



Editor's Note: *This article is adapted from a speech Mr. Palmisano delivered to the annual meeting of ITS America on May 5, 2010 in Houston, Texas.*

A SMART TRANSPORTATION SYSTEM:

Improving Mobility for the 21st Century

We meet at an interesting and consequential moment. I think it's fair to say that the first decade of the 21st century has been remarkably eventful — indeed, disruptive. And I would suggest to you that there has been a pattern to that disruption.

- In the last few years, our eyes have been opened to global climate change, the risk of pandemic, and the environmental and geopolitical issues surrounding energy.
- We entered the new century with a shock to our sense of security on 9/11.
- We have become aware of the vulnerabilities of global supply chains for food and medicine.
- And today, of course, we are working our way out of a global financial crisis.

It's interesting how many of those crises are linked to transportation. Indeed, more recently, transportation had its own major crisis — the disruption of global air traffic caused by the volcanic eruption in Iceland.

What links this decade-long series of crises?

It is this: These are manifestations and consequences of being globally integrated. These are all wake-up calls reminding us that we are all now connected — economically, technically and socially. But, we see now that being connected is not enough.

Have you noticed how often in the past decade we have used or read the term “systemic breakdown?”

Yes, connecting economies, business flows, supply chains — and transportation networks — is important and has yielded tremendous benefits. But connectivity by itself does not make for reliable, resilient, well-functioning systems.

Fortunately, something else is happening at the same time. In a word, our planet is becoming smarter. This isn't just a metaphor.

Intelligence is being infused into the way the world literally works — the systems and processes that enable services to be delivered; physical goods to be developed, manufactured and sold; everything from people and freight to oil, water and electrons to move and billions of people to work and live.

First, our world is becoming instrumented. Today, there are nearly a billion transistors per human, each one costing one ten-millionth of a cent. There are 4 billion mobile phone subscribers, and 30 billion radio frequency identification (RFID) tags produced globally.

Because of their increasing sophistication and low cost, these sensors and devices give us, for the first time ever, real-time instrumentation of a wide range of the world's systems — natural and man-made.

Second, our world is becoming interconnected. Very soon there will be 2 billion people on the Internet. But that's just the beginning. Systems and objects can now “speak” to one another, too. This is what some call the “Internet of Things.”

Think about the prospect of a trillion connected and instrumented objects — cars, cameras, roadways, pipelines, even livestock and pharmaceuticals. And then think about the amount of information produced by the movement and interaction of all those things. It will be unprecedented.

Third, all things are becoming intelligent. Thanks to advanced

ALL THINGS ARE BECOMING INTELLIGENT. AND THAT INTELLIGENCE CAN BE TRANSLATED INTO MAKING OUR SYSTEMS, PROCESSES AND INFRASTRUCTURES MORE EFFICIENT, MORE PRODUCTIVE AND RESPONSIVE.

analytics and ever more powerful supercomputers, we can turn mountains of data into insight. And that intelligence can be translated into making our systems, processes and infrastructures more efficient, more productive and responsive.

From a smart bay in Ireland, to smart power in Malta, to smart telecommunications in India, to smart food tracking in Norway, companies and institutions are applying technology in new ways.

And all around the world, economic stimulus is being injected by governments, much of it aimed at smart grids, healthcare data integration — and crucially, smart transportation — to improve the systems that make our world work.

Now, there's no need for me to tell you about smarter transportation. You have witnessed many of these shifts first-hand. Your mission is to inject smarter technologies into our transportation

system—and it has yielded many successes in recent years.

But as we look ahead to the needs and challenges of the 21st century, I think it is clear that we must do more.

Here's what we know.

We know what any transportation system is, on the most basic level. From ancient times to the present, any such system has been made up of three elements:

- Vehicles: cars, ships and planes, which move goods from one place to another;
- Pathways: roads, rail lines, shipping lanes: The infrastructure that allows movement to take place; and
- Terminals: stations, car parks, airports, seaports: These are the endpoints where journeys begin and end, where passengers transfer from one mode of transportation

to another, and where goods are tracked, organized and assembled.

That's the system.

We also know that population growth, unprecedented urbanization and continued globalization are placing great strains on all elements of that system, pushing them beyond the capacity of their serviceable life.

And we know that the United States is not investing in its infrastructure at the same levels as other countries.

The U.S. spends at most 2.6 percent of gross domestic product (GDP) on infrastructure — 27th among 36 Organization for Economic Cooperation and Development (OECD) nations.

Compare that to China, which invests at a rate of 9 percent to 12 percent of its GDP.

This underinvestment creates strains on our transportation system that put our citizens and businesses at risk of deteriorating safety conditions, competitiveness and quality of life, not to mention the waste of precious resources and productivity.

It does not have to be this way.

Over the past two centuries, advances in transportation — from canals, to rail, to automobiles, to aircraft — created the modern world, determining which cities would thrive, and ushering in a new age for business, for society and for how we lead our lives.

Now the time has come to return to transportation what it has given us: new opportunity. We must reinvent transportation to meet the needs of the 21st century.

We have the tools and know-how to address the challenges.

Intelligent technologies are emerging to enable transportation networks and users to communicate with each other, improving system performance, safety and convenience — making IT just as important to 21st century transportation as airplanes, asphalt and petroleum were in the last century.

Over the past year and a half, IBM has been working with cities and nations around the world to improve many kinds of systems and make them smarter — with particular success in transportation.



In doing so, we have learned that our transportation system isn't, in fact, a system. It's a collection of related industries, operating in close proximity to one another.

In doing so, we have learned what is required for a system to be well-functioning, reliable and resilient.

- First, there must be clarity on the system's purpose or goal — a vision of its end-state.
- Second, its elements must actually be connected — which is another way of saying, interfaces matter.
- Third, we must be able to know, continually and with confidence, the status of the system and its critical components.

- Finally, the system must be able to adapt as conditions change, often in real time.

Viewed against these four characteristics, every well-functioning system looks strikingly similar. Now let's look at American transportation today.

In theory, everyone agrees on the system's purpose. There is a broad consensus that American transportation must become traveler-centric — whether that "traveler" is a person or a package.

That's what both passengers and shippers want today — the ability to control their own journeys, across multiple modes of transportation, in real time.

THE PROBLEM IS: THE SYSTEM HAS TO BE ACTUALLY CONNECTED TO TRULY DELIVER ON ITS GOAL.

You don't have to look far for examples of traveler-focused initiatives. U.S. Transportation Secretary Ray LaHood's distracted driving campaign, airline passenger rights, and the livable communities initiative are doing just that.

The idea is simple: The traveler's time, safety and experience should be the initial design point. And a system's design point matters. What you optimize it for — the way you envision its end state — will determine the value it ultimately delivers.

The problem is: The system has to be actually connected to truly deliver on its goal.

In many areas of life, this kind of connectivity is so basic that we simply take it for granted. Consider banking: We take it for granted that we can transfer funds and make payments among institutions. Consider retail: We take it for granted that we can use the same payment and billing systems, regardless

of store, Web site or industry. All these systems have standards and interfaces that permit information to flow.

So, a true transportation system would need to connect the vehicles, pathways and terminals I mentioned before — and the government agencies and regulators, and the freight and logistics carriers, and the vehicle and infrastructure manufacturers, and the travel-service providers.

It would also need to connect the travelers themselves: people, packages and containers that are providing a steady stream of data on their journeys, condition and location. And it would do so across all modes of transportation. Clearly, transportation in America today fails this key test of a well-functioning system.

Third, many of the components and subsystems of transportation are not instrumented — or are differently instrumented from state to state — so that it is impossible to know with confidence what their current status is.

This isn't just a colossal waste of time and money. It also introduces inconsistencies in quality and multiple opportunities for error.

Consider, for example, the potential impact of an emergency like the Iceland volcano. What if that happened here? What if, say, Mt. St. Helens erupted again? Or what if there were another 9/11? What would the economic, societal and innovation impact be of this lack of system knowingness?

And when it comes to the fourth characteristic of a well-functioning system — adaptability — ask yourself: Is our transportation system in America today — spanning roads, parking, railroads, airports, seaports, bridges, tunnels and communications — is that ecosystem ready for what's coming?

Because demand is only going to grow. Especially as population growth and urbanization continue to expand. The instrumentation of things and cities — and the empowerment of individuals with mobile devices — will continue to increase exponentially. We will need far more physical and digital capacity from our transportation networks.

So, if we agree on the need for, and lack of, a true smarter transportation system, how do we get there?

As we have worked with clients over the past 18 months, we have validated that the key to smarter systems lies not in the chip, or the sensor, or the mobile device. It's not the smart meter, or the smart power line. It's not even the software, per se.

It's the data.

Thanks to an instrumented and interconnected planet, we're capturing data in unprecedented volumes. In just three years, IP traffic is expected to total more than half a zettabyte. (That's a 1 followed by 21 zeroes.)

We're receiving these enormous streams in real time, and they are coming in multiple forms: from text to rich media, sensors to cell-phone cameras. And we're capturing it from just about every kind of system or event imaginable: supply chains, rail vibration, weather patterns and billions of individuals using social media.

But the most important point about this is not how much data there is. The important point is what it could tell us. To capture that, you need to dive deeper — to move from "big data" to smarter data.

That's why analytics are key — the sophisticated mathematical algorithms that can detect the patterns, spot the correlations and see the context of the data — because a data point by itself is just about useless.

Where once we inferred, now we can know. Where once we interpolated and extrapolated, now we can determine. That's the promise of a smarter planet.

And it's coming to life in smarter transportation all over the world:

- **Smarter transportation is helping to predict demand and optimize available capacity:** A smart card system has enabled Singapore Land Transport Authority to develop optimal routes and schedules, reducing congestion, increasing the appeal of public transit, and cutting fare leakage by 80 percent and the cost of fare processing by 2 percent.
- **Smarter transportation is dramatically enhancing the end-to-end traveler experience:** Air Canada developed applications for smart phones that allow travelers to download electronic boarding passes, check in, get flight status and book rental cars. There was

a 60 percent increase in mobile check-ins, and 93 percent of Air Canada passengers say self-service improves their travel experience. By the way, the app also saves 80 percent of the check-in cost.

- **Smarter transportation is also improving operational efficiency while reducing environmental impact:** For instance, France's SNCF manages passenger and freight railways, as well as city buses and trams. They operate 14,000 trains per day, including the high-speed TGV and segments of the Paris and regional transit systems. A predictive maintenance system using intelligent sensors is helping SNCF prevent accidents, reduce delays, and cut maintenance costs by an estimated 30 percent.
- **Last, smarter transportation is ensuring safety and security:** DHL's RFID-based system monitors the temperature of pharmaceutical shipments at various points from departure to arrival — helping its customers keep products fresh and generating a new source of revenue growth.

Smarter transportation can also help with our nation's economic recovery.

A recent study from the Information Technology & Innovation Foundation found that for every \$1.25 billion invested in transportation infrastructure in the United States, 35,000 jobs are created and supported.

All in all, smarter transportation means advanced traffic management for air, land and sea. It is optimized around the traveler, is connected across all elements of the system, and communicates its status in real time.

Finally, it fluidly interacts with the other systems of our planet — from healthcare, to public safety, to commerce and more. Because we are increasingly coming to understand that our communities, cities and our entire nation are systems. Complex systems. In fact, systems of systems that span both nature and human society.

In the future, smarter transportation will even apply advanced modeling to something as previously unpredictable as, say, the flow of volcanic ash across the Atlantic Ocean.

All of this and more is possible today, or soon will be. The progress of technology is only accelerating.



To get there, I believe those of us in this room, and our peers across the transportation ecosystem, must take a leadership role. The initiatives undertaken by Secretary LaHood and his colleagues at DOT are promising, but the truth is that the rest of us do not have to wait for the government — or anyone else. Indeed, we must not.

Let me close by asking for your help in four key areas.

First, standards: We must establish agreed-upon data standards for transportation. This is long overdue, but I am hopeful that it will soon be accomplished. As we do, however, it is essential that those standards be open. That's the only way to interconnect processes and data sets across

the whole system. On this, you need to be an active voice.

Second, smart systems by design: In anything as complex, interdependent and fluid as the transportation ecosystem, the qualities we seek cannot be “bolted on” after the fact. We need to build in the key criteria of interconnectivity, system knowingness, analytics and security from the beginning, by design.

Third, moving to a true transportation system will enable — and require — far more collaboration: I’m not just talking about the familiar idea of “private sector-public sector cooperation.” A diverse, multi-stakeholder world requires all the parties actually working together, shoulder-to-shoulder on a daily basis. Yes, we all have particular responsibilities — to customers, to partners, to regulators, to citizens. But in today’s world, fulfilling those responsibilities requires that we also fulfill our responsibilities to the system as a whole. That will be transformative. But it will also require change.

And by the way, speaking of collaboration: Let’s come together and use the next nine months to educate members

of Congress on incorporating smart technology into the nation’s transportation infrastructure in preparation for passing the full, six-year surface transportation authorization bill.

Finally, policy and ethics: From new models of technology, to the changing form of the corporation, to the changing role of the individual in modern life, to new expectations for sustainable living, we are entering a very different world. We must come together around clear guidelines on how to operate and manage our organizations and industry, from an ethical and societal point of view.

As transportation professionals, you know how exciting it is to embrace technology to improve speed, safety, efficiency and passenger experience. But the idea of pervasive sensors and cameras sharing data with transportation providers and governments: Not everybody is going to be happy about that. If we don’t come together to forge a new policy framework that protects the individual’s privacy, people may say “stop.” And they should.

Let me conclude with a dose of optimism.

Smarter transportation is not some grand, futuristic ideal. For one thing, the examples I've mentioned are real, and more are being deployed right now, around the world.

For another, smarter transportation is practical because it is non-ideological. Yes, debates will continue to rage on many contentious issues that impact transportation — from energy, to security, to climate change, to the economy. But no matter which viewpoints ultimately prevail, the system that results will have to be smarter: more transparent, more efficient, more accessible, more resilient, more innovative.

And that's one final reason for hope. Making transportation smarter is in everyone's interest. For a whole spate of reasons, the boldest action and the most pragmatic action are now one.

We find ourselves today at a unique moment. The key precondition for real

change now exists: People want it. And they are hungry for leadership. Such a moment doesn't come around often, and it will not last forever.

So ask yourself this: In hindsight, when the circumstances that cry out for change are gone, when things have returned to "normal," don't we always wish we had been bolder? More ambitious? Gone faster, gone farther? Did anybody ever wish they had done less?

Despite the litany of challenges we face, I am confident that the U.S. will do what leaders do: lead. I'm convinced we can build a smarter and safer transportation system in America. And I'm convinced that in doing so, we will achieve both societal progress and economic growth for our cities, states and nation.

I hope you share my excitement about the opportunity before us, and that you will join with us in this exciting journey.

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