

# TRANSPORTATION and the **ECONOMY**

**Leading Globally  
Succeeding Locally**

**A Volpe Thought Leadership Series  
2014 - 2015**

**Final Report  
August 2015**

Prepared by the Office of Strategic Initiatives  
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# Contents

- List of Figures ..... ii**
- Distinguished Speakers..... 1**
- Transportation and the Economy: Series Summary ..... 2**
- At a Glance: Stakeholder Engagement ..... 4**
- Megacities and Logistics Clusters ..... 5**
  - Transportation, Economic Competitiveness, and Megaregions..... 5
  - Logistics Clusters: Jobs, Growth, and Economic Development ..... 8
- Intermodal Freight Systems ..... 12**
  - The Nation’s Requirements for an Intermodal Transportation System ..... 12
  - Connecting to America’s Ports, Our Connections to the World ..... 13
  - Connecting the Global Economy Through Trade and Transportation ..... 15
- Technology Innovation ..... 17**
  - Delivering Efficiency with NextGen..... 17
  - Navigating the Mobility Transformation..... 21
  - MOVE: Putting America’s Infrastructure Back in the Lead ..... 25
- For More Information..... 28**
- Appendix: Stakeholder Engagement..... 29**

# List of Figures

- Figure 1. Gregory Winfree ..... 2
- Figure 2. Emerging Megaregions ..... 6
- Figure 3. Catherine Ross ..... 7
- Figure 4. Yossi Sheffi ..... 9
- Figure 5. Anne Aylward ..... 13
- Figure 6. Kurt Nagle ..... 14
- Figure 7. Rich McArdle ..... 16
- Figure 8. Modernizing Flight ..... 18
- Figure 9. Michael Whitaker ..... 19
- Figure 10. Global Gridlock and Cities ..... 22
- Figure 11. John Moavenzadeh ..... 23
- Figure 12. Rosabeth Moss Kanter ..... 27
- Figure 13. Megaregion Representation ..... 29
- Figure 14. Online Registration Statistics ..... 30

# Transportation and the Economy: Leading Globally, Succeeding Locally

## *Distinguished Speakers*

(In order of appearance)

**Yossi Sheffi, PhD**

Elisha Gray II Professor of Engineering Systems  
Director, Center for Transportation and Logistics  
Professor, Civil and Environmental Engineering  
Massachusetts Institute of Technology

**Catherine L. Ross, PhD**

Director, Center for Quality Growth and Regional Development  
Harry West Professor of City and Regional Planning  
Deputy Director, National Center for Transportation System Productivity and Management  
Georgia Institute of Technology

**Anne Aylward**

Deputy Associate Administrator for Research and Technology  
Volpe, The National Transportation Systems Center

**Michael G. Whitaker**

Deputy Administrator  
Federal Aviation Administration

**Kurt Nagle**

President and CEO  
American Association of Port Authorities

**Rich McArdle**

Managing Director for Global Operations Policy  
United Parcel Service

**John Moavenzadeh**

Senior Director, Head of Mobility Industries  
World Economic Forum, USA

**Rosabeth Moss Kanter, PhD**

Arbuckle Professor, Harvard Business School  
Chair and Director, Harvard University Advanced Leadership Initiative

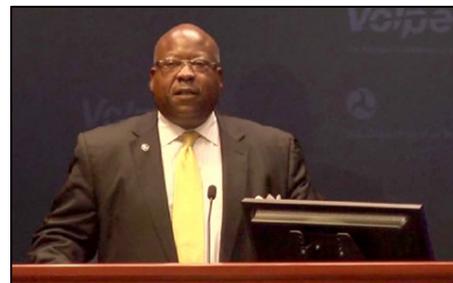
# Transportation and the Economy: Series Summary

The U.S. Department of Transportation (U.S. DOT) Volpe Center (Volpe) hosts a thought leadership lecture program that informs the national transportation conversation by coalescing insights from experts in innovation, advanced technology, resiliency, automation, and numerous other topics critical to a safe, efficient, and globally competitive transportation system.

Volpe's 2014-2015 thought leadership lecture series—*Transportation and the Economy: Leading Globally, Succeeding Locally*—highlighted three forces driving transportation innovation in modern economies:

- **Logistics.**  
The nation's economic growth is driven by business clusters and the geographic spacing of populations in large urban centers.
- **Infrastructure.**  
Economic growth in those centers is stimulated by their transportation networks' modal structure and capacity.
- **Technology.**  
Technological innovations can be an engine of economic growth and solve many transportation network challenges.

U.S. DOT Assistant Secretary for Research and Technology Gregory D. Winfree kicked off the series on October 3, 2014. Mr. Winfree articulated the overarching theme of the series: our transportation system is the keystone of the nation's economic growth, and it is the canary in the coalmine. He emphasized that an efficient transportation system can propel an economy—but it can also stall an economy's development when existing infrastructure does not offer capacity needed for growth, serving as a warning signal that a nation lacks critical elements for economic vitality.



**Figure 1. Gregory Winfree**  
Mr. Winfree introduced the three forces that link transportation and economic success.

Mr. Winfree's remarks centered on the idea of the modern transportation system as a network of intricately connected hubs, nodes, and links. When those complex combinations are made they can turn a city into a thriving economic network—or a congested, declining metropolitan center. When network links, nodes, and hubs connect, the resulting system is an economic lifeline to regional economies.

**The ability to move goods and people safely and efficiently, and to do so while maintaining the capacity to adapt to a changing world, is the cornerstone of prosperity, social equity, and quality of life.**

**-Gregory Winfree**

Transportation systems often connect in similar ways across many scales within a network. Mr. Winfree likened the modern transportation network to the fractal geometry of a [Mandelbrot set](#), in which the configuration of the road, rail, and marine network in an urban corridor shows fractal densities that are nonlinear and scale-free: they don't follow a bell-curved distribution pattern, but rather have self-

similar patterns at many scales and sizes of the network. The distribution of this fractal pattern corresponds closely to how network links, nodes, and hubs connect—or fail to connect—to provide lifelines to regional economies through network connectivity. Mr. Winfree concluded that the GROW AMERICA Act—the Administration's proposed funding reauthorization for surface transportation—and U.S. DOT's Intelligent Transportation System (ITS) advanced technology program are key components to making the U.S. transportation system an effective piece of the global economy, along with the following concepts:

- Transportation is the foundation for the complex, interlinked geographic network of the nation's urban and rural economies that feed the national economy and, through megacities and logistics corridors, are lifelines to the global trade arena.
- The connectedness of the nation's intermodal transportation is a key metric for measuring how effectively America's roads, railroads, and air and marine services move goods and people.
- Advanced transportation technology enables economic vitality, goods production, and wealth creation, while providing effective solutions for mitigating adverse impacts of transportation and lack of access to economic opportunity.

Speakers at Volpe's *Transportation and the Economy* series provided supporting evidence for the threefold premise Mr. Winfree laid out, and explored the role of transportation in the economy within the following framework:

- **Megaregions and logistics clusters link sectors of the transportation network that support the global economy.** Professor Catherine Ross of the Georgia Institute of Technology and Professor Yossi Sheffi of the Massachusetts Institute of Technology (MIT) discussed the role of transportation in developing megacities, trade corridors, and logistics clusters, and their positive and negative impacts on economic growth, congestion, and the environment.
- **Intermodal freight systems are the cornerstone of global trade.** Three distinguished transportation experts—American Association of Port Authorities President Kurt Nagle, United Parcel Service (UPS) Managing Director for Global Operations Policy Rich McArdle, and Volpe's Deputy Associate Administrator for Research and Technology Anne Aylward—discussed the role of transportation in

stimulating global commerce, trade, and gross domestic product (GDP) growth.

- **Technology innovation enables efficient mobility, safe navigation, and sustainable ecosystems.** Federal Aviation Administration (FAA) Deputy Administrator Michael Whitaker, John Moavenzadeh of the World Economic Forum (WEF), and Rosabeth Moss Kanter of the Harvard Business School discussed the impacts of modern ITS technologies that support innovations in safety, mobility, and congestion mitigation.

## At a Glance: Stakeholder Engagement

The series had a wide-ranging appeal among key transportation stakeholders in government, industry, academia, and nonprofit organizations. *Transportation and the Economy* drew more than 2,000 online registrants. Total in-person attendance was 480 people.

More than 700 professionals from state, regional, and local transit agencies and metropolitan planning organizations (MPOs) attended in person or by webinar, including:

- State government officials representing 34 state departments of transportation.
- Representatives from 55 MPOs and commissions registered for the web series, representing more than 130,000 square miles of urbanized area with a total population of 95,600,000.

More than 400 companies, 50 U.S. and international colleges and universities, and a dozen federal agencies also participated in the series.

Please see the Appendix for a full report on stakeholder engagement for this series.

# Megacities and Logistics Clusters

## *The Hubs of the Global Trade Network*

Drs. Ross and Sheffi brought thought-provoking ideas on how the geographic layout of businesses and employment opportunities affect the growth of megaregions, logistics hubs, and trade corridors that provide the productive energy and network hub connectivity to stimulate economic and trade growth.

### **Transportation, Economic Competitiveness, and Megaregions**

[Dr. Catherine Ross](#)

**Georgia Institute of Technology**

*October 15, 2014*

Dr. Ross spoke about how burgeoning megaregions in America are impacting economic competitiveness. Megaregions are collections of large cities, suburbs, exurbs, and the areas between, characterized by concentrated economic opportunities and huge transportation challenges, Dr. Ross said. Trade globalization and technological advances, she said, have created an increasingly complex world in which we are interconnected in trade, communication, and transportation.

**Not all corridors are equal. Some are directly tied to global markets and our economic viability. Do we conceptualize them in that way? If these corridors don't work, then we don't work.**

**-Dr. Catherine Ross**

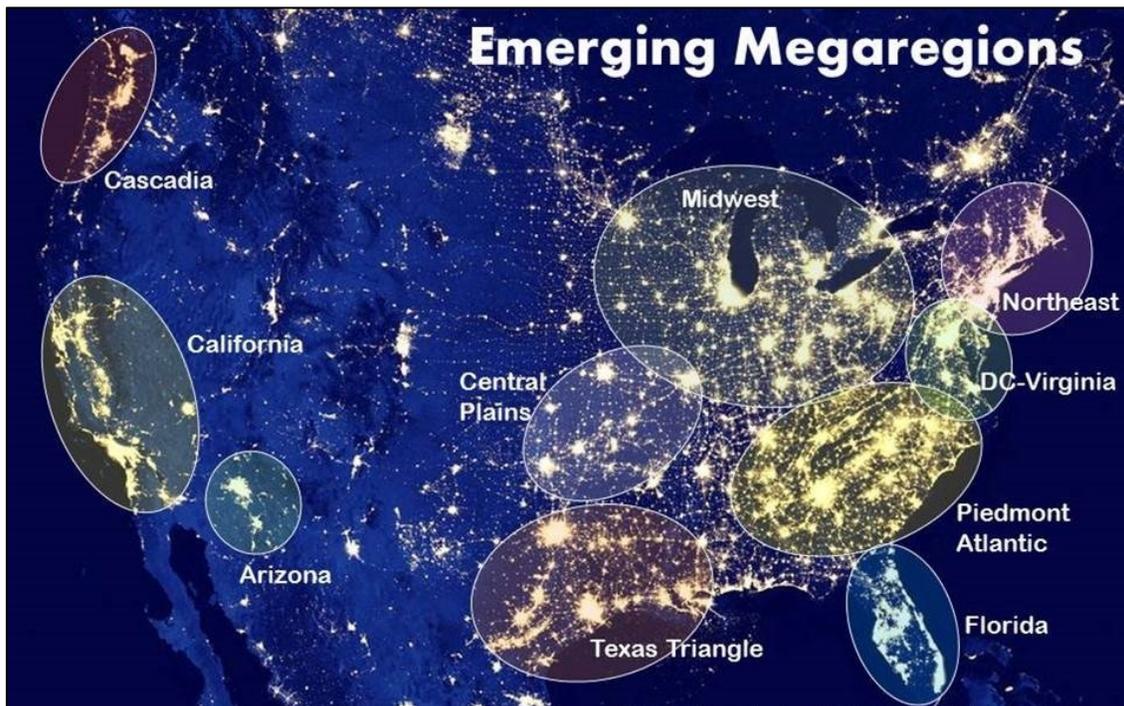
There are 10 megaregions in America: Northeast, DC-Virginia, Piedmont Atlantic, Florida, Texas Triangle, Central Plains, the Midwest, Arizona, California, and Cascadia. These megaregions account for 30 percent of national territory, more than 76 percent of population and employment, 82 percent of gross regional product, 92 percent of the revenues of the nation's Fortune 500 companies, and 86 percent of patents. Each megaregion offers areas of economic specialization. The Northeast megaregion, for instance, is a technological hub. The Southern California megaregion is a hub of global containerized trade, while energy production and trade drive the Texas Triangle. The Central Plains megaregion facilitates commodities production by shipping and distributing goods to the rest of the country. Most goods produced in the Piedmont and Cascadia megaregions remain in-region.

Dr. Ross proposed that these diverse megaregions serve as critical engines of economic activity for America because they share the following attributes:

- **Megaregions are anchored around large cities and metropolitan areas.** Metropolitan areas with populations ranging between 150,000 and 10 million account for 70 percent of America's GDP, 75 percent of employment, and are the headquarters of more than 90 percent of Fortune 500 companies. Yet these metropolitan areas, and the geographic corridors along which they

are located, do not uniquely define the essence of megaregions. Cities become megaregions when the following two criteria are met.

- **For a city to be a megaregion anchor it must serve as a primary engine of economic activity and global trade.** Whether a city is a megaregion anchor depends on the region's size, employment density, share of GDP, concentration of Fortune 500 companies headquartered there, and other indicators. Many metropolitan areas serve as national gateways for freight movement and are major trade and transportation corridors, Dr. Ross said. Some corridors are directly tied to global markets and America's economic viability. Those corridors have the characteristics of a megaregion.



**Figure 2. Emerging Megaregions**

Megaregions are changing transportation planning and linkages. Multimodal, seamless transportation systems in megaregions are critical to ensuring America's global economic competitiveness.

*Image source: Center for Quality Growth and Regional Development, Georgia Tech.*

- **For megaregions to emerge, component cities must have a network of transportation links and nodes.** Transportation networks connect centers of production, consumption, and trade and let labor and financial markets link to manufacturing and goods distribution locations that underpin viable megaregions. Dr. Ross emphasized that the transportation nexuses that connect the disparate parts of a megaregion have two central characteristics: they don't respect geopolitical boundaries, and they play different roles across the global and national landscape. For instance, the transportation linkages that connect agricultural production nodes in the Central Plains require a rail and barge network to move bulk commodities. Linkages in the Southern California transportation network are the rail and trucking modes that move

containerized cargo to and from production, warehousing, and import and export nodes. Achieving fluidity across the geographic and modal boundaries of megaregions is a major challenge. To ensure adequate investment and capacity, planners must navigate dozens of local and regional planning agencies and state DOTs so that transportation corridors connect and have funding.

Dr. Ross cautioned that megaregions have inherent risks. If transportation planners think about their work with an eye toward emerging megaregions, they must also recognize several challenges. These challenges cut across the driving forces of job creation, wealth generation, and cultivating an efficient transportation network:

- **Network congestion and capacity shortfalls.**

Major road congestion in megaregions and cities can adversely impact access to jobs and production resources. Dr. Ross pointed out that highways in Atlanta, the hub of the Piedmont Atlantic megaregion, are already chronically congested and pose a major planning challenge.



**Figure 3. Catherine Ross**

Dr. Ross explained that while each megaregion is unique, their economic success—and the success of the American economy in the global sphere—depend on efficient freight and personal transportation.

- **Pollution and environmental damage.**

The spread of megaregions has been associated with rising greenhouse gases (GHG) and carbon dioxide (CO<sub>2</sub>) emissions. Urbanized areas account for some 80 percent of the world's CO<sub>2</sub> emissions, Dr. Ross said. Building more highways to relieve congestion will invariably lead to growing vehicle miles traveled (VMT) and more CO<sub>2</sub> emissions. In the Southeast megaregion, for instance, the transportation network does not have an adequate supply of environmentally efficient rail, pipeline, and marine modes.

- **Infrastructure is skewed toward vehicle use.**

Highways and roads dominate in megaregions, and they compound environmental costs. Shifting more highway traffic to transit and freight rail is a positive alternative to increasing highway capacity, Dr. Ross said. Rail network capacity can accommodate our freight needs, and in many megaregions rail is not used to move commodities. Some 45 percent of our rail network will still be operating under-capacity by 2035, Dr. Ross predicted. By expanding rail and pipeline modes, transportation planners will be able to promote environmentally efficient methods and reduce highway congestion. A funding strategy that cuts across geographic and jurisdictional silos and removes limitations set by state boundaries can address environmental challenges in the wider context of the global economy. Gains from a robust economy, global trade, and efficient goods movement have significant tradeoffs, Dr. Ross said. Environmental costs need to be part of the growth equation.

Dr. Ross said that a vision of 21<sup>st</sup> century transportation as an international gateway fueled by a web of seamless, efficient intermodal networks—linked by roads, high-speed rail, commuter rail, water transportation, and alternative technologies—requires transportation planners who recognize that:

- Infrastructure challenges are likely to continue. The growth in trade, population, and economy will require new ways of coordinating investments across boundaries.
- New and ever-changing dynamics of global trade keep freight movement in permanent flux, driven by economic processes and technological innovations.
- The existence of multiple critical stakeholders will present challenges in transportation planning. It will be important to bring together public- and private-sector actors to test opportunities for refining planning practices.

## Logistics Clusters: Jobs, Growth, and Economic Development

[Dr. Yossi Sheffi](#)

Massachusetts Institute of Technology

October 3, 2014

**If you want to understand the size of commercial activity in the United States, just watch the trains in Chicago coming in from Los Angeles-Long Beach.**  
-Dr. Yossi Sheffi

Dr. Sheffi defined logistics clusters as geographic areas where natural resources, specialized labor, and expert knowledge come together to provide services that support global supply-chain movements and trade. He traced the theoretical origins of the rationale for *geographic agglomeration* of economic production into logistics clusters to Alfred Marshall's classic 1920 work,

*Principles of Economics*. Marshall explained the growth in economic activity and job creation that happens when industrial complexes from different sectors are co-located as a function of *positive externalities* generated from interaction between the following concepts:

- Knowledge sharing and spillover among co-located firms.
- Development of a specialized and efficient supplier base that offers customers competitive pricing and improved products and service.
- Development of local labor pools with specialized skills.

Urban clusters spur external economies that generate economic benefits, spur productivity, and lead to many new businesses. Economists have long maintained that these benefits easily override competitive forces that would ordinarily be a deterrent to clustering around competitors.

Dr. Sheffi noted several examples of well-known logistics clusters, including:

- Silicon Valley
- Napa Valley
- Wall Street
- The Cambridge, Massachusetts bio-technology industry cluster
- The logistics cluster in Zaragoza, Spain.
- Singapore
- Holland
- Panama Canal
- Chicago and Joliet, Illinois
- Louisville, Kentucky
- Memphis, Tennessee

Once logistics clusters get started, they tend to be self-sustaining, supporting the premise that “success begets success,” Dr. Sheffi said. He stressed that logistics clusters are distinct from urban clusters and megacities, and do not share all the transportation and economic attributes of megacities. For instance, in some cities, logistics services develop outside cities, as in some Germany cities where trucks are prohibited from entering city centers. Such developments, Sheffi said, are “urban clusters.” Logistics clusters are different. They attract firms that provide third-party logistics services, such as trucking carriers, warehousing companies, freight forwarders, retail and wholesale distributors, and manufacturing suppliers for new and after-market parts.

In Memphis’ intermodal transportation hub, the logistics sector accounts for nearly one in three jobs. In Chicago, the freight rail cluster supports 200,000 workers, while in Louisville a UPS package processing facility supports 55,000 jobs, pays \$277 million in taxes, and processes 1.6 million packages a day. Louisville is also the operations hub for online companies such as the shoe retailer Zappos, which has its warehousing and order processing operations there.

*Knowledge spillover* in clusters happens through informal contacts and information sharing and may have a multiplier effect and be conducive to further collaborative ventures. These benefits from activity clusters are captured through self-reinforcing mechanisms. Logistics density creates a positive feedback loop of more efficient transportation operations. Dr. Sheffi characterized logistics clusters as flourishing like a naturally evolving ecosystem. He explained that the functions of logistics clusters are threefold:

- Facilitate access to national resources and supply bases.
- Make labor pools available.
- Build trust among participants by generating opportunities for exchange of tacit knowledge, collaboration, and benefit from publicly funded research and development.



**Figure 4. Yossi Sheffi**  
Dr. Sheffi focused on logistics clusters, those self-sustaining centers of freight movement and trade activity that provide jobs and growth.

Dr. Sheffi further explained that out of those core functions, the following benefits emerge:

- **Cost reduction.**  
Logistics clusters reduce overall transportation costs for businesses. They offer *greater density of demand*, which leads to load consolidation and fewer empty container miles. *Scale economies* reduce unit costs by increasing the size of equipment—larger vessels, rail cars, and containers—spreading costs over a larger number of customers. *Load consolidation* moves operations away from higher-cost point-to-point service to consolidated hub and spoke networks. And, *stable prices* emerge as operational liquidity for small and large carriers improves.
- **Improved service frequency and quality.**  
As service providers offer more frequent pickup and delivery and expedited next-day service, customers can bypass intermediate terminals and share equipment pools, such as containers and chassis. In general, co-located firms flourish as they exchange ideas, share labor and equipment, and expand individual successes. Customers also benefit as digital content enables improved quality of service from personalized manufacturing and customized services.
- **Access to multiple modes and carriers.**  
Pools of modes and carriers grow as access grows to multimodal shipment options, with improved operational flexibility and price stability. Greater density of suppliers and conveyances, so that more equipment is available on demand, reduce price volatility and create greater stability as a result of risk-pooling effect—with a balance among high- and low- demand urgency—in different industrial segments.
- **Logistics jobs cannot be off-shored.**  
Logistics services revolve around high-service, just-in-time and end-stage customization jobs that require local service that cannot be outsourced. Logistics jobs—from blue collar transport and warehousing, to white-collar information technology jobs, to value-added jobs in light manufacturing and repair jobs—are all needed locally.
- **Logistics jobs support principles of social justice and public responsibility.**  
Logistics clusters support the skills of a diverse workforce. Such clusters underscore the critical importance of the need for the public sector to play a pivotal role in urban development. Responsibilities include providing shared infrastructure, deciding on land-use and issuing local user permits, offering business incentives and subsidies, offering mediation or collaborative services, and providing public funding for research and development.

Dr. Sheffi acknowledged that logistics clusters have the following downsides:

- **Adverse economic and environmental consequences.**  
Logistics clusters may cause labor shortages, increase land values, and contribute to growing congestion, GHG emissions, and other environmental pollution.
- **Collusion and exclusion.**  
As national and local governments in logistics clusters get strategically engaged in bolstering economic gain, they may also be forced to promote strategies that benefit certain industries or businesses over others, which may not be consistent with public missions or objectives.
- **Groupthink.**  
Clusters may exclude alternative views and ideas that may be beneficial, a paradoxical outcome of the prime advantage of a cluster: the free flow of information and knowledge. Dr. Sheffi observed that the groupthink phenomenon is more likely to take place in mature clusters that are settled on a dominant design and set best processes. He presented the example of Akron, Ohio, which from 1900 to 1935 was one of the most innovative tire industry clusters in America. But, the Akron tire cluster failed to react in the 1970s when Michelin introduced radial tires, which reduced blowouts and gasoline consumption. In less than two years, three of four Akron tire manufacturers had folded. The groupthink phenomenon suggests that in mature clusters, where existing processes and common wisdom are taken for granted, the benefits of knowledge exchange are likely to decline as inertia and resistance to change develop—regardless of changes in the competitive environment.<sup>1</sup>

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<sup>1</sup> Sheffi, *Logistics Clusters: Delivering Value and Driving Growth*, MIT Press, 2012, pp 51-52; citing study by Bruce Hoffman *American Icon: Alan Mulally and the Fight to Save Ford Motor Company*.

# Intermodal Freight Systems

## *The Cornerstone of Global Trade*

The next major theme of the series was the role of intermodal freight movement as the cornerstone of global trade and economic growth. Volpe’s Anne Aylward, Kurt Nagle of the American Association of Port Authorities, and Rich McArdle of UPS described the role of the intermodal freight system in enabling global commerce, and the challenges of today’s complex funding and service environment. They demonstrated how intermodal goods movement is the keystone of the nation’s economic growth.

### **The Nation’s Requirements for an Intermodal Transportation System: A 20-Year Perspective**

[Anne Aylward](#)

**Volpe Deputy Associate Administrator for Research and Technology**

*October 30, 2014*

Ms. Aylward provided a tour of the nation’s intermodal freight sector over a 20-year period that began with the National Commission on Intermodal Transportation (NCIT), established in 1994. She described her experience serving as Executive Director of NCIT, comparing the challenges the Commission addressed then with obstacles America faces today regarding investment in rail infrastructure. The NCIT final report emphasized the need to spur intermodal rail operations, given that excess rail capacity had disappeared after a decade of rail and trucking deregulation. The Commission found that promoting intermodal rail would increase operational efficiency and mobility because rail has lower operating costs and helps reduce highway congestion and gasoline use.

**No one likes truck traffic going by their house. But when you go to the store you expect to find Cheerios on the grocery store shelf. How do you think the Cheerios got there? There’s no such thing as the immaculate conception of Cheerios. Freight has to move.**  
*-Anne Aylward*

Ms. Aylward noted that over the past 20 years, progress has been made toward clearly recognizing the role of the federal government in infrastructure investment and strategic planning. Despite that progress, however, “we’re still a patchwork of investment decisions made at the local and state level by the private sector,” she said. On the positive side, she noted that over the past decade—with the Moving Ahead for Progress in the 21<sup>st</sup> Century Act (MAP-21), Transportation Investment Generating Economic Recovery ([TIGER](#)) grants, the National Freight Advisory Committee (NFAC), and now with the proposed GROW AMERICA Act—there has been a more pronounced emphasis on freight.

Looking to the needs of the economy 20 years from now, today’s challenges are much like those we

faced 20 years ago, Ms. Aylward said. By 2045, the size of the economy is likely to double. Demand for reliable freight service will continue to grow, although transportation will be less freight-intensive because the crude weight of materials shipped will be less. The strain on ports, border crossings, and the multimodal truck-rail infrastructure will also grow.

Ms. Aylward stressed the need to address capacity constraint. The need to reduce adverse emissions impacts and energy use underscore the need to promote smart infrastructure to facilitate efficient first-mile/last-mile solutions and address urban congestion and environmental damage from freight container shipments.



**Figure 5. Anne Aylward**  
Ms. Aylward shared decades of experience in intermodal freight research.

## Connecting to America's Ports, Our Connections to the World

### [Kurt Nagle](#)

President and CEO

American Association of Port Authorities

December 9, 2014

**Ports throughout the world, and certainly here in the U.S., need to prepare for larger vessels. We need to make sure that navigation channels are deep and wide enough to accommodate those vessels and to make sure marine terminals have the equipment to handle larger vessels and landside connections.**  
*-Kurt Nagle*

Mr. Nagle spoke about how North American ports connect worldwide trade. He discussed the history of the American Association of Port Authorities (AAPA), established in 1912 to represent the seaports of the Western Hemisphere to support world commerce. To underscore the critical importance of the nation's ports for the U.S. and global economies, Mr. Nagle said that in 2013 U.S. merchandise imports reached \$2.3 trillion, more than half of which was moved by ship.

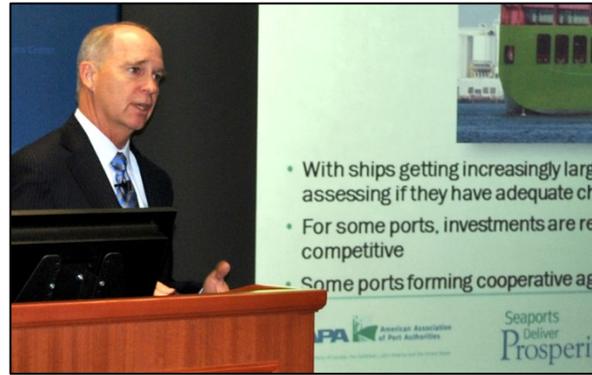
Opportunities, priorities, and challenges for North American ports stem from three broad trends: growth in container traffic, growth in the size of containerships, and shifting port traffic routes.

- **Growth in container traffic.**

Containerized trade will double by 2020 and America's trade volume will quadruple by 2030, according to forecasts. That growth will be driven primarily by changing demand for energy and the growth of exports from the U.S; ports in the U.S. are expected to spend \$46 billion over the next five years to address expected changes in port traffic and infrastructure challenges.

- **Bigger containerships.**

Containerships have grown from 4,000 twenty-foot equivalent units (TEUs) to more than 10,000 TEUs, further changing the cost structure and infrastructure needs of container ports. Existing agreements and alliances among ocean carriers mean that from 2014 to 2018 there will be 154 new vessels delivered, each with a capacity of 10,000 to 18,600 TEUs.



**Figure 6. Kurt Nagle**

Mr. Nagle advocated for upgrading America’s ports to account for larger containerships and estimated increases in trade volume.

AAPA works with ocean ports to accommodate larger containerships,

demonstrating the need for port authorities to invest in wider and deeper harbors. The Water Resources Reform and Development Act (WRRDA), signed in June 2014, ensures full maintenance of navigation channels supported by the Harbor Maintenance Tax (HMT). Mr. Nagle noted that WRRDA streamlines the project delivery of work done in navigation channels, and sustainable dredging practices that reuse dredged material. To sustain competitiveness in global freight markets, U.S. ports will need to fully use HMT revenues, he said.

- **Shifting global trade routes.**

After an expansion project completed in summer 2015, the Suez Canal can now accept more containerships per day with less waiting time, shortening the water freight route from Asia to Europe for more vessels. The Suez shift has significantly altered the pattern of global container movement. In addition to Suez Canal infrastructure improvements, the route shift is attributed in part to slower economic growth in China and the shift of manufacturing to Southeast Asia, Mr. Nagle said.

Mr. Nagle concluded his presentation by outlining AAPA strategies for dealing with financing and planning. He noted that two freight advisory committees, NFAC and the Freight Stakeholders Coalition, were set up to facilitate the implementation of parts of MAP-21 that cover freight movement. AAPA priorities include:

- Assisting with state and federal planning for designating gateways and corridors.
- Identifying connectors of the primary freight network.
- Ensuring that maritime planning is part of every state DOT plan.
- Ensuring that short-sea shipping and America’s Marine Highways are part of U.S. DOT’s planning.

- Supporting the Transportation Infrastructure Finance and Investment Act.
- Ensuring dedicated freight funding provisions that make port authorities eligible to apply directly for funding and receive funding for [Projects of National and Regional Significance](#).

Mr. Nagle closed by emphasizing the need to use navigation and communications technologies to meet the growing need for container throughput while using existing harbor capacity.

## Connecting the Global Economy Through Trade and Transportation

[Rich McArdle](#)

Managing Director of Global Operations Policy

UPS

January 20, 2015

Mr. McArdle's presentation addressed barriers to trade, which are built by outdated geopolitical boundaries and highlight the need for harmonized international trade agreements. Operating a modern logistics system across geopolitical borders drawn hundreds of years ago is difficult because it is impossible to cross a single border without encountering a new set of trade priorities, Mr. McArdle said. On our complex global map there are some 200 nations and territories, each with their own governments and subdivisions, making it complicated to deliver traded goods.

**When you take a snapshot of the 48 contiguous states, we have over 3,000 counties and 20,000 municipalities. If you go even a bit further and you take a look at the global map, you get 200 nations and territories in the world, most with their own government subdivisions. This is our chess board.**

*-Rich McArdle*

Trade agreements have attempted to make the global chess board look more like an open field where goods move fluidly without roadblocks such as regulations and tariffs.

Mr. McArdle cited Peterson Institute for International Economics [research](#), which estimated that by 2025 the value of global trade with the Trans-Pacific region will be around \$223 billion annually. The Institute estimated the U.S. portion of that trade will be about \$77 billion, driven primarily by exports. Proposed and developing trade agreements designed to facilitate international trade flows include the [Transatlantic Trade Investment Partnership](#) between the U.S. and Europe, and the [Trans-Pacific Partnership](#) between the U.S., Australia, and countries in eastern Asia and South America.

In addition to international trade agreements, an efficient transportation system is critical to global logistics, Mr. McArdle said. Transportation network efficiency has improved significantly because today more than half of the world's population lives in urban areas and megaregions, making trade and logistics operations move more smoothly. However, regardless of the geographic size of a region, trade stalls when transportation and logistics systems are inefficient.

Access to electronic information and communications systems for processes such as advanced shipping notices is a key factor in streamlining cross-border shipments, Mr. McArdle said. He pointed out that many countries still don't take advantage of electronic information to obtain or transmit pre-arrival shipments data. While pre-clearance and automated screening is available almost universally, some countries still wait until goods arrive to conduct manual shipment processing, a practice that increases time, costs, and delays.

Mr. McArdle reiterated the need for adequate infrastructure upkeep, noting the operational costs due to inadequate network capacity. Traffic delays alone cost UPS \$105 million every year, he said. Nationwide, the economy could lose up to \$3 trillion from problems with infrastructure capacity. He noted that UPS uses advanced technology to reduce environmental damage to the logistics network. With proprietary Global Positioning System (GPS)-based technology—called ORION—UPS has reduced CO<sub>2</sub> emissions and saves time as drivers find shorter and better routes to deliver their shipments, Mr. McArdle said. However, he stressed that without infrastructure upkeep, there is a limit to how much technology can improve logistics and limit environmental impacts.



**Figure 7. Rich McArdle**  
Mr. McArdle discussed how trade policy can improve America's standing in global trade and transportation.

# Technology Innovation

## *Enabling Transportation and Navigation Safety, Congestion Mitigation, and Ecosystem Sustainability*

Three prominent speakers—FAA’s Michael Whitaker, WEF’s John Moavenzadeh, and Harvard’s Rosabeth Moss Kanter—described how advanced technologies are enabling a safer and more efficient transportation system while reducing adverse impacts of urban congestion and energy consumption.

### **Delivering Efficiency with NextGen**

[Michael Whitaker](#)

**Deputy Administrator**

**Federal Aviation Administration**

*November 18, 2014*

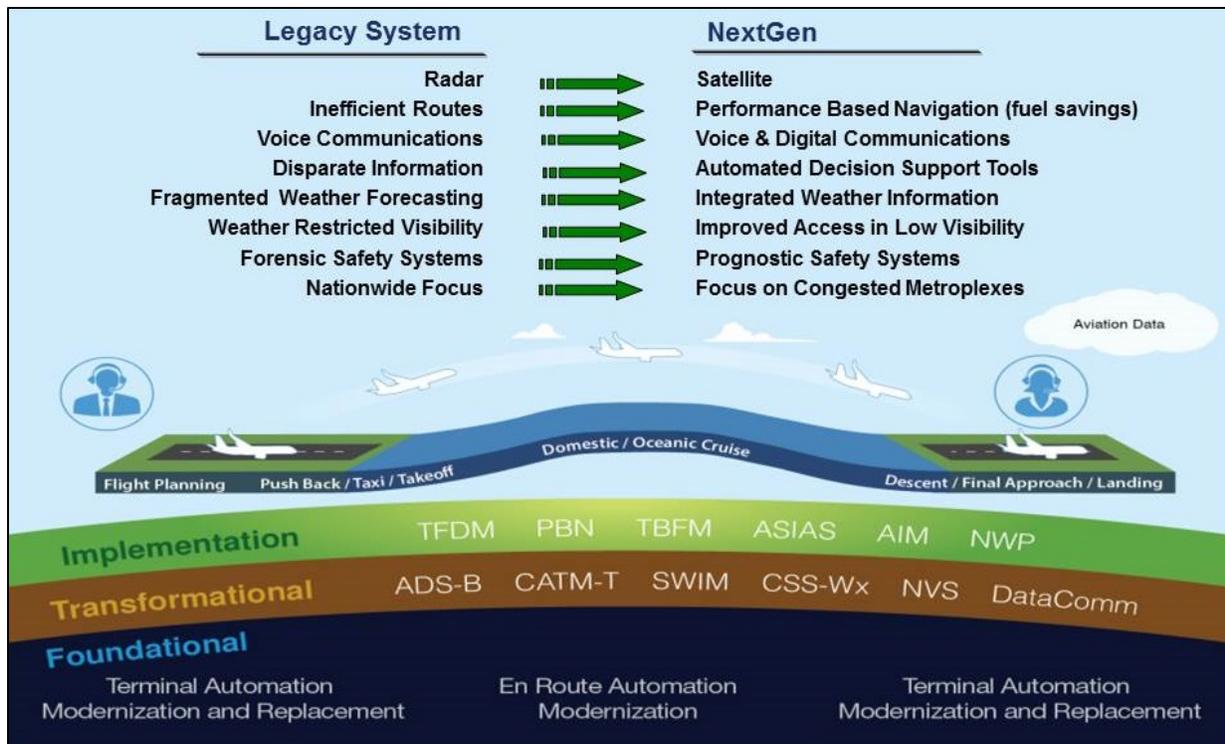
**With new non-state entrants in the air transportation market, new flight patterns, and novel modes such as UAVs, the primacy of safety has become increasingly paramount.**

**-Michael Whitaker**

Mr. Whitaker discussed the implementation process and technology components of the FAA Next Generation Air Transportation System (NextGen), adding that the U.S. has an extremely safe air transportation system that is the envy of the world. With NextGen efforts to modernize aviation, the emphasis on system safety will continue. Mr. Whitaker noted the primacy of safety has become even more

critical, particularly with new players—such as smaller global airlines or non-state aviation firms—in the air transportation market, coupled with new vertical and horizontal flight patterns and novel aircraft modes such as Unmanned Aerial Vehicles (UAVs) and Unmanned Aerial Systems (UASs).

Mr. Whitaker pointed out that NextGen technologies are making aviation safer across the world, adding that the perception that the program is 10 years behind schedule is not accurate. NextGen implementation did not begin in earnest until 2009—when dedicated funding became available—although NextGen was introduced in early 2000 as a 20-year, \$20 billion program. Mr. Whitaker detailed flight automation, navigation, and communications as the three aviation technologies FAA has implemented since 2009 that form the structure of NextGen:



**Figure 8. Modernizing Flight**

FAA’s NextGen system modernizes many elements of a typical commercial flight, including navigation, routing, and weather forecasting.

*Image source: Federal Aviation Administration.*

- Satellite-based flight automation.**

GPS navigation in air traffic control towers and the cockpit is a major technology development that has greatly contributed to global aviation safety. Small and large airlines throughout the world can now access precise GPS navigation information in the cockpit.
- Full upgrade of navigation and surveillance.**

Automatic Dependent Surveillance-Broadcast (ADS-B) has improved the navigation and surveillance components of flying. The upgrade from a land-based radar network to ADS-B has changed aviation navigation from relying on very high frequency (VHF) omnidirectional range beacons to a state-of-the-art satellite-based system. GPS-based navigation works by building navigation routes between city pairs through a performance-based navigation process. The modernization process has involved pulling out old equipment and installing new equipment while the systems remain operational.
- Digital communications.**

NextGen has modernized the communications component of aviation by complementing voice-based radio communications—which used to be the sole means of relaying information related to navigation and surveillance—with digital communications capabilities. Before this

modernization, air traffic controllers were the key actors in ensuring aircraft separation, carrying the full burden of responsibility for air domain surveillance. NextGen has changed the nature of communication between the control tower and the aircraft's own communication tools by moving from radio and voice communication to digital data communication, replacing inefficient landlines with digital networks. One key benefit of NextGen's move to digital communications is that it enables data sharing. By making a huge volume of data available to all players in aviation operations, FAA's System Wide Information Management system has shown significant improvements in data-sharing for both surface-operations and tools and flight management data. As an example of the benefits of data sharing, Mr. Whitaker mentioned the September 2014 sabotage incident that disrupted the Chicago Terminal Radar Approach Control Facilities (TRACON) network, which was resolved by moving control functions to the Minneapolis TRACON.

Mr. Whitaker reiterated that aviation safety is the key benefit of NextGen, which lets air traffic professionals conduct risk management as a proactive strategy rather than a set of post-mortem forensic operations. He pointed out that technology is not a major challenge in achieving many NextGen objectives, and that proactive risk management capability has significantly improved aviation safety.

Widely available digital operational data enables rigorous evaluation of error data, particularly on new aircraft. NextGen is no longer next: ADS-B has been tested for instantaneous location identification, first in Alaska and then for offshore oil platforms in the Gulf of Mexico. Those tests showed positive impacts in reducing incidents. In the Houston airspace, ADS-B operations are running smoothly. The Houston deployment consisted of 61 new procedures implemented through a seamless redesign and transition.<sup>2</sup>

Nevertheless, Mr. Whitaker acknowledged the need to address critical aviation risks and vulnerabilities, concluding that in addressing the risks of aviation disruption, FAA has ensured abundant redundancy, with backup radars and redundant surveillance devices. However, some hurdles remain regarding communicating the complexity of aviation challenges to the general public and Congress.

- **Cyber security.**

With the growth of digital navigation and communications, the national airspace (NAS) is becoming increasingly vulnerable to cyber security threats. Continual monitoring of all data



**Figure 9. Michael Whitaker**  
Mr. Whitaker detailed major upgrades in the nation's airspace happening through FAA's NextGen program.

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<sup>2</sup> The new surveillance system divides the country into 20 air traffic control centers for enroute flight management. A tech refresh has been done for every operational step. Each step in flight management works seamlessly with new platforms and apps.

flows is needed.

- **Unmanned aerial vehicles.**

UAVs pose another challenge for the NAS and aviation industry. There are two categories of UAVs, each with different aviation challenges. Small UAVs that use line-of-sight control are increasingly used to inspect pipeline assets, for search-and-rescue operations, and in the motion picture industry. A notice of proposed rulemaking is underway to guide the deployment of small devices in the NAS. Larger UAVs would require the more traditional type of regulatory control.

- **Airport congestion and capacity.**

Mr. Whitaker recognized the difficulty of dealing with congestion and capacity constraints at the nation's major airports. He noted that congestion and capacity issues are not network-wide and there is no macro-data available on congestion. The European Union, he pointed out, has used slot allocation to deal with airport-specific congestion. As a matter of policy principle, FAA has chosen not to go with the slot rule control option.

- **Funding.**

The biggest challenge for FAA remains unpredictable funding for the envisioned 20-year NextGen improvement program. The system-of-systems complexity of aviation operations and technologies makes it harder to communicate the importance of continuing NextGen to the general public and lawmakers. While it has been difficult to convince lawmakers that NextGen is a critical component of a safe aviation system, Mr. Whitaker noted the old land-based radar infrastructure was no longer viable as a long-term aviation surveillance system, and replacing it was not a choice.

## Navigating the Mobility Transformation

[John Moavenzadeh](#)

Head of Mobility Industries

World Economic Forum USA

February 26, 2015

Mr. Moavenzadeh discussed the “automotive mobility transformation” happening in global transportation. He described the mobility transformation as a “fundamental change that is unlocking new sources of value via new technology, new business models, and new and changing customers.”

Changes transforming the automotive, aviation, and logistics industries are driven by broad demographic and economic shifts, including *urbanization*, an *aging urban population*, and *structural changes in the global economy*, Mr. Moavenzadeh said. Those drivers shaping a new mobility system and changing the service it delivers are in turn shaped by the spread of information technologies, overall shifting demographics, and shifting customer needs and preferences:

**We’re living on the cusp of a profound and exciting transformation of many global industries that enable mobility: the automotive, airline, and logistics industries. These industries are going to change more in the next 10 years than they have in the previous 100 years.**

**-John Moavenzadeh**

- **Urbanization.**

Over the next 15 years, roughly one billion people around the world will migrate to urban centers, on top of additional populations being born into them. When combined with rising income, urbanization will strain the capacity of the world’s cities to handle more cars. Traffic congestion is getting worse in almost every world city, but the problem is particularly pronounced in rapidly developing economies.

## Global Gridlock and Cities

In just the next 15 years, urban populations will grow by 1 billion, putting more strain on already-stressed transportation systems.

2015



In Cairo, gridlock costs

**\$8 billion**

each year—that's 4% of Egypt's entire GDP.

2050



By 2050, **two-thirds** of the world population will live in cities, up from **one-half** today.

(Volpe Center image)

Figure 10. Global Gridlock and Cities

References: World Health Organization; U.S. Bureau of the Census; World Bank; United Nations World Urbanization Prospects.

- **Aging urban population.**

Rising traffic congestion stifles urban vitality, as cities are the economic lifeblood of nations, Mr. Moavenzadeh said. When cities are congested, available labor talent—including highly skilled and mature workers—available for any given job decreases. When labor pools are smaller, a city has reduced economic competitiveness, making it a less attractive place to live. Urban congestion also leads to the flight of skilled labor and loss of economic vitality for urban centers. Older customers are also likely to be less interested in vehicle performance and more interested in convenience and access.

- **Increasing wealth.**

Rising incomes in mature economies do not correspond to greater demand for auto ownership. People in developed markets are driving less and are less likely to own a vehicle. As such, the different mobility demands of mature developed economies are driving another facet of the current transformation in mobility industries. These changes in the mobility industry are

demonstrated in three global transportation market trends: the rise of car sharing, an ecosystem view of mobility, and an approach to managing transportation demand that draws on cross-industry data and goals.

- **The steep rise in car sharing.** Many European cities in particular are experiencing a boom in car-sharing services, with multiple providers competing for an increasing customer base.<sup>3</sup> The city of the past—where the rich drove cars and the poor took public transportation—is no longer the model for the mobility needs of people in urbanized areas, Mr. Moavenzadeh said. The city of the future is one where consumers choose from an array of different options to meet their mobility needs of the moment. Urban planners from London to Johannesburg are focused on offering more mobility modes to their citizens and better integrating those modal options, he said.
- **From automotive industry to automotive ecosystem.** Mr. Moavenzadeh observed, in the old automotive model, clear boundaries were drawn around internal industry players—suppliers, vehicle manufacturers, dealers, users—and players outside the system—energy companies, infrastructure providers, and governments at all levels. Today, with shifting mobility demands, this boundary is becoming increasingly blurred and we’re likely to see increasing partnerships within the industry and with non-automotive companies. So it’s no coincidence, he added, that non-automotive companies such as Qualcomm, Panasonic, and IBM are increasingly interested in the automotive sector and investing and building automotive business units designed to sell solutions, not parts.



**Figure 11. John Moavenzadeh**  
Mr. Moavenzadeh detailed fundamental changes happening in the global mobility sphere.

Transforming the automotive industry to an automotive ecosystem requires bringing together the service requirements that meet our mobility needs as well as goals for reducing CO<sub>2</sub> and energy consumption. Such an ecosystem view of mobility is envisioned in an urban transportation system that would integrate with a personal phone or web-capable device to provide real-time information about air travel, taxis, ride sharing, and public transportation, along with corresponding information on fares, costs, and CO<sub>2</sub> emissions. Such transparency of information would pave the way to a

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<sup>3</sup>As an indication of this trend, Mr. Moavenzadeh commented on the recent stock market gains by Uber, and its ranking as one of the most valuable startup companies in the world.

mobility system that is economically and ecologically efficient.

- **Integrating the car of the future with the energy and telecommunications sectors.**  
Weaving together automotive design with other elements of the mobility industry introduces many design flexibilities. For instance, batteries in electric vehicles could be used to power homes during peak electricity demand, thereby smoothing peaks on the grid. In the telecommunications sector, such integration would enable automobiles to operate within an urban center as nodes in a wireless mobile mesh, networked to deliver Wi-Fi to smartphones and freeing up spectrum for other applications.

The challenges in bringing together the complex web of manufacturers, service providers, and public and private stakeholders are daunting, Mr. Moavenzadeh said. He concluded his presentation by noting two key barriers:

- **Lack of an eco-friendly power structure.**  
This barrier is demonstrated by the speed with which auto manufacturers have been able to ramp up production and reduce our reliance on the gasoline-diesel infrastructure and reduce CO<sub>2</sub> emissions. However, whether the electricity grid can provide adequate capacity is an open question. If five Teslas were to plug in at the same time in a typical midsized European city, they would quite likely bring down the grid, Mr. Moavenzadeh speculated. This is a system interface that perhaps requires a bit of foresight, requiring that we not only build new eco-friendly energy infrastructure, but also maintain and expand existing energy infrastructure.
- **Gaps between automotive technology and transportation infrastructure capacity.**  
Vehicles are getting smarter by the month, but our roads remain simple. Bridging the gap in investment and implementation of innovative network information would require policy incentives and bold implementation steps. The gap identified by Mr. Moavenzadeh highlights the urgency of implementing the U.S. DOT vision of an intelligent transportation system that integrates vehicles and infrastructure through vehicle-to-vehicle and vehicle-to-infrastructure technologies.

## MOVE: Putting America's Infrastructure Back in the Lead

[Dr. Rosabeth Moss Kanter](#)

Chair and Director of the Harvard University Advanced Leadership Initiative

Professor at Harvard Business School

June 9, 2015

**It doesn't take a village. It takes a multijurisdictional stakeholder coalition.**

**-Dr. Rosabeth Moss Kanter**

Dr. Kanter discussed challenges related to crumbling infrastructure, delayed maintenance, and recurring road network congestion. She suggested several solutions that technology and regional collaboration can offer.

For nearly six decades, America has neglected or underinvested in some critical sectors of transportation infrastructure and has fallen behind in international comparisons, Dr. Kanter said. But the answer is not simply a revamped maintenance program.

The nation's defense-motivated infrastructure vision of the past 150 years—driven by the country's need to facilitate troop movement and evacuate citizens—has spurred major transportation infrastructure projects, such as the transcontinental railroad in the 19<sup>th</sup> century and the National Highway System, started in the 1950s. But the defense rationale is no longer an infrastructure vision applicable to today's challenges. Maintenance is not a vision; neither is the fear of a catastrophic bridge collapse, nor the promise of massive job creation, Dr. Kanter said. We need a new vision for 21<sup>st</sup> century transportation infrastructure, a new narrative to motivate action.

The rationale for an effective national strategy has to be future economic success, growth, and personal mobility, she said. The strategy should let us maintain the mobility of our people and goods with minimal environmental impacts. This vision must be regional in scope, collaborative among public and private sectors, and be technology-driven, Dr. Kanter said.

- **A Vision to Address Infrastructure Challenges.**

While a national framework is essential, the vision need not be a singular strategy or a centrally administered plan, Dr. Kanter said. Within this national strategic framework, implementation should be led by regional or metropolitan players with the flexibility to direct funding.

Infrastructure projects in the U.S. can be so complex and come with so many contracts and regulations they can seem more like a means to provide jobs for lawyers rather than to improve transportation, Dr. Kanter said. Multiple layers of regulatory hurdles, environmental permitting, and high levels of political uncertainty can have the effect of driving away investors. Addressing the challenge at the regional level can be a step toward overcoming some of the obstacles to major investments projects. An incremental approach here works best—we don't need to work on everything at once, Dr. Kanter said.

Thinking locally, she said, does not mean retreating into isolated territories. When the local or regional leadership drives the strategic energy, regional plans should encourage corridor-level strategies that define intercity and cross-regional pathways that are essential for the flow of people and trade. Because regions are fluid and cross the boundaries of political jurisdictions, investment plans need to have a different kind of leadership and governance. One successful investment example that Dr. Kanter mentioned was Oregon’s experiment to fund road projects with a VMT-based fee—instead of a gas tax—initially implemented with volunteers in a pilot test. The experiment was effective in pushing the national agenda for fee-based highway use.

- **Collaborative Public and Private Efforts.**

The public sector cannot solely address the complex challenges of planning and investing in infrastructure systems. These challenges need to be addressed with a robust public-private partnership (PPP) structure. The debate about the poor record of public investment programs, and the superior private performance in managing infrastructure systems is not a valid starting point, Dr. Kanter said. The U.S. rail system, she said, is one of the world’s most efficient freight rail systems; yet it is a privately owned enterprise that has worked closely with public sector oversight agencies to move goods at low cost with minimal environmental damage. *The Economist* has hailed the “quiet success” of U.S. rail companies due to its unparalleled cost-effectiveness, Dr. Kanter said.

For more than 150 years, the federal government has been closely involved in railroad operations and has stepped in numerous times to stimulate funding or reorganize the failing rail industry. Dr. Kanter noted that in 1970, President Richard Nixon created Amtrak as the main national passenger rail service after the bankruptcy of the Penn Central railroad. Shifting more freight and passenger traffic to private rail operations could offer an effective solution that might amount to “reinventing transportation,” Dr. Kanter said. That shift could not only make the system safer and lower rail congestion, but also reduce environmental damage and carbon emissions. Another successful PPP example Dr. Kanter mentioned is the Port of Miami tunnel project, financed by the port for \$1 billion and built in partnership with a French firm using a German drill manufacturing company.

- **Technology Needs Central to the Nation’s Mobility Vision.**

We should rethink the question of whether technology will address all of our transportation problems, Dr. Kanter said. Instead, we need to figure out how to implement solutions we already have. “Technological innovation is an American strength in international comparisons, but the U.S. scores are far lower in technology deployment,” Dr. Kanter said. “We’re still not using enough of what we invent.”

Zero emission electric cars, DOT-connected vehicles and vehicle-to-vehicle programs, smart car technologies, car-sharing initiatives, and smart parking technology deployment efforts are among the technology solutions that have proven effective in many deployment efforts. Dr. Kanter emphasized that information technology is an essential component of a mobility

strategy. “Moving people and goods won’t happen without moving information,” she said. Yet, we see companies in highly interdependent businesses that rarely communicate. “America needs a cross-sector, cross-industry discussion involving entrepreneurs, large manufacturers, and visionary public leaders to identify priorities,” Dr. Kanter said.

Although technology deployment has lagged behind our innovation, perhaps technology that “excites the public imagination” can also be an effective strategy to “arouse the political will” and stimulate constructive steps towards solving infrastructure challenges, Dr. Kanter said.



**Figure 12. Rosabeth Moss Kanter**

Dr. Kanter advocated for a new overarching vision to guide public-private infrastructure investment.

# For More Information

For more information on Volpe's thought leadership programs, please contact:

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For feature stories, video highlights, speaker bios, and additional information from the *Transportation and the Economy* speaker series, please visit: [www.volpe.dot.gov/events/transportation-and-economy](http://www.volpe.dot.gov/events/transportation-and-economy).

# Appendix: Stakeholder Engagement

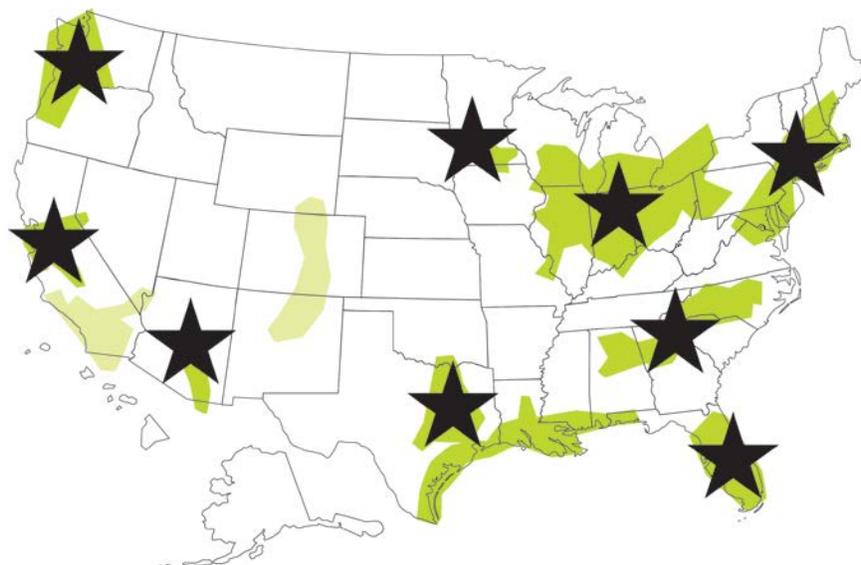
The *Transportation and the Economy* speaker series had wide-ranging appeal among key transportation stakeholders in government, industry, academia, and nonprofit organizations. The extensive reach of the series reflects Volpe’s impact on how the transportation enterprise thinks about, invests in, and plans for the global transportation system of the future.

As previously mentioned, online event registration continues to be a huge draw for lecture series participants. There were more than **2,000** online registrations over the course of the series. An average of **60** people attended each lecture in person, while **480** people attended in total.

## State, Regional, and Local Agencies

More than **700** professionals from state, regional, and local transit agencies and MPOs attended in person or by webinar, including:

- State government officials representing 34 state departments of transportation.
- City officials from Bisbee, Arizona; Durham, North Carolina; Lubbock, Texas; Newport, Rhode Island; Ocala, Florida; Phoenix, Arizona; Seattle, Washington; Cobb City, Georgia; New York City; and many others.
- Representatives from 55 MPOs and commissions registered for the web series, representing more than 130,000 square miles of urbanized area with a total population of 95,600,000.



**Figure 13. Megaregion Representation**  
In-person and web attendees came from 9 out of 11 megaregions.

## Academia

More than **140** representatives from nearly **50** U.S. and international colleges and universities participated in the series, including professors, researchers, and doctoral candidates. Academic participation was **double** that of the 2013–2014 series on climate change.

## Federal Agencies

More than **440** registrations were received from staff in federal agencies. In addition to U.S. DOT and Volpe, connections by other federal agencies **doubled** from the previous year's events.

Participants included decisionmakers, economists, engineers, planners, analysts, attorneys, statisticians, policymakers, investigators, highway safety specialists, and scientists who joined to learn more about transportation system innovations that are crucial to economic vitality.

The following U.S. DOT organizations participated in the series:

- Federal Aviation Administration
- Federal Highway Administration
- Federal Motor Carrier Safety Administration
- Federal Railroad Administration
- Federal Transit Administration
- Maritime Administration
- Office of Inspector General
- Office of the Secretary
- Pipeline and Hazardous Materials Safety Administration

Other federal agencies and entities beyond U.S. DOT that participated in the series included:

- Amtrak
- U.S. Department of Agriculture
- U.S. Department of the Army
- U.S. Department of Energy – Idaho National Laboratory
- U.S. Department of Homeland Security
- U.S. Department of the Interior (National Park Service)
- U.S. Environmental Protection Agency
- U.S. Government Accounting Office
- National Transportation Safety Board
- NASA
- U.S. Coast Guard Marine Safety Center

## Private Sector

There was a sharp spike in private sector involvement compared to previous series. More than **400** companies participated in the economy lectures—many of them via webinar—representing a **150-percent jump** in private sector attendance from Volpe’s preceding series.

Private sector registrants, representing a wide range of expertise, came from large and small companies (organized by industry):

### Large firms

- Aerospace
- Aviation
- Energy
- Environmental engineering
- Financial
- Information technology
- Infrastructure engineering
- Law
- Logistics
- Manufacturing
- Medical
- Oil and gas
- Rail
- Software development
- Wastewater treatment

### Smaller firms

- Architecture
- Business management
- Construction and operations
- Education
- Emergency management
- Transportation services
- Management consulting
- Media and public relations
- Product development
- Security technology
- Urban planning

## Online Registration

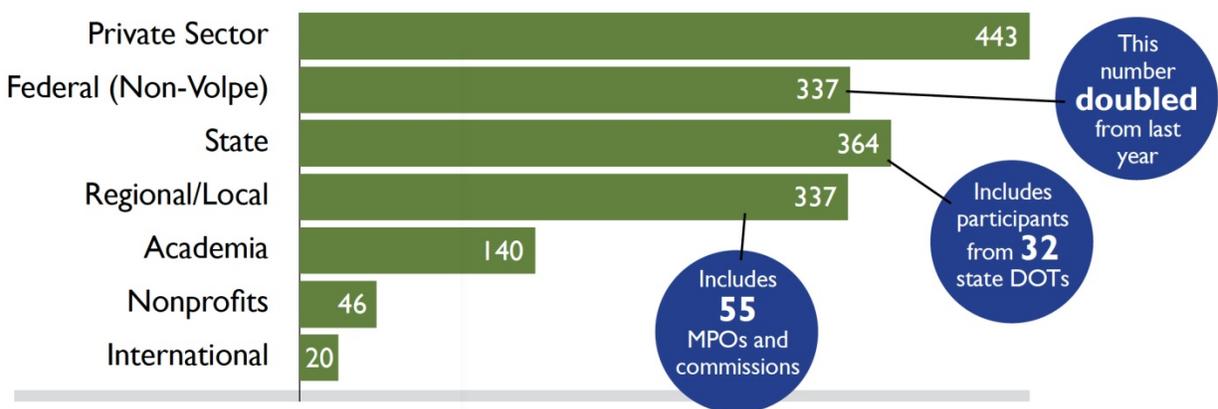


Figure 14. Online Registration Statistics

Online registration continues to be a huge draw for Volpe’s thought leadership speaker program.

## **Associations and Nonprofits**

A range of nonprofit organizations participated in this series, including a number of key U.S. DOT partner organizations:

- American Association of State Highway and Transportation Officials
- Battelle Memorial Institute
- Brookings Institution
- Eno Center for Transportation
- Intelligent Transportation Society of America
- Global Automakers
- National Academy of Sciences
- National Association of Regional Councils

In all, more than 25 representatives from nonprofits took part in the series.

## **International**

The webinar component made it possible for international transportation professionals to participate from Belgium, Canada, China, Colombia, India, Malaysia, Mexico, the United Arab Emirates, and the United Kingdom.

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