds for bridges, buildings, roads, and libraries. As political leader of a growing urban area, Peña worked across jurisdictions to develop a multimodal transportation plan for the Denver metropolitan area that would combine highways, traditional mass transit, and innovations like light rail. His future-oriented approach to the national transportation system can fundamentally improve our quality of life, national economy, and global competitiveness. Prior to becoming the first Hispanic elected to lead Colorado's largest city, Secretary Peña served in the State's legislature for 4 years. In his second term, Peña's peers marked his political and administrative skills by elevating him to the position of Minority Leader of the Colorado House. As Minority Leader, he was involved with transportation and planning decisions statewide and the transportation needs of a largely rural state.

Louise F. Stoll
*Assistant Secretary for Budget and Programs,
U.S. Department of Transportation*

Louise F. Stoll, Assistant Secretary for Budget and Programs at the U.S. Department of Transportation, was nominated by President Clinton May 17, 1993, and confirmed by the U.S. Senate August 5, 1993. The Assistant Secretary for Budget and Programs reports directly to the Secretary of Transportation and is the Secretary's primary advisor on financial matters relating to the Department. The Assistant Secretary develops and defends before the Office of Management and Budget and the U.S. Congress the \$40 billion budget for the Department and monitors all programs for compliance with Federal requirements. Before coming to the U.S. Department of Transportation, Stoll was Senior Vice President of O'Brien-Kreitzberg & Associates, Inc., a nationwide construction management firm that specializes in major public works projects, including rail, transit and highway projects, and airports.

Facilitators

Barbara Jordan
Lyndon B. Johnson Centennial Chair in National Policy, The Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin

Barbara Jordan is currently the Lyndon B. Johnson Centennial Chair in National Policy at the Lyndon B. Johnson School of Public Affairs at the University of Texas at Austin. From 1972 to 1978, Jordan was a member of the United States House of Representatives, serving the 18th District of Texas. She was a member of the House Committee on the Judiciary, the House Committee on Government Operations, and the Steering and Policy Committee of the Democratic Caucus. Jordan's major legislative achievements enacted into law included Amendments of the Voting Rights Act which expanded its coverage and provided for the printing of bilingual ballots; repeal of Federal authorization for state "Fair Trade" laws which sanctioned vertical price-fixing schemes; and detailed mandatory Civil Rights enforcement procedures for the Law Enforcement Assistance Administration and the Office of Revenue Sharing. In 1966, she was elected as Senator to the Texas State Legislature and served as Presi-

dent Pro Tempore of the Texas Senate in 1972. Jordan is a member of several corporate and advisory boards and has received numerous awards.

C. Michael Walton
Ernest H. Cockrell Centennial Chair in Engineering, Chairman of the Department of Civil Engineering, The University of Texas at Austin

C. Michael Walton holds the Ernest H. Cockrell Centennial Chair in Engineering and is Chairman of the Department of Civil Engineering at the University of Texas at Austin. He holds a joint academic appointment in the Lyndon B. Johnson School of Public Affairs. He has been actively involved in research related to transport policy and engineering analysis for approximately 29 years, and he has served on or chaired a number of national study panels. Walton was elected to the National Academy of Engineering in 1993. He is a Past-Chair of the Executive Committee of the Transportation Research Board of the National Research Council. Walton is actively involved in numerous professional activities. He serves on the Board of Directors of the International Road Federation, is chairman of the Technical Activities Committee for the American Society of Civil Engineers, and is chair of the IVHS America Technical Committee on Commercial Vehicle Operations.

Transportation and the Environment

Raymond C. Loehr
Hussein M. Alharthy Centennial Chair and Professor of Civil Engineering, and Head, Environmental Solutions Program, The University of Texas at Austin

Raymond C. Loehr is the Hussein M. Alharthy Centennial Chair and Professor of Civil Engineering, as well as the Head of the Environmental Solutions Program, at the University of Texas at Austin. He has been a member of the National Academy of Engineering since 1983 and has been a member of several National Research Council Committees, including Multi-Media Concerns in Pollution Control, the Environmental Studies Board, and the Board on Science and Technology for International Development. Loehr is currently the Chairman of the Executive Committee

of the Environmental Protection Agency's Science Advisory Board, and has served on many other EPA Science Advisory Board Committees. In addition to his work at the University, he is a consultant to numerous industries, agencies, and engineering firms on matters dealing with industrial and hazardous waste management, particularly in the petroleum, petrochemical, food processing, and pulp and paper industries.

William F. Hayes
President, Defense Systems and Electronics Group, Texas Instruments

William F. Hayes is president of the Texas Instruments Defense Systems and Electronics Group (DSEG), which was awarded the Malcolm Baldrige National Quality Award in 1992. He is responsible for managing Texas Instruments' defense business, including the design, development, and production of electronic and missile systems, RF and night vision subsystems, and the basic technologies needed to serve these markets. From 1989 to 1991, Hayes was executive vice president and deputy manager of DSEG. Previously, he was manager of the Business Development Entity, responsible for advanced microwave, infrared, microelectronics, and systems technology for use across DSEG.

William R. Stockton
Director of Public Works and Transportation, City of Austin

William R. Stockton has served as the Director of Public Works and Transportation for the City of Austin since January 1989. As Director, he is responsible for the planning, construction, operation, and maintenance of the City's transportation and drainage systems, as well as for providing services to all other City entities in the areas of engineering, design, and construction of City facilities, and the acquisition and leasing of real estate. Stockton directs the activities of 810 employees and a \$62 million budget. From 1984 to 1985, he worked as Deputy Director of Austin's Urban Transportation Department. He was involved in all of the planning and transportation engineering aspects of departmental operation. In addition to his work for the City of Austin, Stockton is a member of the Texas Transportation Institute's

Advisory Committee in the Texas A&M University System.

Infrastructure Rehabilitation and Maintenance

John E. Breen
Professor of Structural Engineering, University of Texas at Austin

John E. Breen holds the Nasser I. Al-Rashid Chair in Civil Engineering at the University of Texas at Austin, where he is past Director of the Phil M. Ferguson Structural Engineering Laboratory. Breen is noted for reinforced and prestressed concrete research and development, and frequently serves as a consultant on major bridge and building projects. He played a key role in design and construction of the United States' first segmentally constructed post-tensioned box girder bridge, which received the PCI Award for Merit in 1974. Breen's research and development work has earned the American Concrete Institute (ACI) Wason Medal for Most Meritorious Paper in 1972 and again in 1983, the ACI Reese Medals in 1972 and 1978, the PCI State-of-the-Art in 1981, and the T.Y. Lin Award from the ASCE in 1985, 1989, and 1991. His highest honor was election to the National Academy of Engineering in 1976.

Harry W. Voccola
Senior Vice President, Lockheed IMS

Harry W. Voccola is Senior Vice President of Lockheed IMS and heads its Transportation Systems and Services line of business. He is a pioneer in his field, recognized for his vision and his ability to apply advanced technology to congestion management and other transportation issues. Voccola has extensive experience with project and operations management for public sector clients, and more than 25 years' experience in designing data processing systems. A nationally recognized subject matter expert in the field of IVHS for the transportation industry, his accomplishments include the company's present position as the leading provider of commercial vehicle regulatory, taxation, and enforcement systems, as well as electronic toll and traffic management systems in the United States. Voccola is a Founding and Charter Member of the Intelligent Vehicle/Highway Society of America (IVHS)

America), is a member of its Board of Directors, and has recently been selected to chair the Electronic Industry Association's 1993 Transportation Market Study.

Henry R. Muñoz III
Member, Texas Transportation Commission

Henry R. Muñoz III was appointed to the Texas Transportation Commission by Governor Ann Richards in November 1991. This appointment was historic in that Muñoz became the department's first minority commissioner. Muñoz previously served the State as a member of the Texas High Speed Rail Authority, where he chaired the franchise agreement committee and successfully negotiated a 50-year agreement that created the environment to bring high-speed rail to Texas. Muñoz is president and chairman of the board of Kell Muñoz Wigodsky of San Antonio. An active civic leader, he has served on the boards of many local and statewide organizations, including current involvements with the Texas Lyceum, the advisory board of Paragon Cable, the Guadalupe Cultural Arts Center, and the San Antonio Symphony. He is a recipient of the J.C. Penney Golden Rule Award and the Profiles in Leadership Award.

New Vehicle Technology

N.C. Griswold
Associate Head and Professor of Electrical Engineering, Texas A&M University

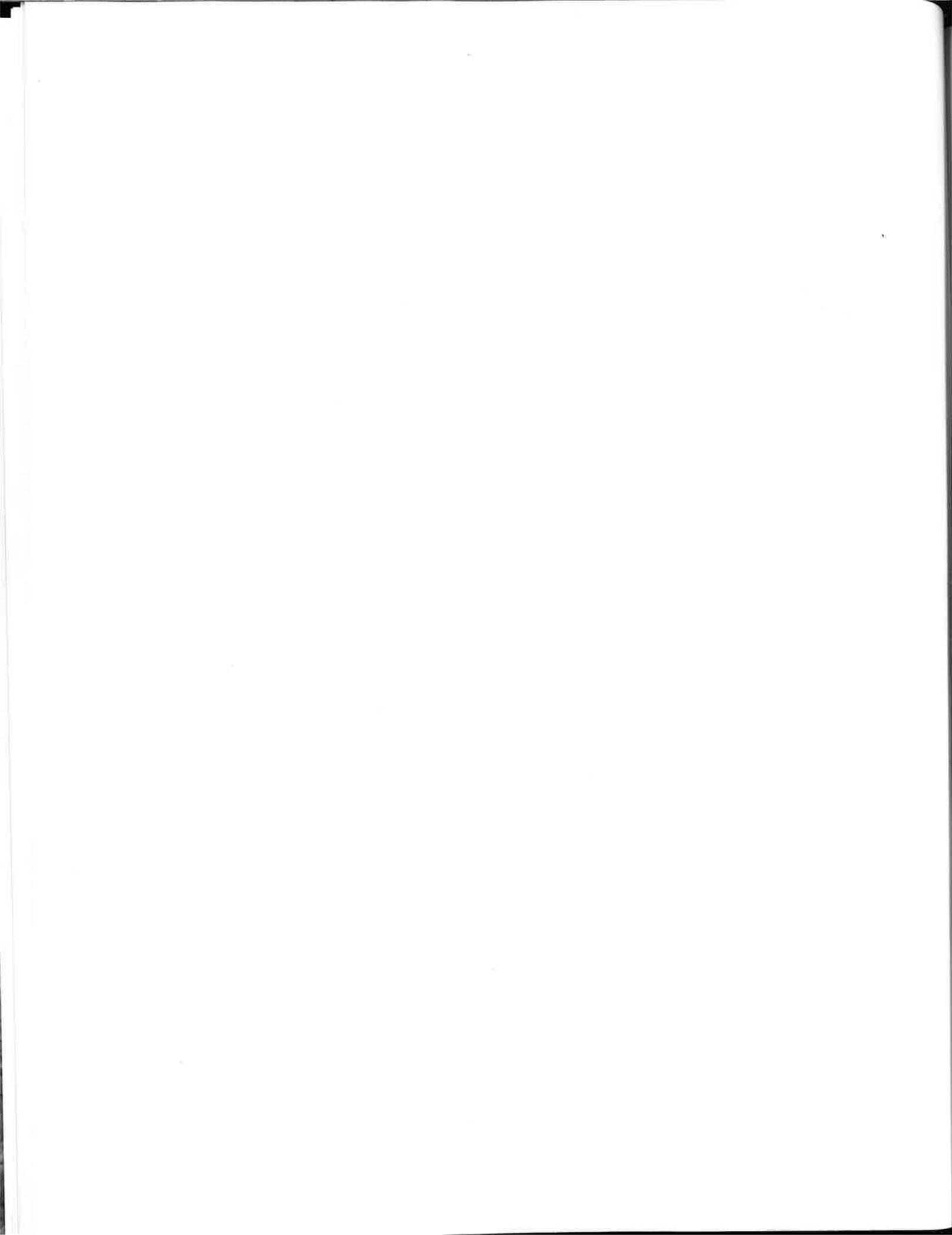
N.C. Griswold is currently the Associate Head and Professor of Electrical Engineering at Texas A&M University. Griswold joined the Department of Electrical Engineering in August 1978. Prior to this time (1960 to 1978), he held several civilian positions in the Air Force Avionics laboratory at Wright Patterson AFB, Dayton, Ohio. This combination gives Griswold a unique background in sensors, bandwidth compression, image-signal processing, and unmanned vehicle control. With his extensive background in sensors, he applied his research to vehicle platooning for military and commercial uses. In this capacity, he has been active in IVHS. Griswold developed and has demonstrated the only stereovision-controlled commercial vehicle in the world for platooning or vehicle tracking.

William B. Craven
Vice President, Business Development, Electrosource, Inc.

William B. Craven is well known in the field of alternatively fueled vehicles. Besides directing Electrosource programs for the commercialization of the electric vehicle and general business development, he is cofounder and executive director of the South Central Electric Vehicle Consortium. The consortium consists of electric utilities in the south central portion of the United States dedicated to the commercialization of electric vehicles. Craven is cofounder, board member, and past president of Lyntech, Inc., an advanced electrochemical research and development firm. Lyntech has been awarded more than 30 Federal Small Business Innovative Research contracts in the past 3 years, totalling more than \$3 million. Craven is also currently director of the Electric Power Research Institute (EPRI) of Palo Alto.

Russell H. Pentz
Assistant General Manager, Houston METRO

Russell H. Pentz is the assistant general manager of Houston METRO. Before joining Houston METRO, Pentz worked for the U.S. Air Force. He progressed to the rank of Colonel with the responsibility of managing the maintenance and operations of the Air Force vehicle fleet worldwide. Upon his departure from the Air Force in 1981, Pentz was selected to supervise the maintenance of the bus and rail fleet with the public transit system in Baltimore, Maryland. During 1983, he was recruited by Houston METRO to lead its efforts in improving the reliability, safety, appearance, and cost-effectiveness of its fleet vehicles. He has since initiated the world's first heavy-duty transit LNG program. Pentz is responsible for 799 employees and a \$60 million operating budget.



APPENDIX C

LIST OF PARTICIPANTS

University of Michigan at Ann Arbor — Tuesday, September 28, 1993

- Carlos J. Acevedo
Commissioner
Board of Commissioners
Washtenaw County
- Helen Albertson
University of Michigan Transportation
Research Institute
- Dave Andrea
University of Michigan Transportation
Research Institute
- Todd Anuskiewicz
Executive Vice President
MERRA
- Dale A. Ausherman
Vice President
Environmental Research Institute of
Michigan (ERIM)
Sensor Systems Division
- Max E. Bair
Manager, Transportation Systems Center
Environmental Research Institute of
Michigan (ERIM)
- Robert Beck
- Crosby Beene, Jr.
Principal
C. Beene & Associates
- Ellen E. Bell
Management Analyst, Transportation
Strategic Planning & Analysis Office
U.S. DOT/Volpe National Transportation
Systems Center
- Tim Beltz
Special Assistant to the Secretary
U.S. DOT/Office of the Secretary of
Transportation
- Michael Bolton
Executive Director
Ann Arbor Transportation Authority
- Garry D. Brewer
Dean, School of Natural Resources and
the Environment
University of Michigan
- William M. Brown
President
Environmental Research Institute of
Michigan (ERIM)
- Dwight D. Carlson
President & CEO
Perceptron
- Clark Charnetski
Member, Board of Directors
Michigan Association of Railroad
Passengers
- Mechelle Conley
Staff Assistant
Congressman William D. Ford
Marie Corbin
- Grace Crunican
Deputy Administrator
U.S. DOT/Federal Transit Administration
- Jessie Deer In Water
Loan Coordinator
Ann Arbor Community Development
Corporation
- Samir El-Ahmud
Management Advisor
Michigan Department of Transportation
- Robert D. Ervin
Head, Engineering Research Division
University of Michigan Transportation
Research Institute

Paul Fancher
Research Scientist
University of Michigan Transportation
Research Institute

Eugene Farber

Robert J. Foy
General Manager
Mass Transportation Authority

Thomas D. Gillespie
Research Scientist
University of Michigan Transportation
Research Institute

Anne Ginn
Senior Staff Assistant
General Motors

Russell A. Gronevelt
Assistant County Executive
Director, Wayne County Department of
Public Services

Bill Hartwig
Administrator, Project Planning Division
Michigan Department of Transportation
Bureau of Transportation Planning

Jeff High
Special Assistant to the Secretary
U.S. DOT/Office of the Secretary of
Transportation

Richard N. Johnson
Associate Director
BIRL/Northwestern University

Elaine E. Joost
Director, Office of University Research and
Education
U.S. DOT/Research and Special Programs
Administration

James Kenworthy

Snehamay Khasnabis
Wayne State University

Richard Marczewski
Manager, Technology Leveraging
General Motors Corp.

Joan McDonald
Systems Project Manager
Motorola GSTG

Karen McHenry
Management Analyst
U.S. DOT/Volpe National Transportation
Systems Center

Bob Morris
Infrastructure Coordinator
Wayne County Department of Public
Services

Homer A. Neal
Vice President for Research
University of Michigan

Stephen E. O'Toole
Senior Washington Representative
Industry-Government Relations
General Motors Corporation

Stephen Palmer
Administrator, Corktown Citizens District
Council
Southwest Detroit Business Association

Frank Pentti
Deputy Director
U.S. DOT/Office of Intermodalism

A. N. Perakis
Professor, University of Michigan
Department of Naval Architecture &
Marine Engineering

Thais Anne Peterson
Mayor Pro Tem
City of Ann Arbor

William Powers
Executive Director, Research
Ford Research Laboratory
Ford Motor Company

James F. Quinn
Staff Engineer
General Motors NAO R&D Center

Barbara C. Richardson
President
Richardson Associates, Inc.

Donald M. Rote
Argonne National Laboratory

Sally Rushton
Michigan Department of Commerce
Office of Procurement Assistance

Rocky Shih
Consultant to Administrator of RSPA
U.S. DOT/Research and Special Programs
Administration

Roger Shulze
Technical Development Executive
Chrysler Corporation
Liberty & Technical Affairs

Jack Simon
Manager, Technology Leveraging
General Motors

James M. Storey
Executive Director
State of Michigan
Wurtsmith Base Conversion Authority

Martin L. Straub
Commissioner
Board of Commissioners
Washtenaw County

Bob Sweet
University of Michigan Transportation
Research Institute

William C. Taylor
Professor
Michigan State University
Department of Civil Engineering

James Thomson
Assistant Director
University of Michigan Transportation
Research Institute

Herbert N. Underwood
Research Engineer
BIRL/Northwestern University

Nuno A. Vaz
General Motors

Richard Wallace
Graduate Student Research Assistant
University of Michigan

Patricia F. Waller
Director
University of Michigan Transportation
Research Institute

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Manager, Business Development
BIRL/Northwestern University

William R. Wheeler
Public Services Director
City of Ann Arbor

Chelsea White
Senior Associate Dean
Department of Industrial and Operations
Engineering
College of Engineering
University of Michigan

Chris White
Ann Arbor Transit Authority

Karl B. Williams
Reg'l Mer.
Michigan Jobs Commission

Alan Wolsky
Associate Division Director - Technology
Evaluations
Argonne National Laboratory
Energy System Division

Bill Wright
Director
Saginaw County Metropolitan Planning
Commission

Yasuhisa Yoshino
Executive Engineer
Nippon Denso Technical Center USA, Inc.

**University of California at Davis —
Tuesday, October 26, 1993**

Keith L. Abrams
General Manager
Genesis Data Inc.

John Anglescu
Project Manager
PAL Consultants

David Arrieta
Principal
DNA Associates

Linda Assadian
Clean Air Transportation
Pacific Gas & Electric Company

Ellen E. Bell
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George D. Bellino
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Hughes Power Control Systems

Tim Beltz
Special Assistant to the Secretary
U.S. Department of Transportation
Office of the Secretary

Donald W. Bentrutt
Programs Manager
Interlog, Inc.

Julius A. Bertrand
Chairman
Business Spectrum Associates

Avtar Bining
Energy Commission Supervisor
California Energy Commission

Philip Borden
Executive Director
Asian American Economic Development
Enterprises

Sompol Chatusripitak
Chief, Office of Advanced Vehicles &
Infrastructure Development
Caltrans

Grace Crunican
Deputy Administrator
U.S. DOT/Federal Transit Administration

Rich Davis
Director, Equipment Engineering &
Advanced Technology
Los Angeles County Metropolitan
Transportation Authority

Lee Deter
Deputy Director of Transportation
Management
Caltrans

Joseph S. Developmentinny
Co-Director, CRESPE
University of Southern California

John G. Diehl
Vice President
Agbabian Associates, Inc.

Tom Evashenk
Air Resources Engineering Associate
California Air Resources Board

Alan Ewen
Chairman and CEO
ADTech

Daniel Flaming
President
Economic Roundtable

Michael Gage
President
Calstart

Mohammed S. Ghausi
Dean of Engineering
College of Engineering
University of California, Davis

Anthony Gray
Vice President
Precision Group of Company

Albin J. Gruhn
President
California Labor Federation AFL-CIO

Nora A. Hackett
Technology Liaison Officer
University of California, Davis

Kent S. Harris
Corporate Representative
Pacific Gas & Electric Company

Jeff High
Special Assistant to the Secretary
U.S. DOT/Office of the Secretary

Howard H. Hirano
Manager
Sandia National Laboratories

Bob Hodges
Manager, Transportation Systems
ESL/TRW

Michael Hoffacker
Executive Director
Sacramento Area Council of Governments

Theodore Hullar
Chancellor
University of California

Marybeth Hunt
Rocketdyne Division
Rockwell International Corporation

Steve Jarvis
Director
State of California Trade & Commerce

Elaine Joost
Director, Office of University Research &
Education
U.S. DOT/Research and Special Programs
Administration

Paul Jovanis
Professor
Institute of Transportation Studies
University of California, Davis

Howard Klein
Project Manager
TRW

Ronald P. Koopman
Alternative Energy Program Leader
Lawrence Livermore National Laboratory

Jack Korman
Benchmark Quality Institute

Raffy Kouyoumdjian
Associate Development Specialist
Office of Economic Development
California Trade & Commerce Agency

Barbara Lehenbauer
Manager, Market Assessment
Aerojet

Robert Marchbanks
Director of Business Development
Centennial Engineering Group
Morrison Knudsen Corp.

Robert Marth
Senior Staff Scientist
ESL Inc.

Karen R. McHenry
Management Analyst
U.S. DOT/Volpe National Transportation
Systems Center

Linda Means
Manager, Market Development
Aerojet

Patricia L. Mokhtarian
Assistant Professor
Institute of Transportation Studies
University of California Davis

Phillip Mook, Jr.
EV Project Officer
US Air Force

Kevin J. Morley
Field Representative
Congressman Vic Fazio
3rd District California

Richard Napier Councilmember City of Sunnyvale, California	Steven Scott New Business Development Team GenCorp/Aerojet
Gary Neuner Manager, Commercial Business Development Westinghouse	Frieder Seible Professor of Structural Engineering University of California, San Diego
David Panush Consultant Office of Senator Roberti	Robert N. Shelton Vice Chancellor Office of Research University of California
Robert Parsons President Parsons Transportation Associates	Richard Sherman IVHS Program Manager Loral Western Development Labs
Jess W. Phelan Principal Contract Analyst University of California, Davis	Rocky Shih Associate Administrator for Research, Technology, & Analysis U.S. DOT/Research and Special Programs Administration
William Pichon Consultant Wilson Composite Group Inc.	Robert Singer Manager, Mobile Communications & Information Systems Hughes Aircraft Company
Michael Picker Chief of Staff to Mayor Serna City of Sacramento	Robert Smiley Dean and Professor of Economics Graduate School of Management University of California -- Davis
Brian Pickerall Manager, Depot Systems ARINC Research Corporation	Gordon Spear Manager, Technology Assessment Aerojet
Lynn Pozzi Mirage Systems	Chris Spelius Analyst TRW/Ellen Williams and Associates
James L. Quillin Secretary Treasurer California Conference of Machinists	Daniel Sperling Director of Transportation Studies University of California
Steven L. Robinson Member of Laboratory Staff Sandia National Laboratories	Russell Steele Director of Planning TRW - Transportation Systems
Kenneth David Ryan NHA, Inc./Sierra Club California	A. Gregory Stone Program Development Specialist Amerigon, Inc.
Jeff Salmon Director, Industrial Products Group	
Obe Schrader Deputy Division Manager Parsons Brinckerhoff Quade & Douglas - EMC	

Kenneth Stroud
Associate Air Pollution Specialist
California Air Resources Board

David Swan
Institute of Transportation Studies
University of California Davis

Frank Tokarz
Assistant Deputy Associate Director
Lawrence Livermore National Laboratory

James van Loben Sels
Director
Caltrans

Fons van Reisen
Delft University, the Netherlands

Steven Velinsky
Professor
Advanced Highway Maintenance &
Construction Technology
Center

William A. Volz
Advanced Projects Manager
Westinghouse

David Wallace
Regional Salesman
Titan Rubber & Supply

Melvin M. Webber
Director
Region IX Transportation Center
University of California, Berkeley

Lois Wolk
Mayor
City of Davis

Lois Wright
Government Affairs Representative
Electric Transportation Department
Sacramento Municipal Utility District

Pete Zaniewski
Senior Engineer
California Department of Transportation
(Caltrans)

**Massachusetts Institute of
Technology—
Thursday, October 28, 1993**

Liberato L. Abriam
President
GLA Engineering, Inc.

J. Edward Anderson
Chairman and CEO
Taxi 2000 Corporation

Jim Babish
Manager, CAD/CAM Software
Development
Raytheon Company

Ellen Bell
Transportation Strategic Planning and
Analysis Office
U.S. DOT/Volpe National Transportation
Systems Center

Tim Beltz
Special Assistant to the Secretary
U.S. Department of Transportation
Office of the Secretary

Moshe Ben-Akiva
Professor, Department of Civil Engineering
Massachusetts Institute of Technology

Larry S. Blair
Executive Vice President
Alliance for Transportation Research

Bernard Blood
Chief, Transportation Strategic Planning &
Analysis
U.S. DOT/Volpe National Transportation
Systems Center

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Administrative Assistant
MIT Center for Transportation Studies

Michael Bradley
Executive Director
NESCAUM

Aviva Brecher
Transportation Strategic Planning and
Analysis Office
U.S. DOT/Volpe National Transportation
Systems Center

Robert W. Brindley
IVHS Engineer
Bechtel/Parsons Brinckerhoff

John N. Brown
Vice President
GIS/Trans, Ltd.

Peter S. Butler
Capital Program Analyst
Massachusetts Bay Transportation Authority

Beth Callsen
General Engineer
U.S. DOT/Research and Special Programs
Administration

Jay Cashman
President
Cashman Associates

John Collura
Professor, Department of Civil Engineering
University of Massachusetts

Kristen Connell
Marketing Representative
Bell Associates

Gil Cooke
Principal
C Enterprises Inc., Engineers

Frank Coughlin, Jr.
Pol-Tec Group

Elizabeth J. Councilman
Associate Director, Highway Research
Project
University of Massachusetts
Civil and Environmental Engineering

Michael E. Curcio
Director of Advanced Development
SSG Inc.

Kevin R. Daly
Technical Planning
Raytheon Company

Salvano Daniel
U.S. Department of Transportation

Mike Dinning
Division Chief
U.S. DOT/Volpe National Transportation
Systems Center

Anne Donner
Director
Move Massachusetts 2000

Francis H. Duehay
City Councilor
City of Cambridge

Jim Dumke
Transportation Strategic Planning and
Analysis Office
U.S. DOT/Volpe National Transportation
Systems Center

Kathleen Estridge
Director
Northeastern University

Bowman H. Evans
District Manager, Boston District Office
TRW Systems Integration Group

Arthur W. Eve
Executive Director
Donahue Institute for Governmental
Services

Richard F. Fox
Dean of Continuing Education
Mount Wachusett Community College

Emil Frankel
Commissioner of Transportation
State of Connecticut Department of
Transportation

Richard Gannon
Director
Textron Defense Systems

Jane Garvey
Deputy Administrator
Federal Highway Administration

Loretta Grayson
Assistant Secretary
MIT Center for Transportation Studies

Sonia Hamel
Director of Air Policy and Planning
Executive Office of Environmental Affairs

Jeff High
Special Assistant to the Secretary
U.S. Department of Transportation
Office of the Secretary

John Hopkins
Transportation Strategic Planning &
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Thomas F. Humphrey
Senior Research Associate
MIT Center for Transportation Studies

Maurice Isaac
Program Manager, Technology
GE Automotive

Richard John
Director
U.S. DOT/Volpe National Transportation
Systems Center

Elaine Joost
Director, Office of University Research and
Education
U.S. DOT/Research and Special Programs
Administration

John Judge
Director of Operations
Massachusetts Turnpike Authority

Steve Karol
Chair, Transportation Committee
Massachusetts State Representative

Daniel R. Kelly
Manager, Marketing SSD
Raytheon Company

Allan Kleinman
Staff Analyst, Systems Division
Dynamics Research Corporation

Patrick D. Krolak
Director, Center for Productivity
Enhancement
University of Massachusetts, Lowell

Annalynn Lacombe
Senior Policy Analyst
EG&G/Dynatrend

David Larcombe
Executive Vice President
Bell Associates Inc.

Eric W. Lawrence
Logistics Management Services

Len Long
Electronics Engineer
U.S. DOT/Volpe National Transportation
Systems Center

John Malinowski
Administrative Assistant
MIT Center for Transportation Studies

Michael Markow
Cambridge Systematics Inc.

Pierre Martin
Director, R&D Program Development,
Corporate R&D Center
M/A-COM

Kenneth Maser
President
INFRASENSE Inc.

Richard Mastronardi
Vice President
Teeogen Division, Thermo Power Corp.

Karen McHenry
Transportation Strategic Planning and
Analysis Office
U.S. DOT/Volpe National Transportation
Systems Center

Joyce S. Mehring
Associate Professor
University of Massachusetts at Lowell
College of Management

Peter Metz
Deputy Director
MIT Center for Transportation Studies

Stephen Milligan
Principal Scientist
BBN

James C. Morrison
The Donahue Institute for Governmental
Services
The University of Massachusetts

Thomas Mottl
Vice President, Director System Sciences
Division
TASC

Jim O'Leary
Principal
Alternate Concepts, Inc.

Ross R. Olander
Vice President of Marketing
Foster Miller, Inc.

William Osborn
General Manager
TravElectric Services Corporation/Boston
Edison

A. Jan Patrick, Jr.
Director, Business Development - Energy
Technology
Textron Defense Systems

Stephen Pepin
Bureau of Transportation
Executive Office of Transportation and
Construction

Karen Polenske
Professor, Urban Studies & Planning; Dir.
Spurs Prog.
Massachusetts Institute of Technology

Spiro Pollalis
Associate Professor
Harvard University

John F. Reeder
Manager for Policy Development
GTE Government Systems

James P. RePass
President and CEO
The Northeast Corridor Initiative, Inc.

Robert Ricci
Director, Office of Research and Analysis
U.S. DOT/Volpe National Transportation
Systems Center

Frederick P. Salvucci
Senior Lecturer
MIT Center for Transportation Studies

Daniel Schodek
Kumagai Professor of Architectural
Technology
Harvard University

Yossi Sheffi
Director
MIT Center for Transportation Studies

Clay Sherrod
Project Engineer
Bechtel/Parsons Brinckerhoff

Edward Silva
Planning and Research Engineer
FHWA Regional Office

Louise F. Stoll
Assistant Secretary for Budget and
Programs
U.S. DOT/OST

Ronald P. Suduiko
Special Assistant to the President
Massachusetts Institute of Technology

Peter Szabo
Executive Assistant to the Commissioner
Connecticut Department of Transportation

Edward R. Terceiro, Jr.
Executive Dean of Administrative Service
Mount Wachusett Community College

Basil Tommy
Deputy Director for Planning
Massachusetts Turnpike Authority

William Weinstein
Principal Member of the Technical Staff
Charles Stark Draper Laboratory

David P. Wolt
Manager, Business Development
Litton Amecom

Wallace K. Wong
Systems Engineering Manager
SSG Inc.

Jung-Ming Wu
Senior Consultant
Arthur D. Little, Inc.

Steven Zelubowski
Engineering Manager - Automotive
M/A-COM

**University of Texas at
Austin—Tuesday, November 2, 1993**

Michael Aulick
Planning Director
Austin Transportation Study

Jesse Balleza
Director of Planning
VIA Metropolitan Transit

Ellen Bell
Management Analyst
Volpe National Transportation Systems
Center

Tim Beltz
Special Assistant to the Secretary
U.S. Department of Transportation
Office of the Secretary

Robert M. Berdahl
President
The University of Texas at Austin

Jeff Bonham
Special Assistant to the Lieutenant
Governor
Office of the Lieutenant Governor

John E. Breen
Professor of Structural Engineering
University of Texas, Austin

John Brown

Dock Burke
Director
Southwest Region University Transportation
Center

Tom Burke
President
XPM, Inc.

Beth Callsen
General Engineer
U.S. DOT/Research and Special Programs
Administration

Laura Cisneros Quin
Research Analyst
Office of Senator Carlos Truan
Senate Committee on International
Relations, Trade & Technology

William B. Craven
Vice President of Business Development
Electrosource, Inc.

Robert Cuellar
Deputy Executive Director for
Transportation Planning & Development
Texas Department of Transportation

Dottie Drinkwater
Lockheed IMS

Thomas J. Farrell
Technology Transfer Specialist
IC2 Institute
NASA Technology Commercialization
Centers

Charles W. Gates
Director of Aviation
Robert Mueller Municipal Airport

Katherine Gillman
Special Assistant for Defense Conversion
White House Office of Science and
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Kenneth R. Goodwin, Jr.
Site Manager
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Assistant Executive Director for Multimodal
Transportation
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Associate Head and Professor of Electrical
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Chairman
Southwestern Engineer & Equipment Co.

Scott Harmon
President
Southwestern Engineering and Equipment
Co.

William Hayes
President, Defense Systems & Electronic
Group
Texas Instruments Inc.

Jeff High
Special Assistant to the Secretary
U.S. Department of Transportation
Office of the Secretary

Charles A. Jacobson
President
Clear Lake Transportation Partnership

Winsome Jean
Policy Council
Office of the Governor

Barbara Jordan
Lyndon B. Johnson Centennial Chair in
National Policy
The Lyndon B. Johnson School of Public
Affairs
The University of Texas at Austin

Mounir Kamal
Executive Director of Research
General Motors

John Kelly
District Engineer
Texas Department of Transportation

Mike Klonsinski
Director of Office of Advanced
Technology
Texas Department of Commerce

Richard Lakata
Transportation Engineer
Austin Transportation Study

Ross J. Leonard
Manager, Program Development
Loral Space Information Systems

Raymond C. Loehr
Professor of Civil Engineering
University of Texas at Austin

Randy Machemehl
Department of Civil Engineering
University of Texas at Austin

Jag Mathur
Principal Scientist
Tracor Aerospace

Karen McHenry
Management Analyst
Volpe National Transportation Systems
Center

David S. Millar
Engineer
WHM Transportation Engineering
Consultants, Inc.

Henry R. Muñoz III
Texas Transportation Commission

Soheil Nazarian
Director
Center for Geotechnical & Highway
Materials Research
The University of Texas - El Paso

Doug Peck
Director of Vehicle Maintenance
VIA Metropolitan Transit

Federico Peña
Secretary of Transportation
U.S. Department of Transportation

Russell Pentz
Assistant General Manager
Houston METRO

Kirby Pickett
District Engineer
Texas Department of Transportation

Steven M. Polunsky
Texas High Speed Rail Authority

Robert Rainwater
Manager, Program Development
ATEC, Inc.

Ron R. Reber
Manager, Civil TiltRotor Business
Development
Bell Helicopter Textron, Inc.

David Rohde
Director
Tracor Applied Sciences

Rocky Shih
Associate Administrator for Research,
Technology & Analysis
U.S. DOT/Research and Special Programs
Administration

Richard L. Sitton
Vice President, Strategic Development

Martha Sorrell
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