ITS Affirmative – SS

AT: T-Infrastructure

ITS is transportation infrastructure

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

Intelligent Transportation Systems (ITS), formerly called Intelligent Vehicle-

Highway Systems (IVHS), are “groups of technologies that use sensors, computers, and

related information/communications systems to improve the management and control of

roadways, vehicles, and driving capabilities” (Rothberg, Ducca and Trullinger, 1997: 1).

The concept can be applied to a vast transportation infrastructure of highways, streets,

and bridges, as well as all kinds of vehicles. According to the U.S. Department of

Transportation’s web site, ITS is expected to serve as “the next step in the evolution of

the nation’s entire transportation system” in the United States. All over the world, it has

been increasingly expected to hold the answer to traffic congestion, travel safety,

economic development, and air pollution.

Inherency – ITS Inevitable

#### US transportation investment is inevitable – but none of it is going the ITS Stephen Ezell senior analyst with the information technology and innovation foundation (itif) 10

(Stephen Ezell, senior analyst with the information technology and innovation foundation (itif), Explaining International IT Application Leaderhip:Intelligent Transportation Systems, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf)

Over the next five years, the United States is poised to invest more than $500 billion on the nation’s surface transportation infrastructure. Intelligent transportation systems must be a critical component of these investments in order to maximize the operational performance of the transportation system and attain the significant benefits enumerated in this report. If the United States does not take advantage of the current opportunity to significantly fund ITS as part of the next surface transportation authorization, it risks not only falling further behind world leaders and other developed economies in ITS, but also losing ground to rising countries such as China and India, which are beginning to make substantial investments in ITS development and deployment.Inherency – US Lacks ITS

The US is lagging in ITS development – lack of funding, organization and state based approach

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of transforming transportation systems. While many think improving a country’s transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in using IT. IT enables elements within the transportation system—vehicles, roads, traffic lights, message signs, etc.—to become intelligent by embedding them with microchips and sensors and empowering them to communicate with each other through wireless technologies. In the leading nations in the world, ITS bring significant improvement in transportation system performance, including reduced congestion and increased safety and traveler convenience. Unfortunately, the United States lags the global leaders, particularly Japan, Singapore, and South Korea in ITS deployment. For the most part, this has been the result of two key factors: a continued lack of adequate funding for ITS and the lack of the right organizational system to drive ITS in the United States, particularly the lack of a federally led approach, as opposed to the “every state on its own approach” that has prevailed to date.

Inherency – No ITS Now

No ITS now – lack of awareness and organizational issues

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But whether it’s with regard to ITS systems that face systemic barriers or those that can be deployed locally, many regions, states, and countries underinvest in ITS. This happens, in part, because transportation funding is often allocated without consideration of performance, giving transportation planners little incentive to preference investments that can have a maximum impact on optimizing system performance. Part of the problem is that state and local transportation agencies were created to build and maintain infrastructure, not to manage transportation networks, and thus see themselves as “builders of pieces” and not “managers of a system” and therefore place more emphasis on building new roads than ensuring the system functions optimally. For companies developing new ITS products and services, the effort entails much higher risk than does development of many other products and services, in part because governments are key buyers, and in some countries, such as the United States, they have demonstrated at best mixed signals as reliable purchasers. Apart from being generally underfunded, another challenge for ITS projects is that they often have to compete for funding with conventional transportation projects—fixing potholes, repairing roads, building new ones, etc.—that may be more immediately pressing but don’t deliver as great long-term returns. Finally, ITS face a range of institutional and organizational barriers, including limited understanding of the technology and jurisdictional challenges, such as which level of government—federal, state, county, city, public authority, or interstate compact—has responsibility for or jurisdiction over ITS deployments.

Inherency – ITS SRP Fails

RITS Strategic Research Plan fails – too research oriented

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For the most part, U.S. challenges in ITS have been the result of two key factors: a continued lack of adequate funding for ITS; and the lack of a federally led approach, as opposed to the “every state on its own approach” that has prevailed to date. At the federal level, the U.S. ITS effort focuses on research, is funded at $110 million annually, and operates out of the U.S. Department of Transportation’s Research and Innovative Technology Administration’s (RITA) ITS Joint Program Office (JPO). To reorganize and reanimate the U.S. ITS effort, on January 8, 2010, RITA unveiled a new, five-year “ITS Strategic Research Plan, 2010- 2014.” While the Strategic Plan represents an important step forward, the United States needs to make a fundamental transition from a focus mostly oriented around research to include a much greater focus on deployment and endeavor to accelerate the speed at which ITS technologies reach the traveling public.

Inherency – State ITS Fails

State based ITS fails – coverage gaps and non-real time information

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

In November 2009, the Government Accountability Office, at the request of the House Committee on Transportation and Infrastructure, issued a report, “Efforts to Address Highway Congestion through Real-Time Traffic Information Systems are Expanding but Face Implementation Challenges” which, using 2007 data, found shortcomings in states’ abilities to accrue and provide real-time traffic information to the public. State and local agencies distribute real-time traffic information to the public primarily through the Internet, e-mail, television and radio, dynamic message signs, Highway Advisory Radio, and a 511 Travel Information System. 120 The GAO report found thatwhile coverage provided by these services and technologies is expanding, there are gaps in coverage and variations in aspects of real-time traffic information, such as the quality of the data collected and the extent to which state and local agencies share their data. 121 Regarding the collection of real-time traffic information, the report found that technologies used by state and local agencies to do so covered only 39 percent of the combined freeway miles in 64 metropolitan areas providing information. 122 The GAO noted that, while that percentage was up 6 percent from the 33 percent coverage available in 2004, it remained a significant gap, given that urban freeways account for the majority of the nation’s traffic, congestion, and travel time variability. 123 The picture was not much better with regard to the dissemination of real-time travel information to the public. The GAO report found that, in 2007, the percentage of the (94 data-providing) U.S. metropolitan areas delivering real-time highway travel time and highway travel speed information to the public was, respectively, 36 percent and 32 percent (Table 3). 124 The situation was worse with regard to arterial roadways, for which only 16 percent of the (102 data-providing) U.S. metropolitan areas disseminate real-time travel speed information and only 19 percent distribute travel time data in real-time. The United States does do better with distributing incident information in real-time, with 87 percent of metropolitan areas distributing real-time information about incidents on freeways and 68 percent sharing incident information on arterial roadways. 125

Solvency – Potential Actor

DOT/ ITS JPO has jurisdiction

RITA, Intelligent Transportation Systems, 05-01-02, http://www.its.dot.gov/factsheets/pdf/Benefits\_FactSheet.pdf, “Benefits of Intelligent Transportation Systems (ITS)”; AB

The Intelligent Transportation Systems Joint Program Office (ITS JPO), within the U.S. Department of Transportation’s (U.S. DOT’s) Research and Innovative Technology Administration, is responsible for conducting research on behalf of the U.S. DOT and all major modes to advance transportation safety, mobility, and environmental sustainability through electronic and information technology applications, known as ITS. ITS applications focus on both the infrastructure and vehicle, as well as integrated applications between the two, to enable the creation of an intelligent transportation system. The U.S. DOT’s ITS Program supports the overall advancement of ITS through investments in major research initiatives, exploratory studies, and a deployment support program. Increasingly, Federal investments target opportunities or major initiatives that have the potential for significant payoff in improving safety, mobility, and productivity. Some of the most prominent ITS technologies already deployed across the country include electronic toll collection, ramp meters, red light cameras, traffic signal coordination, transit signal priority, and traveler information systems. Among these technologies, ITS deployment appears to have the most broad-based benefit in the area of improved mobility (i.e., in the form of travel-time reduction), according to the U.S. DOT’s ITS Technology Adoption and Observed Market Trends from ITS Deployment Tracking report. Examples cited in the report include:

Solvency – Federal Government Key

USFG Key - vision, standards, funding and leadership

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This report examines the promise of ITS, identifies the global leaders in ITS and why they are leaders, discusses the reasons for the U.S. failure to lead, and proposes a number of recommendations for how Congress and the Administration can spur robust ITS deployment. If the United States is to achieve even a minimal ITS system, the federal government will need to assume a far greater leadership role in not just ITS R&D, but also ITS deployment. In short, it is time for the U.S. Department of Transportation to view ITS as the 21 st century, digital equivalent of the Interstate highway system, where, like then, the federal government took the lead in setting a vision, developing standards, laying out routes, and funding its construction. Just as building the Interstate Highway System did not mean an abandonment of the role of states, neither does this new role; but just as building the Interstate required strong and sustained federal leadership, so too does transforming our nation’s surface transportation through ITS. Accordingly, this report recommends that in the reauthorization of the surface transportation act, Congress should:  Significantly increase funding for ITS at the federal level, by $2.5 to $3 billion annually, including funding for large-scale demonstration projects, deployment, and the ongoing operations and maintenance of already-deployed ITS. Specifically, the next surface transportation authorization bill should include $1.5 to $2 billion annually in funding for the deployment of largescale ITS demonstration projects and should also provide dedicated, performance-based funding of $1 billion for states to implement existing ITS and to provide for ongoing operations, maintenance, and training for already deployed ITS at the state and regional levels.

US lagging behind in ITS – Federal investment is key

Ezell 10 (Stephen Ezell, senior analyst with the information technology and innovation foundation (itif), Explaining International IT Application Leaderhip:Intelligent Transportation Systems, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf)

Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of transforming transportation systems. While many think improving a country’s transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in using IT. IT enables elements within the transportation system—vehicles, roads, traffic lights, message signs, etc. tobecomeintelligentbyembedding them with microchips and sensors and empowering them to communicatewith each other through wireless technologies. In the leading nations in the world, ITS bring significant improvement in transportation system performance, including reduced congestion and increased safety and traveler convenience. Unfortunately, the United States lags the global leaders, particularly Japan, Singapore, and South Korea in ITS deployment. For the most part, this has been the result of two key factors: a continued lack of adequate funding for ITS and the lack of the right organizational system to drive ITS in the United States, particularly the lack of a federally led approach, as opposed to the “every state on its own approach” that has prevailed to date. This report examines the promise of ITS, identifies the global leaders in ITS and why they are leaders, discusses the reasons for the U.S. failure to lead, and proposes a number of recommendations for how Congress and the Administration can spur robust ITS deployment. If the United States is to achieve even a minimal ITS system, the federal government will need to assume a far greater leadership role in not just ITS R&D, but also ITS deployment. In short, it is time for the U.S. Department of Transportation to view ITS as the 21st century, digital equivalent of the Interstate highway system, where, like then, the federal government took the lead in setting a vision, developing standards, laying outroutes, and funding its construction. Just as building the Interstate Highway System did not mean an abandonment of the role of states, neither does this new role; but just as building the Interstate required strong and sustained federal leadership, so too does transforming our nation’s surface transportation through ITS. Accordingly, this report recommends that in the reauthorization of the surface transportation act, Congress should: Significantly increase funding for ITS at the federal level, by $2.5 to $3 billion annually, including funding for large-scale demonstration projects, deployment, and the ongoing operations and maintenance of already-deployed ITS.Specifically, the next surface transportation authorization bill should include $1.5 to $2 billion annually in funding for the deployment of largescale ITS demonstration projects and should also provide dedicated, performance-based funding of $1 billion for states to implement existing ITS and to provide for ongoing operations, maintenance, and training for already deployed ITS at the state and regional levels.  Expand the remit of the ITS Joint Program Office to move beyond R&D to include deployment. Tie federal surface transportation funding to states’ actual improvements in transportation system performance.  Charge DOT with developing, by 2014, a national real-time traffic information system, particularly in the top 100 metropolitan areas, with this vision including the significant use of probe vehicles. Authorize a comprehensive R&D agenda that includes investments in basic research, technology development, and pilot programs to begin moving to a mileage-based user fee system by

2020.

The USFG is key to effective coordination and implementation among dozens of subgovernments

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

In the U.S., the ITS organizational structure is highly coordinative. In their crossnational comparative study, Shibata and French (1997) conclude that the U.S. organizational structure is stronger for coordination and collaboration than are its counterparts of Japan and Europe. Furthermore, Klein (1996: iii) argues that “despite the decentralized nature of U.S. political institutions, the centralized governance structure of the transport sector allowed the ITS developers in the U.S. to initially design the most centralized system architecture of any program.” Figure IV-6 briefly illustrates U.S. organizational structure for promoting ITS. U.S. DOT receives funds from Congress and then provides funds, training and information to businesses, universities, and state and local governments. In addition to these entities, foreign governments, interest groups, and any others with a stake in ITS can participate in ITS America (Intelligent Transportation Society of America), a Federal Advisory Committee to U.S. DOT. Within U.S. DOT, the ITS Joint Program Office (ITS JPO) takes a leading role in coordination of the national ITS program. It provides strategic leadership for ITS research, development, testing, and deployment, as well as ensuring resource accountability. It receives policy guidance from the ITS Management Council chaired by Deputy Secretary of Transportation and planning guidance from the ITS Strategic Planning Group consisting of Federal Highway Administration, National Highway Traffic Safety Administration, Federal Transit Administration, Federal Railroad Administration, and Maritime Administration.

States ITS is ineffective – compartmentalized European ITS proves

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

The European structure is even more fragmented than is the Japanese one. As shown in Figure IV-8, European countries also have no public agency in charge of a panEuropean ITS architecture and intermodal coordination (Shibata and French, 1997: 162). The European Community includes three R&D-specialized agencies, the Directorate General VII (DGVII), the Directorate General III (DGIII), and the Directorate General (DG), each of which covers different R&D areas and supports various organizations in Europe. The European Road Transport Telematics Implementation Coordination Organization (ERTICO) is the European counterpart of ITS America in the U.S. and VERTIS in Japan, and it is a transnational public/private partnership that develops overall ITS implementation strategies for European countries. Actual implementation is proceeded by actor interaction at national or local levels, but national sovereignty issues still hamper the deployment of widespread interoperable European ITS (Shibata and French, 1997: 96). Each of the most European countries has its own national programs 52 and public/private partnership forum such as ITS Focus of UK, ITS Germany, ITS France, and ITS Netherlands. A cross-national comparison of ITS organizational structures shows that three ITS leaders including the U.S., Japan, and Europe all use public/private collaboration to promote ITS. 17However, **the U.S. system is most helpful for coordination and cooperation because it does not face problems of dispersed authority** as in Japan and separate national sovereignties as in Europe. This organizational strength would seem to be a great advantage for the U.S. ITS community, although I have not actually compared coordination levels across the countries.

Solvency – Capability

US has the capability to develop ITS – minimal barriers

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In summary, the United States has every bit the technological capability that Japan, South Korea, Singapore, and other countries possess in ITS, and actually had an early lead in ITS technology in the 1990s with the advent of global positioning system technology and first-generation telematics systems. (In fact, many ITS technologies have been initially developed in the United States but found much greater adoption and deployment elsewhere.) But institutional, organizational, policy, and political hurdles have allowed other countries to wrest the vanguard of leadership from the United States at making the benefits of intelligent transportation systems a reality for their citizens. This report now turns to examining the factors explaining that dynamic.

Solvency – Advocate

[\*\*Bold could be possible plan text?\*\*]

Increasing federal funding solves – key to demonstration projects

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Solvency – Department of Transportation

DOT has jurisdiction in ITS

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Congress should charge DOT with developing, by 2014, a national real-time traffic (traveler) information system, particularly in the top 100 metropolitan areas, and this vision should include the significant use of probe vehicles. By 2014, the top 100 metropolitan areas should have at least 80 percent of freeway and arterial miles enabled by real-time traffic information systems (including incident notification, travel time, and travel speed data), and that information should be available in an interoperable format so that it can be used on any kind of Web, mobile, or in-vehicle application. States should make real-time traffic information freely available to the general public, akin to how the National Weather Service makes weather data available. In leveraging probe vehicles to collect real-time traffic information, the system should employ government vehicles, taxis, and even private fleets that would want to participate. For example, corporate vehicle fleets include hundreds of thousands of vehicles. If necessary, voluntary vehicles could receive a modest subsidy (such as a slightly reduced vehicle registration fee) for installing the probe device. States with cities in the top 100 metropolitan areas that do not achieve real-time traffic information collection and dissemination on 80 percent of their freeway and arterial roadways by 2014 should be penalized each year with fewer federal transportation dollars.

### Computational Science Advantage

IST key to computational science – R&D needed

Winter et al 10 (Stephan Winter: The University of Melbourne, Australia, Monika Sester: Leibniz University Hannover, Germany, Ouri Wolfson: University of Illinois, Chicago, USA, Glenn Geers: National ICT Australia, Sydney, Australia, ACM SIGMOD Record, Volume 39 Issue 3, September 2010 , Pages 27-32, http://www.cs.uic.edu/~boxu/mp2p/39-135-1-SM.pdf)

In the near future, vehicles, travelers, and the transportation infrastructure will collectively have millions of sensors that can communicate with each other. This environment will enable numerous new applications and dramatic improvements in the performance of existing applications. Due to their distributed and mobile nature, future transportation systems may become the ultimate testbed for a ubiquitous (i.e., embedded, highly-distributed) and sensor-laden computing environment of unprecedented scale. This ﬁeld is currently subsumed by intelligent transportation systems, or ITS. However, the question arises whether behind intelligent transportation systems we also need a science (for a similar discussion see [2]). The paradigm shifts witnessed in technical possibilities— for example, from centralized to distributed or decentralized computing, from carefully managed authoritative data to massive real-time data streams of unknown quality—may require new scientiﬁc foundations. More and more aspects of transportation science require sophisticated computational methods to deal with the complexity of dynamic environments. We argue that a better interface between transportation science and computer and information science is needed. The communication and exchange between these scientiﬁc communities would improve, but there are also shared common themes and long-term research questions. Around these core research themes we deﬁne a new discipline: computational transportation science. Computational transportation science (CTS) concerns the study of transportation systems where people interact with information systems (e.g., interfaces for driver assistance, or integrated transport information); where systems monitor and interpret trafﬁc (e.g., mining for activity patterns, or crowd-sourcing to monitor events); or where systems manage the trafﬁc (e.g., control of trafﬁc ﬂow at trafﬁc lights, or toll management). CTS inherits from computer science the aspects of distributed and decentralized computing and spatiotemporal information processing, and from transportation science the aspects of transportation control and management. The discipline goes beyond vehicular technology, and addresses pedestrian systems on handheld devices, non-real-time issues such as data mining, as well as data management issues above the networking layer. CTS studies how to improve the safety, mobility, efﬁciency, and sustainability of the transport system by taking advantage of information technologies and ubiquitous computing. In particular it needs scholars and practitioners that maintain a body of knowledge and push forward an agenda that is deeply rooted in both established disciplines. We are also the ﬁrst to admit that drawing the lines between the established and the emerging discipline is to some extent arbitrary. The intention of claiming an emerging discipline is by no means exclusive or divisive; rather it is to draw together work that is otherwise disconnected, and to foster research in this area through recognition. In all the examples above, and in the research agenda below, there exists research that is already underway. In this way, CTS becomes the science behind ITS. Academic ITS communities, such as in the IEEE ITS Society (founded 2005), already interpret the “S” as science, not systems (otherwise they would not pass scientiﬁc peer review). However, the scientiﬁc discipline behind ITS cannot be named intelligent transportation science in analogy to ITS—there is no such thing as an “intelligent science,” and then there is also an established discourse in artiﬁcial intelligence whether machines can be intelligent. So “computational transportation science” seems to say it all.

IST investment and computational science go hand in hand – applications

Winter et al 10 (Stephan Winter: The University of Melbourne, Australia, Monika Sester: Leibniz University Hannover, Germany, Ouri Wolfson: University of Illinois, Chicago, USA, Glenn Geers: National ICT Australia, Sydney, Australia, ACM SIGMOD Record, Volume 39 Issue 3, September 2010 , Pages 27-32, http://www.cs.uic.edu/~boxu/mp2p/39-135-1-SM.pdf)

As the name “computational transportation science” indicates, important aspects are computational and algorithmic aspects in CTS. The challenges lie in the diversity of sensors and thus data gathered in different spatial, temporal, and thematic resolution. The high volume demands for adequate information reduction for processing. One way to solve it is to exploit the principle of locality, i.e., the fact that information is mainly relevant locally and thus can also be processed locally and need not be communicated and processed on a central server. This leads to concepts of decentralized and distributed processing. The applications described below rely not only on the fact that travelers are provided with information; as travelers are equipped with sensors capable of acquiring information of the local environment, travelers also act as data providers. This leads to a highly dynamic map of the environment that can be exploited in numerous ways. On the one hand, the technology provides real-time data and thus can be used for dynamic trafﬁc assignment; on the other hand, the technology can also enhance the perception range of individuals and allow them to “look around the corner,” or to “look through the cars in front of them.” An additional important beneﬁt is the possibility to augment the environmental information with virtual information about the infrastructure. In this way, virtual trafﬁc lights or virtual lane assignments can be realized to allow for a ﬂexible trafﬁc management. Not only the data can be shared, but also the transportation resources can be shared. This is already the case for the road network and for public transportation. However, sharing can also be envisaged for other vehicles, like private cars. The applications are driven by different factors: • The ever increasing trafﬁc demand leading to congestion, with dramatic effects on public safety, the environment, and the economy due to time spent in trafﬁc jams. • Real infrastructure is expensive and laborious to maintain; furthermore, it is ageing and has to be replaced by modern concepts and systems. • Cars and travelers are increasingly equipped with sensors which can—among other things—capture information about themselves and about the local environment. This rich data source can be exploited. In the following, some future applications are described: 1. Shared transportation resources: If all trafﬁc modes are considered (including private trafﬁc), a better exploitation of the resources is achieved, with several beneﬁts for the users (reduced prices), the infrastructure (less congestion), and as a consequence also the environment (less pollution). 2. Collaborative travelling: Collaboration can be used for platooning: the virtual coupling of vehicles to form larger units like virtual trains. These structures can get priorities, e.g., when crossing junctions. Within a platoon, autonomous driving is possible. Further, there are opportunities for more adaptive trafﬁc management depending on the current trafﬁc situation (e.g., intersection negotiation and intelligent trafﬁc lights). 3. Physical infrastructure is replaced by virtual infrastructure: Virtual infrastructure can offer several advantages over ageing and expensive to maintain physical infrastructure. For example, virtual lanes can compensate for different trafﬁc volume during the day/week. Virtual trafﬁc lights and virtual signs may be possible, as well as transient and ad-hoc warnings, like construction sites, aquaplaning, or slippery roads. 4. Driver assistance: Drivers can be warned of risks in their local environment or when risking to leave their lane. Furthermore, drivers’ visibility range can be expanded by providing up-to-date information from areas that are currently invisible. 5. Evacuation planning: Highly temporal information is provided to support and calibrate simulations, with the objective of emergency preparedness. 6. Autonomous driving: As a long-term goal, highly dynamic maps of the environment have the potential to support autonomous driving. 7. Dynamic road pricing: Knowledge about the current usage of roads can be used to manage trafﬁc, e.g., by reducing prices for collaboratively used cars or platoons. 8. Smart grid, electric cars: Sharing resources opens the way to extend the ﬂexibility of using and sharing electric cars, e.g., by dynamic planning of the electric grid resources, and of routes by considering charging facilities. 9. Road and trafﬁc planning: Road and trafﬁc planning can be greatly enhanced by precise, high resolution travel information, which leads to adaptive trafﬁc systems. For example, the road visibility, precipitation, and pavement condition information can be provided at high spatial resolution.

IST investment leads to investment in computational science

Geers 8 (Glenn Geers, Neville Roach Laboratory National ICT Australia, <http://atp-webproxy1.it.nicta.com.au/__data/assets/pdf_file/0006/19770/985_Some_Resea_3.pdf>)

Currently deployed ITS systems (with few exceptions) have very little intrinsic intelligence. A concrete example is afforded by considering an electronic tolling system which is of great benefit to road users but the installed hardware and software hardly deserves the epithet ‘intelligent’. By combining artificial intelligence and machine learning techniques with wireless communications and distributed computing methods Computational Transportation Science has the potential of really making ‘Intelligent’ Transport systems intelligent. Society as a whole is at a crossroads where connectivity between people, systems and devices of all types and at all times will soon be the norm rather than the exception. From the humble beginnings of the ‘Internet Coke Machine’ [2] at Carnegie Mellon University in the mid-1980s it is now not unreasonable to deploy systems consisting of hundreds of thousands or even millions of (largely iden tical) actively connected and cooperating devices that are capable of delivering useful (and some not so useful) services [1, 8]. More and more, such networked systems will enhance our daily routine and we will be less and less aware of their presence.

IST investment leads to computational science investment

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The discussion above barely scratches the surface of potential research problems for CTS. Those espoused tend to have a practical bent as indeed they should. What CTS must do is develop the next generation of ITS by leveraging the latest techniques from machine learning, distributed systems, constraints programming and a host of other CS disciplines. The inevitable and, seemingly inexorable growth in computing power and networking technologies will enable the transport and traffic engineers of the future to realise the power of grid computing and to run real-time (and even supra-realtime) transport network models on computing systems that are intrinsically part of the transport network being modelled. The model hierarchy described in Section 3.1 above will be mirrored in the computing environment on which the model executes. Transportation needs are driven by the requirements of societal mobility (as embodied in work requirements, family and vacations), goods delivery and (more recently) environmental sustainability. It is the demand for consumer goods coupled with the need for sustainability that is pushing up the cost of petroleum. The increase in petroleum price will in turn, hinder societal mobility. For millennia people were restricted in their potential for travel by the lack of means. If governments are not careful this past and,extremely restrictive state of affairs could return—at the very least for overseas travel. The rising cost of petroleum should expedite the development of non-petroleum powered road vehicles by industry and the proactive development of public transport infrastructure by government. It is evident, however, that the personal automobile will not disappear. The freedom it provides will be too much for society to lose. Future trips to the Pyramids or Stonehenge or the 22nd International Conference on Computational Transportation Science(!) may well be virtual but we should all sleep soundly secure in the knowledge that traffic jams will be around for a good few centuries yet.

Comp Science K2 Biotech

Comp science k2 biotech

Biotech Week, 6/20/2007, “Biotechnology; Recent findings from National University of Singapore, Department of Computational Science highlight research in biotechnology”, Proquest

Researchers detail in "MODEL- molecular descriptor lab: a web-based server for computing structural and physicochemical features of compounds," new data in biotechnology. "Molecular descriptors represent structural and physicochemical features of compounds. They have been extensively used for developing statistical models, such as quantitative structure activity relationship (QSAR) and artificial neural networks (NN), for computer prediction of the pharmacodynamic, pharmacokinetic, or toxicological properties of compounds from their structure," researchers in Singapore, Singapore report.

"While computer programs have been developed for computing molecular descriptors, there is a lack of a freely accessible one. We have developed a web-based server, MODEL (Molecular Descriptor Lab), for computing a comprehensive set of 3,778 molecular descriptors, which is significantly more than the approximately 1,600 molecular descriptors computed by other software. Our computational algorithms have been extensively tested and the computed molecular descriptors have been used in a number of published works of statistical models for predicting variety of pharmacodynamic, pharmacokinetic, and toxicological properties of compounds. Several testing studies on the computed molecular descriptors are discussed," wrote Z.R. Li and colleagues, National University of Singapore, Department of Computational Science.

Comp Science K2 Nanotech

**Computational science is key to nanotech**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Because nanoscience** and nanotechnology **involve manipulation at the molecular level, variables come into play that are not relevant to macroscale bulk materials**. For example, the properties of a nanostructured material can depend strongly on the number of atoms making up the nanostructure. **Quantum effects can be very important or even dominant. Small changes in the conditions under which self-assembly is performed can change radically the final product.** Because of **the unique features of nanomaterials, the results of many nanoscale experiments cannot be understood in the absence of theory. The large-scale** manufacturability of **nanostructured devices will require an extraordinarily detailed and predictive understanding of how the manufacturing conditions impact the desired product.** As a result, **theory, modeling, and simulation** (TMS) **have** **long been recognized as playing a fundamentally important role in nanoscience and nanotechnology, and this is reflected in the prominent role given to TMS in the early planning of the NNI.3 Computational nanoscience—the large-scale computational solution of theoretically derived equations to perform simulations of the structure and/or dynamics of nanostructures and devices—is the crucial unifying element in TMS. Computational nanoscience enables experiments to be understood, properties of nanostructures to be predicted, and new nanostructured materials to be designed.** For instance, computational nanoscience makes it possible to answer the questions “What if we had a quantum computer? What could we do with it that we could not do with conventional computers? What would need to be achieved experimentally to create a quantum computer?” These are important questions to answer before engaging in the high-cost experimental pursuit of a quantum computer. With appropriate investments in theory, modeling, and simulation, computational nanoscience has the potential to be an equal partner with experiment and the most crucial tool in the design of manufacturing processes for devices based on nanoscale structure and function (see Fig. 9.2). In a recent DOE report on computational nanoscience,4 some of the remarkable advances of the past fifteen years that have revolutionized computational nanoscience were identified: Continuation of Moore’s law, and beyond-Moore’s-law increases in computing power enabled by advancing chip technologies and massive parallelization. One measure of the combined impact of Moore’s law and parallelization is to look at winners of the Gordon Bell Prize, given each year at the Supercomputing conference to the application demonstrating the highest sustained performance. In 1988, the prize was given to an application achieving 1 Gflop/s; in 2003, the winner attained 35 Tflop/s. This is a 35,000-fold increase in just 15 years; Moore’s law alone would predict ten doublings for a thousandfold increase if all of the power of the extra transistor density went directly into floating-point rate.

Comp science k2 biotech and nanotech

Professor J.N. Reddy teaches in the Mechanical Engineering Department of Texas A&M, “International Journal For Computational Methods in Engineering Science and Mechanics”, Proquest

Computational mechanics is an integral and major subject of research in many fields of

science and engineering, design and manufacturing. Major established industries such as the

automobile, aerospace, atmospheric sciences, chemical, pharmaceutical, petroleum,

electronics and communications, as well as emerging industries such as biotechnology,

nanotechnology, and information technology rely on computational mechanics-based

capabilities to model and numerically simulate complex systems for the analysis, design, and

manufacturing of high-technology products. Rapid advances in computer architecture,

hardware, software technology and tools, and numerical and non-numerical algorithms, are

making significant contributions to the development of computational models and methods to

model materials and analyze and design complex engineering systems.

The main aim of the Journal is to provide a unique interdisciplinary forum to publish papers

dealing with mathematical models and computational methods and algorithms for the numerical

simulation of natural processes arising in applied science and mechanics. Special emphasis

will be placed on both upstream and applied research and on the transfer of technology to the

industry in the areas of fluid mechanics, heat transfer, solid and structural mechanics in the

disciplines of aerospace, chemical, civil, mechanical, electrical engineering, and computational

biology, chemistry, and materials science. Papers dealing with novel computational methods

to model current and emerging technologies in microelectromechanical systems,

electromagnetics, biotechnology, nanotechnology, and information technology are encouraged.

Computational sciences k2 nanotech and biotech

Michael C. Roco and Williams Sims Bainbridge work for the National Science Foundation, 2003, Proquest

In the early decades of the 21st century, concentrated efforts can unify science

based on the unity of nature, thereby advancing the combination of nanotechnology,

biotechnology, information technology, and new technologies based in cognitive

science. With proper attention to ethical issues and societal needs, converging

technologies could achieve a tremendous improvement in human abilities, societal

outcomes, the nation’s productivity, and the quality of life. This is a broad, crosscutting, e merging an d timely opportunity of interest t o individuals, society and

humanity in the long term.

The phrase “ convergent technologies” refers to the synergistic combination o f

four major “ NBIC” ( nano-bio-info-cogno) provinces o f science and technology,

each of which is currently progressing at a rapid rate: (a) nanoscience and

nanotechnology; (b) biotechnology and biomedicine, including genetic engineering;

(c) information technology, including advanced computing and communications; (d)

cognitive science, including cognitive neuroscience.

Comp Science K2 Biotech

**Computational Science key to breakthroughs in biology**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Progress in biology depends on** the emergence of a **new quantitative, predictive,** and ultimately **systems-level paradigm for the life sciences**. **New experimental methods must be developed to provide comprehensive**, highly accurate **datasets**; **computational infrastructure**, software and algorithms **must be developed to effectively use these datasets**. In addition, a new generation of life scientists must be trained who are facile with the methods of both experimental biology and computational science. Further, ne**w models for organizing, managing, and funding the biosciences must be developed that will enable large-scale, multidisciplinary research projects in biology**. Successful **development of the new tools will require the sustained efforts of multidisciplinary teams of biologists, computational biologists and chemists, computer scientists, and applied mathematicians**, and applications of these tools will require teraflop/s-scale and beyond supercomputers as well as the considerable expertise required to use them. This research endeavor is a task for the entire biological community and will involve many agencies and institutions. In several sidebars we provide success stories in protein structure prediction, large-scale molecular simulations of nucleosome structure and membranemineral interactions, first-principles approaches to the basic chemical mechanism of DNA cleavage, and large-scale organization of patterns for immunological synapse formation**. The progress in computational biology research illustrated in these sidebars provides a strong case history as to the scientific goals that can be accomplished in the future in biology.**

**That’s key to carbon sequestration, alt energy, and bioterror**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Extraordinary advances in molecular biology have been made in the past decade** due in large part to discoveries coming from genome projects on human and model organisms. **Biologists expect the next phase of the genome project to be even more startling in terms of** dramatic **breakthroughs** **in our understanding of** biology and the future of **biotechnology**. This new **biology will allow a level of quantitative understanding** of biological systems that was previously **unimaginable** **and** will **enable the creation of innovative biological solutions to** many of humankind’s most pressing challenges, including human health**, sustainable energy**, **control of atmospheric carbon**, environmental cleanup, **and effective defenses against bioterroris**m. This transformation of biology into a quantitative 37 science requires organization and querying of massive biological datasets and advanced computing technologies that will be combined into predictive simulations to guide and interpret experimental studies. Data management and analysis and computational modeling and simulation will play critical roles in the creation of the biology of the twenty-first century.

Comp Science K2 Chem

**Computational science is key to chemistry – that’s key to economy, warming, ozone, and nanotech**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Chemistry is a** central science. It is an **intellectual quest in its own right**, but **it is also a critical element of many of the other sciences** important to the U.S. Department of Energy. For example, with reference to other chapters, **chemical processes are responsible for the energy produced** and pollutants released by an automobile engine (combustion science). **Catalytic chemical processes are used to remove** these **pollutants** from the tailpipe emissions. Likewise, an understanding of **chemistry is important for predicting and mitigating the spread of pollutant**s in underground plumes (subsurface science**), processing high-level radioactive wastes**, predicting and **alleviating** the **long-term effects of greenhouse gases a**nd stratospheric **ozone depletion** (**climate science**), tailoring the properties of **nanomaterial**s for a broad range of applications (material and nanoscale sciences), **and understanding** and manipulating the biochemical processes on which life is based (**biology**). The U**.S. chemical industries play a major role in the national economy and contribute directly to the high quality of life enjoyed by its citizens.** There is little in everyday life that does not involve these core U.S. industries. The U.S. petroleum, chemical, and pharmaceutical industries are the world’s largest producers of chemicals, ranging from “wonder” drugs to paints, from cosmetics to plastics, from fuels to fertilizers. **The chemical industry represents 10% of all U.S. manufacturing, employing more than one million Americans**. It is also one of the few industries that possess a favorable balance of trade. **The petroleum and chemical industries contribute approximately $500 billion to the GDP of the United States.** These industries maintain their global competitive position by their ability to produce new products using energy-efficient, low-cost, and environmentally clean processes. An understanding of and an ability to predict the structures, energetics, and reactions of molecules are essential to achieving these goals. 5.2 Scientific Opportunities **Computational chemistry has already had an enormous impact on fundamental chemical science. It has provided new insights into the structure and properties of molecules, especially those molecules whose existence is fleeting** (e.g., free radicals) yet whose role in many chemical processes is critical. **Computational chemistry has also dramatically advanced our understanding of how chemical reactions occur—in the energetic changes that drive chemical reactions, in the structural changes that occur as reactions proceed, and in the detailed dynamics of the collision complex**. These insights were initially qualitative; but as computational methods, software, and computer hardware have advanced, chemists are now able to make accurate predictions about a wide variety of chemical phenomena, sometimes literally replacing experiment by computation. With the additional investments envisioned in this report, the capabilities of computational chemistry will dramatically expand, enveloping a far broader range of chemical phenomena than possible today.

Comp Science K2 Warming

**Warming is real, caused by humans, and is solved by computational science**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**An international consensus is emerging that humans are changing Earth’s climate.** Climate change is expected to continue and even accelerate. Clearly, **future climate change will have important impacts on many sectors of society, including agriculture, water resource management, energy production and demand, human health, and recreation**. Natural ecosystems and biodiversity will also be affected. The cost of adaptation to climate change could be large, and we must attempt to anticipate and quantify potential damage resulting from climate change. Adaptation strategies might reduce the damage, but such strategies will also have an associated cost. **Greenhouse gases such as carbon dioxide have long residence times; hence, delay in reducing these gases may dramatically increase costs and decrease effectiveness of mitigation strategies**. Accurate long-term predictions that in clude as many known feedbacks as possible will be required to evaluate the impacts of climate change and the effectiveness of emission-reduction scenarios and carbon-sequestration methods**. Policy makers need such tools now. A better understanding of potential societal impacts is needed to properly weigh the costs of mitigating climate change** (e.g., by developing new carbon-free energy sources or developing carbon sequestration technologies**) against the costs of allowing climate change and its impacts to occur. Demonstration and implementation of carbon sequestration methodologies and new carbon-free energy production technologies will require decades to develop**. Whatever policies are followed in the future, anthropogenic climate change will continue for decades, and the explanation of observed changes will require high-end climate modeling. Improved climate models are essential tools for a more complete understanding of climate and impacts**. Climate models are the only means of integrating our knowledge of the components (atmosphere, ocean, land surface, and sea ice) that make up the complex climate system. And they are the only means for carrying out “experiments” on the climate system to study the projected changes and impacts of different scenarios**. In order to be useful to regional planners, climate models must make credible predictions on a regional spatial scale (e.g., within a state). Because of the coarse resolution and other limitations of today’s climate models, predictions are considered reliable only averaged over continental and larger scales, but not on a regional scale. In order to make reliable and useful region-scale predictions, climate models need greatly increased spatial resolution, improved treatments of subgrid-scale physical phenomena (e.g., clouds), and inclusion of additional physical, chemical, and biogeochemical processes, such as the chlorophyll concentrations in Fig. 6.3. **The United Nations-sponsored Intergovernmental Panel on Climate Change (IPCC) is a highly regarded multinational scientific body that performs extensive studies of potential climate change and publishes their findings on a fiveyear cycle. The IPCC is beginning to collect scientific results for the Fourth Assessment, to be completed in 2007**. The Community Climate System Model (CCSM2) has been developed as a multi-agency initiative with support from the National Science Foundation and the Office of Science in the U.S. Department of Energy. CCSM2 will be one of the primary climate models used in the next IPCC assessment. With an increase in dedicated computing resources in the 100 Tflop/s range, new studies could be performed with a higher-resolution atmospheric model providing much improved spatial detail. An increase of storage and processing capability by a factor of 3, at the current resolution, would allow the addition of dynamic vegetation to a fine-scale land model. Another factor of 2 would provide enough power to routinely include troposphere chemistry. Ocean biogeochemistry could be included in the coupled model for an additional factor of 3 to 5. Interactive carbon in a full carbon cycle will require a further factor of 2. Extending the atmospheric model to include a full stratosphere and increasing the vertical resolution requires another factor of 5 increase in capability. **These additional physical mechanisms may not be fully exploited unless the ocean and atmospheric horizontal resolution is substantially increased. An eddy-resolving ocean model would require another factor of 1200. In the ten-year time frame, it will be important to include cloud-resolving atmospheric simulations in a fully coupled Earthsystem- modeling framework.** The cumulative requirement supporting these developments is estimated to be a factor of nearly four orders of magnitude in aggregate flops. To accomplish such runs in today’s turnaround times requires petaflops computing. A more extensive discussion of these issues is given below.

Comp Science K2 Combustion

**Computational science key to combustion science – that’s key to sustainable energy**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**In spite of the fundamental scientific and technological importance of combustion, our knowledge of combustion processes is surprisingly incomplete**. Much of the difficulty in combustion science results from the complex interaction of turbulent flow processes with the myriad chemical processes occurring in a flame. New **diagnostic techniques developed over the past two decades years have given us quantitative and detailed measures of the structure of many combustion processes.** They are, however, **still far from quantifying the full range of species involved in complex chemical reactions, and far from resolving the finest spatial structures characteristic of interfacial and high-pressure processes. Computational implementation of theory and models, coupled with experiments such as depicted in Fig. 7.1, has enabled great progress in our understanding of idealized, and aspects of more complex, combustion processes, but have been unable to directly explore the full complexity of realistic and important regimes of combustion representations of the chemistry and transport**. With moderate extensions of the rapidly evolving state-of-the-art in these technologies, long-standing problems in combustion science can be solved. A few examples of the combustion topics that can be addressed as computational power increases are illustrated in Fig. 7.3 and are further described below. One area that is well primed to exploit increased computing resources is the exploration of fundamental turbulence/chemistry interactions in laboratoryscale, atmospheric-pressure flames. **A recent computation of a turbulent premixed methane-air “V” flame is shown in Fig. 7.4. While this computation exceeded the resources normally accessible, a hundredfold increase in available computational power will enable routine detailed simulations of turbulent natural gas combustion in laboratory-scale flames.** For the first time, researchers will be able to probe the detailed dynamical and chemical properties of these types of flames over the full range of length scales observed. They will be able to quantify how turbulence alters the chemical pathways in the flame and how chemistry affects the turbulent flame speed. With an additional order of magnitude in compute power and continued algorithmic advances, they will be able to predict the pollutant emissions from such flames, understand how the presence of larger hydrocarbons affects the flame chemistry, and quantify pressure effects on flame dynamics. They will also be able to investigate the chemical behavior and emissions characteristics of turbulent jet diffusion flames, such as those pictured in Fig. 7.1, where mixing plays a dominant role in the dynamics.

Comp Science K2 Material Creation

**Computational science key to material research – that’s key to the economy**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Advanced materials drive economic, social, and scientific progress**, shape our everyday lives, and **play a crucial enabling role in virtually all technologies**. Indeed the current information age is built on the twin foundations of semiconductor processor and magnetic storage technologies developed over the past 40 years. **The exponential growth rate in both processing power and storage density has been made possible through exploitation and control of materials properties on ever smaller length scales and increasing complexity**. Structural materials that are stronger and lighter, retain their strength at higher temperatures, or adsorb energy when deformed enable more efficient energy production as well as more efficient and safer automobile and airline transportation. **Currently, storage capacity** (areal density or Gbits/in2) **of magnetic disc drives is doubling ever year** (Fig. 8.1). **This phenomenal rate of increase—up from the already impressive 60% per year in the early 1990s and 30% per year prior to that—was facilitated by the introduction of Giant Magneto-Resistance (GMR) read heads and was the result of a scientific discovery made less than ten years previously.** Impressive as these advances are, they cannot continue for more than a few years without significant new scientific breakthroughs because the individual storage elements will be so small as to be unstable (superparamagnetic limit) and of no use for long-term storage of information. As cast, the ordered intermetallic compound, Ni3Al, is brittle. However, recent scientific discoveries involving addition of small amounts of boron, slight modification of the Ni:Al ratio, and control of microstructure have resulted in a new class of commercial alloys that are ductile, strong at high temperature, and corrosion resistant. These alloys are now resulting in substantial energy and cost savings in the steel, automotive, and chemical industries (Fig. 8.2). In 2001, the development of these alloys was listed as one DOE Basic Energy **Sciences’ 100 most significant scientific advances of the previous 23 years. In numerous other areas of materials science the basis for future scientific breakthroughs is being laid—understanding the origins of high-temperature superconductivity, transition metal oxides with totally new properties and functionality, and the exploration of the fascinating world of nanostructured materials.** 8.2 Scientific Opportunities **During the next two decades the opportunity exists to develop a new paradigm for materials research in which modeling and simulation are integrated with synthesis and characterization to accelerate discovery.** During the past two decades, application of first-principles quantum theories of the electronic structure of materials, coupled with simulations using idealized models, has resulted in a revolution in the understanding of many simple systems – ideal crystals and alloys, surfaces, and localized defects. Future development of multiscale modeling capabilities will allow the study of microstructure and its influence on strength and fracture, as well as the synthesis and processing routes required to control microstructure. Significantly increasing the size and complexity of systems that can be studied at the quantum level can make it possible to solve fundamental problems not currently accessible to theoretical description—dynamics of electron spin, strong electron correlations, and high-temperature superconductivity. In addition, theory and modeling can be used to take maximum advantage of ex periments performed at the nation’s advanced characterization facilities through direct calculation and simulation of that which is measured.

Comp Science K2 Plasma Research

**Computational science is key to fusion energy – plasma research**

**Strayer 4** (Michael Strayer, Acting Director of Mathematical, Informantion, and Computational Science Division of the US Department of Energy, September 19, 2004, <http://science.energy.gov/~/media/ascr/pdf/program-documents/archive/Scales_report_vol2.pdf>)

**Although plasmas play an important role in many aspects of everyday life** (e.g., neon signs, plasma video displays, spark plugs, and flames), **a major focus of research in plasma science is the quest for harnessing fusion energy**. **The development of a secure and reliable energy system that is environmentally and economically sustainable is one of the most formidable scientific and technolog- ical challenges facing the world in the twenty-first century**. The vast supplies of deuterium fuel in the oceans and the absence of long-term radiation, CO2 generation, and weapons proliferation concerns makes fusion the preferred choice for meeting the energy needs of future generations. The DOE Office of Fusion Energy Sciences (OFES) supports an active research program in fusion energy science with three major U.S. Magnetic Fusion Energy (MFE) experiments under way and is currently negotiating a role for the United States in the upcoming ITER burning plasma experiment**. The United States also supports a large magnetic fusion theory effort, which has a long history of being at the cutting-edge of computational physics research**. In fact, the present National Energy Research Scientific Computing Center (NERSC) is an outgrowth of the MFE computer center, MFECC, which was established in the late 1970s as the first national supercomputer center. **In MFE experiments, high-temperature (100 million degrees centigrade) plasmas are produced in the laboratory in order to create the conditions where hydrogen isotopes (deuterium and tritium) can undergo nuclear fusion and release energy (the same process that fuels our sun). Devices called tokamaks and stellarators are “magnetic bottles” that confine the hot plasma away from material walls, allowing fusion to occur.** Unfortunately, confining the ultrahot plasma is a daunting technical challenge. The level of microturbulence in the plasma determines the amount of time it takes for the plasma to “leak out” of the confinement region. Also, global stability considerations limit the amount of plasma a given magnetic configuration can confine, and thus determine the maximum fusion rate and power output. **A complementary approach to MFE is called Inertial Fusion Energy (IFE). DOE’s IFE program, also within OFES, is coordinated with, and gains leverage from, the much larger Inertial Confinement Fusion (ICF) program of the National Nuclear Security Administration (NNSA).** In IFE, intense beams of particles (ion-beam fusion) or light (laser fusion) are focused on small targets that contain pellets of frozen heavy hydrogen. When these pellets are imploded sufficiently rapidly and symmetrically, the conditions for a small nuclear fusion “explosion” are created. These explosions release substantial energy, but are small enough that their energy can be confined within the fusion chamber, where it can be converted to a useful form. Plasma physics issues arise in the beam itself in the case of ion-beam fusion, in obtaining high compression ratios and maintaining symmetry in the target, and in an advanced concept known as fast ignition. **Plasma science is also of great importance in understanding crucial interactions between the sun and the Earth. Plasma is always being emitted from the sun in the form of a supersonic wind called the “solar wind.” In addition to the solar wind, plasma in the sun’s outer atmosphere, called the “corona,” can undergo sudden and violent activity in the form of “coronal mass ejections” and “solar flares,” examples of which can be seen** in Fig. 10.1. As a result of these activities, billions of tons of matter and intense energetic particles can be thrown out of the solar corona into outer space, causing “storms” that can disturb significantly the near-Earth environment. All of the various phenomena that occur in the near-Earth environment whose behavior and interactions directly affect the planet and human technologies on and in orbit around it make up “space weather.” Space weather can have significant effects for several Earth-based technologies such as satellites, communications and navigation systems, and radiation exposure in manned space missions. 10.2 Scientific Opportunities **Computational modeling currently plays an essential role in all aspects of plasma physics research. Perhaps nowhere is this as evident as it is in magnetic fusion energy (MFE) research where simulation models are actively being improved, tested and applied to the interpretation of data and to the design of new experiments. Improvements in the modeling comes in the form of both more complete models that include better descriptions of the physical processes and more efficient models that use advanced algorithms.** Present capability is such that we can apply our most complete computational models to realistically simulate both nonlinear macroscopic stability and microscopic turbulent transport in the smaller fusion experiments that exist today, at least for short times. Anticipated increases in both hardware and algorithms during the next 5–10+ years will enable application of even more advanced models to the largest present-day experiments and to the proposed burning plasma experiments such as ITER (see Fig. 10.2 and the discussion below).

Environment Advantage

ITS key to curb emissions - tech application, congestion and fuel efficiency

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

Intelligent transportation systems are positioned to deliver environmental benefits by reducing congestion, by enabling traffic to flow more smoothly, by coaching motorists how to drive most efficiently, and by reducing the need to build additional roadways through maximizing the capacity of existing ones. Vehicle transportation is a major cause of greenhouse gas emissions. In England, the transport sector contributes about one-quarter of the country’s CO2 emissions, 93 percent of which comes from road transport. 54 In France, transport represents 31 percent of final energy consumption and 26.4 percent of greenhouse gas emissions. 55 Transportation accounts for 25 percent of worldwide greenhouse gas emissions, 56 and 33 percent in the United States. 57 Traffic congestion causes an outsized amount of CO2 emissions. Vehicles traveling at 60 kmph (37 mph) emit 40 percent less carbon emissions than vehicles traveling at 20 kmph (12 mph) and vehicles traveling at 40 kmph (25 mph) emit 20 percent less emissions than the 20 kmph baseline. 58 One study found that computerized operations of 40 traffic signals in Northern Virginia’s Tysons Corner community alone decreased the total annual emissions for carbon monoxide, nitrogen oxides, and volatile oxygen compounds by 135,000 kilograms (and improved fuel consumption by 9 percent). 59 By 2010, Japan expects to reduce CO2 emissions by 31 million tons below 2001 levels, with 9 million tons of reduction coming from more fuel efficient vehicles, 11 million tons from improved traffic flow, and 11 million tons from more effective use of vehicles, the latter two a direct benefit of the country’s investments in ITS. 60 “Eco-driving” is an ITS-enabled application that optimizes driving behavior to the benefit of the environment. Vehicles equipped with eco-driving features provide feedback to the motorist on how to operate the vehicle at the most fuel-efficient speeds across all driving situations; the most sophisticated versions give visual or oral instructions on how much pressure to apply to the acceleration petal. In Japan, Germany, and increasingly the United States, enthusiasts upload records of their driving behavior from vehicles to Web sites where they compete with others to be the most efficient driver. Thus, intelligent transportation systems that decrease congestion and improve traffic flow ameliorate environmental impact considerably. To be sure, by decreasing congestion and enabling traffic to flow more smoothly, intelligent transportation systems may cause some degree of induced demand, encouraging more drivers to take to the roads due to improved traffic conditions. But while ITS may cause some induced demand, overall it is poised to deliver net environmental benefits.

ITS solves warming

Ezell 10 (Stephen Ezell, senior analyst with the information technology and innovation foundation (itif), Explaining International IT Application Leaderhip:Intelligent Transportation Systems, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf)

Intelligent transportation systems are positioned to deliver environmental benefits by reducing congestion, by enabling traffic to flow more smoothly, by coaching motorists how to drive most efficiently, and by reducing the need to build additional roadways through maximizing the capacity of existing ones. Vehicle transportation is a major cause of greenhouse gas emissions. In England, the transport sector contributes about one-quarter of the country’s CO2 emissions, 93 percent of which comes from road transport. 54 In France, transport represents 31 percent of final energy consumption and 26.4 percent of greenhouse gas emissions. 55 Transportation accounts for 25 percent of worldwide greenhouse gas emissions, 56 and 33 percent in the United States. 57 Traffic congestion causes an outsized amount of CO2 emissions. Vehicles traveling at 60 kmph (37 mph) emit 40 percent less carbon emissions than vehicles traveling at 20 kmph (12 mph) and vehicles traveling at 40 kmph (25 mph) emit 20 percent less emissions than the 20 kmph baseline. 58 One study found that computerized operations of 40 traffic signals in Northern Virginia’s Tysons Corner community alone decreased the total annual emissions for carbon monoxide, nitrogen oxides, and volatile oxygen compounds by 135,000 kilograms (and improved fuel consumption by 9 percent). 59 By 2010, Japan expects to reduce CO2 emissions by 31 million tons below 2001 levels, with 9 million tons of reduction coming from more fuel efficient vehicles, 11 million tons from improved traffic flow, and 11 million tons from more effective use of vehicles, the latter two a direct benefit of the country’s investments in ITS. 60 “Eco-driving” is an ITS-enabled application that optimizes driving behavior to the benefit of the environment. Vehicles equipped with eco-driving features provide feedback to the motorist on how to operate the vehicle at the most fuel-efficient speeds across all driving situations; the most sophisticated versions give visual or oral instructions on how much pressure to apply to the acceleration petal. In Japan, Germany, and increasingly the United States, enthusiasts upload records of their driving behavior from vehicles to Web sites where they compete with others to be the most efficient driver. Thus, intelligent transportation systems that decrease congestion and improve traffic flow ameliorate environmental impact considerably. To be sure, by decreasing congestion and enabling traffic to flow more smoothly, intelligent transportation systems may cause some degree of induced demand, encouraging more drivers to take to the roads due to improved traffic conditions. But while ITS may cause some induced demand, overall it is poised to deliver net environmental benefits.

Hegemony Advantage

The US is ceding leadership in IST – federal investment key to solve

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

In explaining international leadership in intelligent transportation systems, policy factors appear to be much more important than non-transportation policy factors. Overall, countries leading the world in ITS deployment: 1) demonstrate national level commitment and vision, 2) make substantial investments in ITS deployment, and 3) feature strong government leadership in crafting a clearly articulated ITS vision, setting a national agenda, convening relevant stakeholders, and spearheading implementation. Many of these countries enjoy a high degree of centralization in ITS decision making and deployment, and in some cases federal governments (as in Japan) have direct control over roadways. But these countries also invest in ITS. For example, South Korea and Japan each invest more than twice as much in intelligent transportation systems as a share of GDP than the United States. Further, these countries recognize ITS as a “force-multiplier” for their transportation networks that will enable a shift to a performance-based transportation funding system, have built their ITS infrastructure through publicprivate partnerships, and view their ITS investments as a platform that will lead to the creation of new value-added products and services, many of which can scarcely be foreseen today. Over the next five years, the United States is poised to invest more than $500 billion on the nation’s surface transportation infrastructure. Intelligent transportation systems must be a critical component of these investments in order to maximize the operational performance of the transportation system and attain the significant benefits enumerated in this report. If the United States does not take advantage of the current opportunity to significantly fund ITS as part of the next surface transportation authorization, it risks not only falling further behind world leaders and other developed economies in ITS, but also losing ground to rising countries such as China and India, which are beginning to make substantial investments in ITS development and deployment.

ITS key to US leadership – investment is needed

Ezell 10 (Stephen Ezell, senior analyst with the information technology and innovation foundation (itif), Explaining International IT Application Leaderhip:Intelligent Transportation Systems, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf)

In contrast to the leaders, the United States lags in ITS deployment, particularly with regard to provision of real-time traffic information, progress to date on vehicle-to-infrastructure and vehicle-to-vehicle integration, adoption of computerized traffic signals, and maximizing the effectiveness of its already fielded ITS systems. While the United States certainly has pockets of strengths with regard to ITS in particular regions and applications—including use of variable rate highway tolling, electronic toll collection, certain advanced traffic management systems such as ramp metering, and an active private sector market in telematics and travel information provision—overall the implementation of ITS varies significantly by state and region, thus tending to be sporadic and isolated and not connected into a nationally integrated “intelligent transportation system.” As one illustration of U.S. challenges in ITS, the percentage of U.S. metropolitan areas delivering real-time highway travel time and highway travel speed information to the public in 2007 was, respectively, 36 percent and 32 percent, while for arterial roadways, only 16 percent of U.S. metropolitan areas disseminate real-time travel speed information and only 19 percent distribute real-time travel time data. For the most part, U.S. challenges in ITS have been the result of two key factors: a continued lack of adequate funding for ITS; and the lack of a federally led approach, as opposed to the “every state on its own approach” that has prevailed to date. At the federal level, the U.S. ITS effort focuses on research, is funded at $110 million annually, and operates out of the U.S. Department of Transportation’s Research and Innovative Technology Administration’s (RITA) ITS Joint Program Office (JPO). To reorganize and reanimate the U.S. ITS effort, on January 8, 2010, RITA unveiled a new, five-year “ITS Strategic Research Plan, 2010- 2014.” While the Strategic Plan represents an important step forward, the United States needs to make a fundamental transition from a focus mostly oriented around research to include a much greater focus on deployment and endeavor to accelerate the speed at which ITS technologies reach the traveling public. In explaining international leadership in intelligent transportation systems, policy factors appear to be much more important than non-transportation policy factors. Overall, countries leading the world in ITS deployment: 1) demonstrate national level commitment and vision, 2) make substantial investments in ITS deployment, and 3) feature strong government leadership in crafting a clearly articulated ITS vision, setting a national agenda, convening relevant stakeholders, and spearheading implementation. Many of these countries enjoy a high degree of centralization in ITS decision making and deployment, and in some cases federal governments (as in Japan) have direct control over roadways. But these countries also invest in ITS. For example, South Korea and Japan each invest more than twice as much in intelligent transportation systems as a share of GDP than the United States. Further, these countries recognize ITS as a “force-multiplier” for their transportation networks that will enable a shift to a performance-based transportation funding system, have built their ITS infrastructure through publicprivate partnerships, and view their ITS investments as a platform that will lead to the creation of new value-added products and services, many of which can scarcely be foreseen today.

Economy Advantage

ITS is key to the economy – productivity, jobs and cost benefit return ratio

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

ITS deliver five key classes of benefits by: 1) increasing safety, 2) improving operational performance, particularly by reducing congestion, 3) enhancing mobility and convenience, 4) delivering environmental benefits, and 5) boosting productivity and expanding economic and employment growth. ITS are contributing to a fundamental reassessment of vehicle safety. Whereas most developments in transportation safety over the past 50 years were designed to protect passengers in the event of a crash, VII and V2V systems such as Japan’s Smartway or the United States’ IntelliDrive are being designed to help motorists avoid the accident altogether. For example, the U.S. IntelliDrive system could potentially address 82 percent of vehicle crash scenarios involving unimpaired drivers. ITS maximize the capacity of infrastructure, reducing the need to build additional highway capacity. For example, applying real-time traffic data to U.S. traffic signal lights can improve traffic flow significantly, reducing stops by as much as 40 percent, reducing travel time by 25 percent, cutting gas consumption by 10 percent (1.1 million gallons of gas annually), and cutting emissions by 22 percent (cutting daily carbon dioxide emissions by 9, 600 tons). ITS can contribute significantly to reducing congestion, which costs U.S. commuters 4.2 billion hours and 2.8 billion gallons of fuel each year, costing the U.S. economy up to $200 billion per year. Overall, ITS can reduce congestion by as much as 20 percent or more. ITS also enable transportation agencies to collect the real-time data needed to measure and improve the performance of the transportation system, making ITS the centerpiece of efforts to reform surface transportation systems and hold providers accountable for results. By improving the operational performance of the transportation network, ITS enhance driver mobility and convenience, deliver environmental benefits, and even boost productivity and economic growth. For Japan, ITS have been crucial as the country strives to meet its goal to reduce, by 2010, CO2 emissions by 31 million tons below 2001 levels, with 11 million tons of savings come from improved traffic flow and another 11 million tons of savings from more effective use of vehicles. For many countries, ITS represents a rapidly expanding, export-led growth sector which contributes directly to national economic competitiveness and employment growth. For example, the U.S. Department of Transportation has estimated that **the field of ITS could create almost 600,000 new jobs over the next 20 years**, and a study of ITS in the United Kingdom found that **a £5 billion investment in ITS would create or retain 188,500 jobs for one year.** Intelligent transportation systems deliver superior benefit-cost returns when compared to traditional investments in highway capacity. Overall, the benefit cost ratio of systems-operations measures (enabled by intelligent transportation systems) has been estimated at about 9 to 1, far above the addition of conventional highway capacity, which has a benefit-cost ratio of 2.7 to 1. A 2005 study of a model ITS deployment in Tucson, Arizona, consisting of 35 technologies that would cost $72 million to implement, estimated that the average annual benefits to mobility, the environment, safety, and other areas would total $455 million annually, a 6.3 to 1 benefit-cost ratio. If the United States were to implement a national real-time traffic information program, the GAO estimates the present value cost of establishing and operating the program would be $1.2 billion, but would deliver present value benefits of $30.2 billion, a 25 to 1 benefit-cost ratio.

ITS investment key to the economy

Ezell 10 (Stephen Ezell, senior analyst with the information technology and innovation foundation (itif), Explaining International IT Application Leaderhip:Intelligent Transportation Systems, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf)

Intelligent transportation systems boost productivity and expand economic and employment growth. By improving the performance of a nation’s transportation system, thus ensuring that people and products reach their appointed destinations as quickly and efficiently as possible, ITS can enhance the productivity of a nation’s workers and businesses and boost a nation’s economic competitiveness. Many transportation agencies already use ITS effectively to reduce traffic congestion and its nearly $200 billion estimated annual impact on economic producitivty and the environment. 61 A 2009 Reason Foundation study found that reducing congestion and increasing travel speeds enough to improve access by 10 percent to key employment, retail, education, and population centers within a region increases regional production of goods and services by one percent. The study reported that achieving “freeflow traffic conditions” (that is, reducing congestion) around key urban and suburban destinations in eight U.S. cities—Atlanta, Charlotte, Dallas, Denver, Detroit, Salt Lake City, the San Francisco Bay Area, and Seattle—could boost the economies in those cities alone by $135.7 billion and generate close to $9 billion in new tax revenues. 62 ITS deliver other economic benefits as well. They can help mitigate the $230 billion annual economic impact—equivalent to nearly 2.3 percent of U.S. GDP— of traffic accidents and associated injuries or loss of life. The Eddington Commission in the United Kingdom estimated the effects of congestion pricing on freight and found commercial services industries would be net beneficiaries. 63 It also noted that businesses, in particular, accrue significant net gains from road pricing and that these cost savings get passed on to consumers in the form of lower prices. ITS will also be an important growth industry over the next 25 years. Scholars predict that, over a 20-year horizon (1997 to 2017), the cumulative global market for ITS-related products and services will reach $420 billion. 64 A number of countries, including South Korea, Germany, and Japan, view intelligent transportation systems as a key industrial sector, capable of generating considerable export-led economic and employment growth. 65 The U.S. Department of Transportation has estimated that the field of ITS could create almost 600,000 new jobs over the next 20 years. 66 A 2009 ITIF study found that a £5 billion investment in intelligent transportation systems in the United Kingdom would support approximately 188,500 new or retained jobs for one year. 67 Nations that lead in ITS deployment are also likely to be international leaders in ITS job creation and to create economic export and competitiveness advantage for themselves.

ITS key to stimulate the economy – congestion, productivity, GDP increases and employment

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Intelligent transportation systems boost productivity and expand economic and employment growth. By improving the performance of a nation’s transportation system, thus ensuring that people and products reach their appointed destinations as quickly and efficiently as possible, ITS can enhance the productivity of a nation’s workers and businesses and boost a nation’s economic competitiveness. Many transportation agencies already use ITS effectively to reduce traffic congestion and its nearly $200 billion estimated annual impact on economic producitivty and the environment. 61 A 2009 Reason Foundation study found that reducing congestion and increasing travel speeds enough to improve access by 10 percent to key employment, retail, education, and population centers within a region increases regional production of goods and services by one percent. The study reported that achieving “freeflow traffic conditions” (that is, reducing congestion) around key urban and suburban destinations in eight U.S. cities—Atlanta, Charlotte, Dallas, Denver, Detroit, Salt Lake City, the San Francisco Bay Area, and Seattle—could boost the economies in those cities alone by $135.7 billion and generate close to $9 billion in new tax revenues. 62 ITS deliver other economic benefits as well. They can help mitigate the $230 billion annual economic impact—equivalent to nearly 2.3 percent of U.S. GDP— of traffic accidents and associated injuries or loss of life. The Eddington Commission in the United Kingdom estimated the effects of congestion pricing on freight and found commercial services industries would be net beneficiaries. 63 It also noted that businesses, in particular, accrue significant net gains from road pricing and that these cost savings get passed on to consumers in the form of lower prices. ITS will also be an important growth industry over the next 25 years. Scholars predict that, over a 20-year horizon (1997 to 2017), the cumulative global market for ITS-related products and services will reach $420 billion. 64 A number of countries, including South Korea, Germany, and Japan, view intelligent transportation systems as a key industrial sector, capable of generating considerable export-led economic and employment growth. 65 The U.S. Department of Transportation has estimated that the field of ITS could create almost 600,000 new jobs over the next 20 years. 66 A 2009 ITIF study found that a £5 billion investment in intelligent transportation systems in the United Kingdom would support approximately 188,500 new or retained jobs for one year. 67 Nations that lead in ITS deployment are also likely to be international leaders in ITS job creation and to create economic export and competitiveness advantage for themselves.

Natural Disasters Advantage

ITS is key to emergency operations during natural disasters

Torin Monahan, Associate Professor of Department of Human & Organizational Development @ Vanderbilt University, 2007 “WAR ROOMS” OF THE STREET: SURVEILLANCE PRACTICES IN TRANSPORTATION CONTROL CENTERS”, http://torinmonahan.com/papers/war\_rooms.pdf; AB

Although ITS officials draw clear lines of demarcation between the functions of their systems and those of law enforcement, as this article will show, in practice these lines are quite blurred and likely the functions will continue to converge. Mainly, the systems are interlinked and accessible by personnel beyond the specific control center with jurisdiction, whether for traffic control or public safety purposes. Some operators also relate stories of listening to police radios while performing their traffic management duties and assisting police officers in locating suspects. Finally, many ITS centers have been slated as “emergency operations centers” to manage evacuation procedures or coordinate response teams in the event of terrorist attacks or natural disasters. The systems are always, if latently, oriented toward national security, such that the operators routinely monitor “critical infrastructure,” such as bridges and tunnels, for suspicious activity (White House, 2003).

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#### ITS is key to disaster response – multiple warrants Simmons 3 (Lee Simmons, Program Manager, National ITS Architecture, National ITS Architecture Team, July 15, 2003, <http://ntl.bts.gov/lib/jpodocs/repts_pr/14064.html#_Toc46037015>)

The following major ITS functions support disaster response and evacuation, addressing the user needs identified in Chapter 2. Each major function (in bold) is further explained with more detailed descriptions and narrative text.¶ 3.2 Disaster Response¶ Coordinate Response Plans. Emergency response strategies and plans are developed and coordinated in advance of a disaster. Operational plans are developed and coordinated across agencies and jurisdictions in advance of a disaster and during the disaster response/recovery.¶ Monitor Alert Levels. As the likelihood of a natural disaster or terrorist attack increases, plans are executed, systems are brought on-line, resources are staged, and personnel assignments are made to increase readiness. Information from alerting and advisory systems such as the Homeland Security Advisory System and the National Hurricane Center are monitored and the transportation system is prepared to respond. For example, Emergency Operations Centers may be activated and transportation personnel assigned to those centers.¶ Detect and Verify Emergency. Although they are not a primary point of detection, transportation agencies may be among the first to identify and report a disaster due to the broad distribution of transportation personnel and surveillance systems. Once detected, the system must verify the emergency, identify potential hazards, define the impact area, and notify public safety and other allied response agencies. Conversely, an emergency notification system is used to alert transportation agencies to disasters that have been identified by other means. ¶ Assess Infrastructure Status. The impact of the disaster on transportation infrastructure and associated ITS systems must be assessed using asset management systems, surveillance systems and sensors, built-in diagnostics of the systems themselves, on-scene reports, and inspections. Damage is assessed and detours or alternative transportation resources are identified.¶ Coordinate Response. Information is shared with the emergency operations centers and incident command during the course of the disaster response. This coordination continues as the initial response is completed and transitions into recovery. The transportation system provides information on egress and ingress routes for the scene and staging areas, routes for specific origins and destinations on request, transportation system condition information including video surveillance information, and information on transportation resources and personnel that are available, en-route, or deployed at the scene. Transportation resources include construction and maintenance equipment used at the scene and transit vehicles that may be used to move emergency response personnel to and from the scene. The public safety systems provide current situation information and make requests for resources and information.¶ Critical Service Restoration. Critical transportation and utility services damaged by the disaster are restored. Emergency maintenance and construction activities are planned, coordinated, and initiated. Emergency access to right-of-way, permits, and needed equipment and resources are coordinated as necessary to support restoration of critical public works (e.g., utilities).¶ Manage Area Transportation. Depending on the nature of the emergency and the status of the infrastructure, closures and detours may be implemented and transit schedules may be modified. Closures may exclude all vehicles except for emergency vehicles or other special vehicles. Special traffic control strategies to manage traffic in the vicinity of the disaster may be implemented to limit and/or manage traffic in the area.¶ Provide Traveler Information. The transportation system will coordinate with public information offices of the allied emergency response agencies in providing traveler information for the disaster scene and surrounding area. Information provided would include information on special traffic restrictions, detours and closures, special transit schedules, and traffic conditions surrounding the scene. Information on care facilities, shelters, and evacuation information is also provided, as covered in the next section.¶ 3.3 Evacuation Coordination¶ Evacuation Planning Support. Federal, state, and local transportation, emergency, and law enforcement agencies can be involved in evacuation planning, depending on the scale of the disaster and the evacuation. The evacuation plan may evacuate the affected population in shifts, use more than one evacuation route, maximize use of transit, and include several evacuation destinations to spread demand and thereby expedite the evacuation, where possible. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, or along the evacuation route must be informed of the plan.¶ Evacuation Traveler Information. The public must be provided with real-time evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary. Once the decision is made to evacuate, evacuation times, one or more evacuation destinations, the evacuation route (tailored for the evacuee), available transit services, expected travel times, expected evacuation durations, and other information are provided that are necessary for an orderly evacuation. This function will also provide guidance for returning to evacuated areas, information regarding clean-up, and other pertinent information to be distributed from Federal, State, and Local Agencies. ¶ Information on the services (shelters, medical services, hotels, restaurants, gas stations) along the evacuation route and at the evacuation destination are also important to the evacuee and should include real-time information on availability and address special needs (disabilities, the elderly, pets/livestock, etc.). Real-time information on traffic conditions, closures, road and weather conditions, and incident information are also provided along with information on alternative routes so that evacuees can better anticipate their travel times and select alternate routes where available.¶ Evacuation Traffic Management. Special traffic control strategies are implemented to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Incident management on the evacuation route is paramount with critical need for service patrols to minimize the traffic flow impact of minor incidents. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Toll and transit agencies must also be notified so that tolls and fares are eliminated during an evacuation. Traffic control strategies are also implemented to facilitate reentry to the evacuated area. ¶ Evacuation Resource Sharing. An effective information sharing service is implemented that keeps all agencies in all affected jurisdictions appraised of the evacuation plan and evacuation status. Resources are coordinated through the same information sharing capability. Resource requirements are accurately forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times. Current status of all resources are tracked so that resource status is known at all times.

#### ITS de-escalates the impacts of a disaster IBI Group 6 (IBI Group, a multi-disciplinary architecture, engineering, consulting and design firm, http://psrc.org/assets/523/ITSfinal.pdf, August 21, 2006)

Major freeway accidents, natural disasters and terror alerts are some of the emergencies and¶ disasters that may require activation of local emergency communications centers and coordination¶ between transportation and emergency management agencies. On a day-to-day basis, traffic management and emergency response agencies (local police/fire and Washington State Patrol)¶ work together to detect, respond to, and mitigate resulting congestion from traffic incidents.¶ Significant transportation infrastructures around the region could be considered “critical” in that the¶ region would be severely impacted if they were to be incapacitated or destroyed. The recognition of¶ these vital structures has been documented in critical transportation infrastructure studies¶ undertaken by WSDOT, King County and others. These assessments of critical infrastructure bring¶ together traffic, transit and emergency management agencies to assess the region’s capability to¶ manage the flow of people and goods in the event of a major disaster.¶ There are a variety of entities throughout the region that must have an active role to accomplish a¶ coordinated response to traffic incident and emergency/disaster situations. From an emergency¶ management perspective, the following stakeholders have been identified:¶ • WSDOT Incident Response¶ • Local Police and Fire¶ • Washington State Patrol¶ • Federal Emergency Response and Security agencies¶ • State, County, and City Emergency Operations CentersDepending on the level of jurisdiction (state, county, local), different relationships between traffic¶ management and emergency management occur. There is a need for future work to develop¶ Incident Management plans to lead the way in developing regional agreements for incident¶ response and for implementing reliable, interoperable communications systems. In general several¶ relationships have been identified as being necessary to support the Emergency Management¶ function. These are:¶ Traffic and Transit Management to Emergency Management: This relationship consists of traffic¶ information sharing, requests from Emergency Management for transit service changes, ITS device¶ status and requests for specific messages to be posted to DMS or HAR, coordination of road¶ closures and detours, traffic camera images or control, and other information as required to¶ implement a coordinated response.¶ Traffic Management to Traffic Management: For some incidents, multiple traffic management¶ agencies will need to coordinate a response. This coordination would include exchanging incident¶ information, response plan implementation, and video surveillance.¶ Emergency, Transit or Traffic Management to Information Service Provider: This relationship¶ will involve the sharing of traffic condition and incident information with the regional or local¶ Information Service Provider (ISP) for dissemination to the general public.¶ The following types of information will be shared:Video: Traffic camera video feeds may be shared with emergency management agencies.¶ Data: Data sharing will include ongoing incident information updates and response plans.¶ Control: Limited control-sharing agreements may be implemented that would allow non-traffic¶ agencies access to ITS devices. For example, the Washington State Patrol (WSP) can control¶ WSDOT cameras.Request: Emergency Management agencies may request that Traffic Management Center¶ personnel move a camera or post an alert message to a DMS or HAR.¶ Status: Device status alerts will notify agency personnel of the status of devices such as reversible¶ lanes and dynamic message signs.

#### Storms increasing now Kerchner et al 6 (Michel Masozeraa,, Melissa Bailey, Charles Kerchner, Gund Institute for Ecological Economics, The University of Vermont, Rubenstein School of Environment and Natural Resources, Johnson, Master of Public Administration Program, The University of Vermont, Department of Community Development and Applied Economics, The University of Vermont, 8 June 2006, http://www.d.umn.edu/~pfarrell/Natural%20Hazards/Readings/Katrina%20article.pdf)

Natural disasters are becoming more frequent, expensive and¶ threatening worldwide. The global economic cost associated¶ with natural disasters has increased 14-fold since the 1950s¶ (Guha-Sapir et al., 2004). The impacts of natural disasters are¶ unevenly distributed among nations, regions, communities¶ and individuals as a result of differential exposures and¶ vulnerabilities (Clark et al., 1998).¶ During the last decade disasters caused an estimated¶ average of US$67 billion/year in damage, with a maximum of¶ US$230 billion and a minimum of US$28 billion worldwide.¶ According to May and Deyle (1998), natural disasters in the¶ United States cause, on average, US$20 billion annually in¶ direct costs to government, the insurance industry, and¶ victims; these costs are continuing to escalate. The United¶ States (US) is seeing the costs of natural disasters increase¶ because people have been migrating towards the coasts,¶ which are more at risk to be hit by natural disasters, and the¶ value of people's possessions has increased (Board on Natural¶ Disasters, 1999).¶ Increased human and economic costs are associated with¶ an increase in frequency of natural disasters and associated¶ damages in the United States. This is part of a worldwide trend, which reflects changing climate patterns. Analysis of¶ hurricane characteristics in the North Atlantic has shown an¶ increase in hurricane frequency and intensity since 1995¶ (Goldenberg et al., 2001; Elsner and Kocher, 2000; Webster¶ et al., 2005; Emanuel, 2005). During the hurricane season of¶ 2004, there were fourteen named storms in the North Atlantic,¶ nine of which achieved hurricane intensity. Four of these¶ hurricanes struck the southeast United States, causing¶ considerable damage and disruption (Webster et al., 2005).¶ During the 2005 hurricane season there were twenty-seven¶ named storms, thirteen of which reached hurricane status;¶ this set new records for both the number of named storms and¶ the number of hurricanes (Pastor et al., 2006). The recent event¶ of Hurricane Katrina was among the deadliest natural¶ disasters in recent US history with more than 1000 fatalities.¶ Much of the damage caused by Katrina is attributed to the¶ flooding that occurred in the City of New Orleans in the days¶ following the hurricane.¶ Understanding the distributional impacts of natural disasters¶ across income groups in a given city or community is¶ critical for planning, mitigation and recovery from natural¶ disasters. Although there has been some refocusing of policy in¶ the last 15 years, from relief assistance to an emphasis on¶ mitigation (Changnon and Easterling, 2000), the overall trend¶ in disaster management has been to invest in natural disaster¶ response (Board on Natural Disasters, 1999), rather than on¶ mitigating pre-existing social vulnerabilities. While response¶ and recovery have been the main strategies for many¶ countries, including the US, and are critically important for¶ humanitarian, economic and political purposes, they must be¶ accompanied by increasing attention to reducing losses¶ through effective mitigation programs (National Research¶ Council, 1997). Therefore, improving mitigation and preparedness¶ for natural disasters requires knowledge of how and why¶ certain groups are vulnerable.¶ The objective of the paper is to understand and assess the¶ distribution of the impacts of Hurricane Katrina across income¶ groups in New Orleans and the socio-economic factors that¶ contribute to vulnerability. Specifically, we investigate the¶ vulnerability of different socio-economic groups during: 1) the¶ hurricane event and subsequent flooding; and 2) the response¶ and recovery phases. Response to natural disaster “includes¶ both the short-termemergency actions taken by police, fire, and¶ other agencies aswell as the longer-termactions taken tomeet¶ needs for food, shelter, rebuilding andrestorationof the affected¶ community” (Board on Natural Disasters, 1999, P. 1944). In this¶ paper we refer to the long-term actions of rebuilding as the¶ recovery phase.

#### Specifically the poor are the most vulnerable – disasters exacerbate poverty Kerchner et al 6 (Michel Masozeraa,, Melissa Bailey, Charles Kerchner, Gund Institute for Ecological Economics, The University of Vermont, Rubenstein School of Environment and Natural Resources, Johnson, Master of Public Administration Program, The University of Vermont, Department of Community Development and Applied Economics, The University of Vermont, 8 June 2006, http://www.d.umn.edu/~pfarrell/Natural%20Hazards/Readings/Katrina%20article.pdf)

Vulnerability in the context of natural disasters is the capacity¶ to anticipate, copewith, resist, and recover from the impact of a¶ natural disaster (Adger, 1999). High levels of vulnerability and¶ low adaptive capacity have been linked to a range of factors that¶ include access and distribution of resources, technology,¶ information, and wealth; risk perceptions; social capital and¶ community structure; and the existing formalized institutional¶ framework which organize warning, planning and other¶ services (Dolan and Walker, 2003). When a disaster hits, some¶ individuals are less affected, or may even benefit, while other¶ individuals may suffer significant or even catastrophic losses¶ depending onwhere they have settled. Cutter et al. (2000) noted¶ that while economic losses might be large in areas of high¶ biophysical risk, the resident population may also have greater¶ safety nets such as insurance and additional financial resources¶ to absorb and recover fromthe loss quickly. Thus, vulnerability¶ to natural disasters is a combined function of exposure (risk of¶ experiencing a disaster event) and the ability to cope.¶ Although the highest magnitude of economic damage is¶ often born by wealthier populations, due to possessions of¶ higher value, the relative impact is generally greater for lowincome¶ groups. For people who cannot afford the costs of¶ repair, reconstruction, or relocation, it may take years to¶ recover from the aftermath of disasters. In addition, the¶ effects of a disaster may persist to the next generation because¶ of a lack of resources to recover (Adger, 1996). By focusing on¶ magnitude, traditional risk assessment fails to account for the¶ higher relative burden born by low income populations.¶ Arecent review of studieson the relationship between poverty¶ and disasters in theUS by Fothergill and Peek (2004) revealed that¶ socio-economic status is a significant predictor of the physical¶ and the psychological impacts in the pre- and post-disaster¶ stages. According to these studies, the poor aremore likely to die,¶ suffer from injuries, have proportionately highermaterial losses;¶ have more psychological trauma; and facemore obstacles during¶ the phases of response, recovery, and reconstruction.¶ Watts and Bohle (1993), Blaikie et al. (1994), Kelly and Adger¶ (2000) argue that people's vulnerability to natural hazards is¶ determined not so much by the event itself, but rather is a¶ function of social conditions and historical circumstances.¶ Thus, protection from the social forces that create inequitable¶ exposure to risk becomes just as important, if not more so,¶ than protection from natural hazards (Hewitt, 1983).¶ The ability to respond to and cope with the impacts of¶ natural disaster is a function of socio-economic as well as¶ biophysical factors. Table 1 summarizes the social and¶ economic characteristics that influence human vulnerability¶ at both individual and community levels.¶ Lack of access to economic or human resources or knowledge¶ can limit the ability of some socio-economic groups to¶ respond adequately to a disaster. Groups who traditionally¶ experience low socio-economic status include minorities,¶ woman-headed households, the elderly, the unemployed, the¶ illiterate or uneducated, the ill or handicapped. In addition,¶ racial and ethnic minorities may be excluded from lines of¶ communication and action due to cultural or language barriers.¶ Housing status, whether renting or owning property, can¶ also limit an individual's ability to respond to natural disaster.¶ According to Bullard and Wright (2005) home ownership is a¶ cushion against inflation, the cornerstone of economic wealth¶ creation, and a long-termasset that can secure advantages and¶ transfer across generations of material wealth and security.¶ Home ownership is a critical pathway for “transformative”¶ assets, inherited wealth that lifts a family beyond their own¶ achievement. Low-income households tend to rent rather than¶ own their homes. In addition, the type and quality of housing¶ affect the potential for damage. Low-income residents tend to¶ occupy mobile homes and poorly constructed or maintained stick-built homes,which are easily destroyed or damaged in the¶ event of a natural disaster (Pastor et al., 2006).¶ As a result of the combination of these factors, low-income¶ households and communities are more vulnerable to natural¶ disasters than wealthier ones; they tend to live in more¶ hazardous places, have less protection, and have fewer¶ reserves, insurance, and alternatives. People living in poverty¶ or with inadequate resources may be less likely to perform¶ necessary actions to mitigate the effects of hazardous agents¶ because of a lack of a sense of personal control over potential¶ outcomes (Vaughan, 1995). Community-level factors, such as¶ urban versus rural setting, infrastructure, medical services,¶ and available social services also affect hazard vulnerability¶ (Cutter et al., 2001).

Congestions Advantage – Internal Link

ITS solves congestion – data awareness

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Indeed, reducing traffic congestion is one of the principal benefits of ITS. American commuters spend five days per year (a full work week) stuck in traffic, a total of 4.2 billion hours per year, wasting over 2.8 billion gallons of fuel. 4 0 When the impacts on lost productivity, unreliability, cargo delay, and safety are considered, the U.S. Department of Transportation’s chief economist concludes that congestion’s toll on the U.S. economy amounts to up to $168 billion each year. 41 In the United States, congestion costs have been growing at 8 percent per year. 42 Over the next 20 years, the cost of congestion could amount to $890.5 billion, or 4.3 percent of the value of the entire national economy. 43 At current rates, congestion in the United States is expected to become so severe by 2030 that 58 urban areas will have regional congestion levels high enough to qualify as “severe” (up from 28 in 2003.) 4 4 European Union countries experience 7,500 kilometers of traffic jams every day on their roads, with ten percent of the EU’s road network affected by congestion. 45 In fact, 24 percent of Europeans’ driving time is spent in traffic congestion, 46 at a yearly cost of one percent of the European Union’s GDP. 47 Australia annually suffers $12.5 billion in costs due to urban congestion. In Japan, congestion costs the nation 3.5 billion man-hours, worth almost ¥11 trillion ($109 billion) each year. 48 Deploying intelligent transportation systems has been shown to have a significant and direct impact on reducing congestion. South Korea found that in the initial cities in which it deployed intelligent transportation systems, average vehicle speed increased 20 percent and delay time at critical intersections decreased 39 percent. Experts predict that, in the United States, traffic jams can be reduced as much as 20 percent by 2011 in areas that use ITS. 49 ITS-enabled variable or congestion pricing can also reduce congestion. According to recent research, a comprehensive pricing approach that incorporates variable pricing tied to travel demand levels (such as congestion pricing) could provide significant congestion benefits. One study estimated that region-wide congestion pricing could reduce peak travel by 8 to 20 percent. 50 A Brookings Institution study estimated that congestion pricing on the nation’s Interstates and other freeways would reduce total vehicle miles traveled by 11 to 19 percent. 51 And a Federal Highway Administration (FHWA) report looking at results from its Value Pricing Pilot Program, which implemented tolling on a number of facilities nationwide, found that even targeted pricing can have a number of effects on driver behavior and traffic volumes, including changes in times, routes, or modes of travel; willingness to pay for faster travel times by traveling on toll lanes; reductions in peak-period traffic volumes; and more-efficient use of highway capacity

Collisions Advantage – Internal Link

IST allows for vehicle to infrastructure integration – solves collisions

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Vehicle-to-infrastructure integration is the archetype for a comprehensively integrated intelligent transportation system. In the United States, the objective of the VII Initiative—as of January 2009 rebranded as IntelliDrive SM —has been to deploy and enable a communications infrastructure that supports vehicle-toinfrastructure, as well as vehicle-to-vehicle, communications for a variety of vehicle safety applications and transportation operations. 23 IntelliDrive envisions that DSRC-enabled tags or sensors, if widely deployed in vehicles, highways, and in roadside or intersection equipment, would enable the core elements of the transportation system to intelligently communicate with one another, delivering a wide range of benefits. For example, IntelliDrive could enable cooperative intersection collision avoidance systems (CICAS) in which two (or more) DSRC-equipped vehicles at an intersection would be in continuous communication either with each other or with roadside devices that could recognize when a collision between the vehicles appeared imminent (based on the vehicles’ speeds and trajectories) and would warn the drivers of an impending collision or even communicate directly with the vehicles to brake them. 24 IntelliDrive, by combining both vehicle-to-vehicle and vehicle-to-infrastructure integration into a consolidated platform, would enable a number of additional ITS applications, including adaptive signal timing, dynamic re-routing of traffic through variable message signs, lane departure warnings, curve speed warnings, and automatic detection of roadway hazards, such as potholes, or weather-related conditions, such as icing. 25

ITS solves collisions – saves millions of lives

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

Intelligent transportation systems can deliver important safety benefits. There are 1.2 million fatalities annually on the world’s roadways. In 2007, a traffic accident occurred every five seconds in the United States (totaling over 6 million accidents), with a traffic fatality occurring every 13 minutes, killing 41,059 Americans and causing approximately 2.6 million injuries. (In 2008, 5.8 million crashes led to 37,261 fatalities.) 29 European Union countries experience a similar number of accidents and fatalities, with 42,943 deaths on European Union roadways in 2006. 30 Japan experienced 887,000 traffic accidents in 2006, injuring 1.1 million victims and causing 6,300 fatalities. 31 A wide range of ITS-based applications—from real-time traffic alerts, to cooperative intersection collision avoidance, to on-vehicle systems such as anti-lock braking, lane departure, collision avoidance, and crash notification systems—have safety as a principle focus. For example, a study of ramp metering in Minneapolis, Minnesota, found that metering reduced total crashes on area roadways between 15 and 50 percent. 32 The U.S. IntelliDrive system could potentially address 82 percent of the vehicle crash scenarios involving unimpaired drivers. 33 In fact, intelligent transportation systems are leading to a fundamental rethinking of vehicle safety. Over the past 50 years, most of the developments in transportation safety—such as the mandatory installation and use of seat belts in the 1970s and the installation of airbags in the 1980s—were designed to protect passengers in the event of a crash. But as Peter Appel, the current Administrator of the U.S. Department of Transportation’s (DOT) Research and Innovative Technology Administration (RITA), notes, “All of those technologies assumed there would be a crash. However, much of the work in the next 50 years will be about avoiding the crash altogether and for that [systems like] IntelliDrive have dramatic potential.” 34

Terrorism Advantage

ITS allows for monitoring of critical infrastructure in the event of terrorists

Torin Monahan, Associate Professor of Department of Human & Organizational Development @ Vanderbilt University, 2007, “WAR ROOMS” OF THE STREET: SURVEILLANCE PRACTICES IN TRANSPORTATION CONTROL CENTERS”, http://torinmonahan.com/papers/war\_rooms.pdf; AB

Although ITS officials draw clear lines of demarcation between the functions of their systems and those of law enforcement, as this article will show, in practice these lines are quite blurred and likely the functions will continue to converge. Mainly, the systems are interlinked and accessible by personnel beyond the specific control center with jurisdiction, whether for traffic control or public safety purposes. Some operators also relate stories of listening to police radios while performing their traffic management duties and assisting police officers in locating suspects. Finally, many ITS centers have been slated as “emergency operations centers” to manage evacuation procedures or coordinate response teams in the event of terrorist attacks or natural disasters. The systems are always, if latently, oriented toward national security, such that the operators routinely monitor “critical infrastructure,” such as bridges and tunnels, for suspicious activity (White House, 2003).

Highways Advantage

ITS reduces the need to build additional highways

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ITS improve the performance of a country’s transportation network by maximizing the capacity of existing infrastructure, reducing the need to build additional highway capacity. Maximizing capacity is crucial because, in almost all countries, increases in vehicle miles traveled dramatically outstrips increases in roadway capacity (and in many countries there is either little more room to build, little political will to build, or both). For example, from 1980 to 2006 in the United States, the total number of miles traveled by automobiles increased 97 percent, but over the same time the total number of highway lane miles grew just 4.4 percent, meaning that over twice the traffic in the United States has been traveling on essentially the same roadway capacity. 35 A number of ITS applications contribute to enhancing the operational performance of transportation networks. For example, traffic signal light optimization can improve traffic flow significantly, reducing stops by as much as 40 percent, cutting gas consumption by 10 percent, cutting emissions by 22 percent, and reducing travel time by 25 percent. 36 Applying real-time traffic data could improve traffic signal efficiency by 10 percent, saving 1.1 million gallons of gas a day nationally and cutting daily carbon dioxide emissions by 9,600tons. 37 Ramp metering can increase vehicle throughput (the number of cars that pass through a road lane) from 8 to 22 percent and increase speeds on roads from 8 to 60 percent. 38 As up to 30 percent of congestion on highways occurs at toll stops, deploying electronic toll collection systems can significantly reduce congestion. Assessing the impact of intelligent transportation systems, including ramp metering, incident management, traffic signal coordination, and arterial access management, a September 2005 Government Accountability Office (GAO) study found that ITS deployments to date had reduced delays in 85 urban areas by 9 percent (336 million hours), leading to a $5.6 billion reduction in annual costs due to reduced fuel consumption and hours of delay. 3

Mass Transit Advantage

ITS is key to public transportation systems

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Advanced Public Transportation Systems (APTS) include applications such as automatic vehicle location (AVL), which enable transit vehicles, whether bus or rail, to report their current location, making it possible for traffic operations managers to construct a real-time view of the status of all assets in the public transportation system. APTS help to make public transport a more attractive option for commuters by giving them enhanced visibility into the arrival and departure status (and overall timeliness) of buses and trains. This category also includes electronic fare payment systems for public transportation systems, such as Suica in Japan or T-Money in South Korea, which enable transit users to pay fares contactlessly from their smart cards or mobile phones using near field communications technology. 22 Advanced public transportation systems, particularly providing “next bus” or “next train information, are increasingly common worldwide, from Washington, DC, to Paris, Tokyo, Seoul, and elsewhere.

Hazmat Advantage

Crashes kills billions – SQ uses flawed impact modeling, means you prefer this ev.  
Barry et al 5

(Spraggins, H. Barry, Ozment, John, Fanchon, Phillip, Journal of Academy of Business and Economics, published by International Academy of Business and Economic, 03/01/2005, Source Volume: 5 Source Issue: 3, <http://www.freepatentsonline.com/article/Journal-Academy-Business-Economics/149213917.html>)lgk

Railroads are an essential component of our transportation economy. Some 40% of all intercity freight goes by rail, including 67% of the coal used by electric utilities to produce power and 20% of the chemicals (USDOT, 2005; AAR, 2005a). There are thousands of chemicals in use today and many more are being introduced all of the time. Railroads carry an even higher percentage of those chemicals essential to the public health and standard of living for the United States. Chlorine, for example, used to purify the nation's water supplies has significant rail movements (AAR, 2005b). Vast quantities of these hazardous substances are being moved by rail alone. Due to the nature of most chemicals, they can pose hazards of explosion, toxic release, and fire. The transportation of these hazardous materials is an important problem due to their pervasiveness. Hazardous materials, or dangerous goods, include explosives, gases, flammable liquids and solids, oxidizing substances, poisonous and infectious substances, radioactive materials, corrosive substances, and hazardous wastes. The fact that the volume of hazardous materials moving by rail more than doubled since 1980 indicates that rail has become an integral part of the tremendous increase in the transport of hazardous materials. Nearly 155 million tons of chemicals are being transported by rail in North America each year which constitutes 1.75 million rail cars of hazardous materials (D'Amico, 2001). The risk associated with a release of these materials during transportation is what differentiates rail shipments of hazardous materials from rail shipments of other materials. Hazardous materials can be extremely harmful to the environment and to human health since exposure to their toxic chemical ingredients could lead to the injury or death of humans, plants, and animals. The events which have traditionally given rise to hazard during rail transportation are container failure or the impact due to collisions. However, on October 24, 2002 the FBI issued a warning, based on information obtained from al-Qaida prisoners, which said terrorists may try to destroy bridges or key sections of railroad infrastructure and tracks. In its warning, the FBI said captured al-Qaida photographs of U.S. railroad engines, cars and crossings increased the agency's concern about the threat. The 140,000 mile network of rail tracks, bridges, and terminals, more than three times the Interstate Highway System, presents a huge security challenge. Much of the network is in isolated areas where fencing is neither practicable nor effective. Intelligence officials continue to believe that aI-Qaida plans to attack targets such as railroads that would be readily recognized as representing U.S. economic interests. In sum, security has placed a new dimension of concern on the rail system across the country. Terrorism must now be added to the risk equation. Models dealing with hazardous materials rail transportation problems must deal with uncertainties when assessing risks, because data are often sparse and of questionable quality. Uncertainties also arise because researchers frequently encounter estimating very small probabilities associated with events which may have never occurred such as terrorist attacks. Thus, a model which explicitly recognizes uncertainty is preferable to one which does not. However, building stochastic models is significantly more difficult than building deterministic ones, and the bulk of work to date has been of the deterministic variety (List, et al., 1991).

Crashes escalate – industry collapse and inhalation

Ellis et al 10

(Lewis M. Branscomb: Professor Emeritus, Harvard University and Adjunct Professor, University of California, San Diego, Mark Fagan:Senior Fellow, Mossavar-Rahmani Center for Business and Government, Harvard Kennedy School, Harvard University, Philip Auerswald: Professor, George Mason University, Ryan N. Ellis: Ph.D. Candidate, Department of Communication, University of California, San Diego Raphael Barcham: Research Assistant, Harvard Kennedy School, Harvard University, Belfer Center Discussion Paper #2010-01

Science, Technology, and Public Policy Program, Harvard Kennedy School, February 2010, <http://belfercenter.ksg.harvard.edu/files/Rail-Transportation-of-Toxic-Inhalation-Hazards-Final.pdf>)

Hazardous materials — industrial materials that are flammable, corrosive, toxic, explosive, or infectious — play a vital role in the U.S. economy. They are used by industries from farming and mining to manufacturing and pharmaceuticals, in the form of fertilizers, raw materials, fuels, and other essential inputs. Of all hazardous materials, toxic inhalation hazards (TIH) may be among the most dangerous. 1 Chlorine gas and anhydrous ammonia are the most common TIH chemicals; others include sulfur dioxide, ethylene oxide, and hydrogen fluoride, and a variety of other products that are important manufacturing inputs. 2 After the terrorist attacks of September 11, 2001, the security of hazardous materials became increasingly salient in public concern and political debate. Release of toxic inhalation hazards, whether the result of attack or accident, could result in devastating consequences. Many hazardous chemicals are transported over long distances by rail, during which they are particularly vulnerable. 3 Safety from accidents as well as security against attack are of concern. Toxic inhalation hazards were involved in a number of deadly rail accidents in the early part of this decade. They could have been far worse: all of the TIH accidents we describe in this paper occurred at night in areas of relatively sparse population, limiting the number of people exposed to the effects of the chemicals. A daylight TIH release in a densely populated area could have catastrophic consequences.

Crashes escalates – collapses industry and chems spread through air

Ellis et al 10

(Lewis M. Branscomb: Professor Emeritus, Harvard University and Adjunct Professor, University of California, San Diego, Mark Fagan:Senior Fellow, Mossavar-Rahmani Center for Business and Government, Harvard Kennedy School, Harvard University, Philip Auerswald: Professor, George Mason University, Ryan N. Ellis: Ph.D. Candidate, Department of Communication, University of California, San Diego Raphael Barcham: Research Assistant, Harvard Kennedy School, Harvard University, Belfer Center Discussion Paper #2010-01

Science, Technology, and Public Policy Program, Harvard Kennedy School, February 2010, <http://belfercenter.ksg.harvard.edu/files/Rail-Transportation-of-Toxic-Inhalation-Hazards-Final.pdf>)

TIH chemicals are among the most dangerous hazardous materials because they are very toxic and they can spread easily in the air if released. Nonetheless, TIH chemicals are economically essential. Over $660 billion worth of hazardous materials were transported in the United States in 2002, the latest year for which comprehensive data are available, with each shipment moving an average of 136 miles. 4 Without the movement of these hazardous materials, gas stations would close, crop yields would diminish, potable water prices would rise, and many manufacturing activities would come to a halt. We focus in this paper on two of the most extensively used TIH products, chlorine and anhydrous ammonia. Chlorine gas is used for purifying potable and waste water at treatment plants throughout the country and is also used as a chemical intermediary in various manufacturing processes, for products ranging from PVC pipes to shampoo. 5 Anhydrous ammonia is the nation’s dominant commercial fertilizer and is applied extensively throughout the country’s main agricultural regions, particularly the Midwest farm states.

Even one railroad crash causes the impact – routes are small and in populated areas

Ellis et al 10

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Science, Technology, and Public Policy Program, Harvard Kennedy School, February 2010, <http://belfercenter.ksg.harvard.edu/files/Rail-Transportation-of-Toxic-Inhalation-Hazards-Final.pdf>)

Producer-consumer geographical relations are also complicated. Chlorine, for example, is produced at chemical plants mostly concentrated in the southeast part of the country (see Figure 1) from which it is shipped to customer sites, such as water purification plants and other chemical plants. There are some cases in which chlorine is both produced and used at the same plant; this avoids exposure over long shipping times and distances. A chlorine user can sometimes also persuade a manufacturer to relocate nearby, in order to reduce transportation costs and risks. The use of chlorine in large chemical plants and at water treatment sites results in a limited number of nodes in the transportation network (in contrast to the dispersed usage patterns of ammonia-based fertilizers described below). Even so, chlorine tank cars must travel significant distances. A tank car typically carries 90 tons of liquid chlorine. As Figure 1 shows, chlorine production is concentrated along the Gulf Coast and in a few other locations, but it is used at water treatment facilities and manufacturing sites all over the country. Many of these facilities are located in or near large cities, requiring chlorine transport through populated areas. This creates the need for long-distance carriage and potential exposure of large populations. The economics of transportation favor rail transportation and indeed the majority of chlorine shipments in the United States are shipped by rail. The other safe and practical mode for long-distance transportation of chlorine is by barge, which is indeed considered to be safer than rail but is less available. Trucking companies are reluctant to offer long- haul chlorine transportation services 21 and since, unlike railroads, motor carriers are not subject to common-carrier obligations, they are therefore free to accept or decline shipper requests to transport TIH products or to charge very high prices (but perhaps noncompetitive) prices to do so. Due to these factors, an estimated 85 percent of longdistance chlorine movements occur by rail. 22 Ammonia is widely used throughout the main U.S. agricultural areas and thus, like chlorine, must be transported from a limited number of production and import locations to a large number of users. As Figure 2 shows, thirty-two plants in 19 states produced ammonia, with most production concentrated in Texas, Louisiana and Oklahoma, near sources of natural gas (the primary chemical feed stock for ammonia production). 23 A large quantity of ammonia travels by pipeline and barge and most local distribution to farmers occurs by truck, but rail plays a vital long-haul transportation role. 24

ITS solves – crash response   
Hamilton 98 (Booz·Allen & Hamilton, Highway & Vehicle Technology Group, Prepared for:U.S. Department of Transportation Booz·Allen & Hamilton Federal Highway Administration, <http://www.fhwa.dot.gov/publications/research/operations/its/jpo99035/fothazmat.pdf>)

The Operation Respond ITS FOT demonstrates

a HazMat identification and monitoring system

called Operation Respond Emergency

Information System (OREIS). The OREIS

software system acts as a communications

routing service between HazMat carriers and

emergency response units and as a source of

response guidelines and protocols. The project

demonstrates several advanced communication

and information handling technologies that

provide information faster and more accurately.

The goal of the test is to improve emergency

response to HazMat incidents involving motor

carriers and/or railroads.

Operation Respond provides a central point for

the dissemination of HazMat information.

Participating HazMat carriers (railroads and

motor carriers) establish a database of

information about the identification and contents

of their HazMat shipments. The database may

also contain information about how to respond

to an incident involving the shipment. Each

shipment registered in the database has an

identification code.

In the event of an incident or accident involving

a registered shipment, police and fire personnel

can quickly obtain details of the shipment

involved. The units responding to the incident

can identify the shipment either by the railroad

car ID or motor carrier ID. The police or fire

dispatcher calls the OREIS point of contact. The

dispatcher supplies the shipment code and the

OREIS software directs the request for

information to the correct carrier database. The

dispatcher then obtains the details of the

shipment and the suggested response protocol.

Knowing the details of the shipment, the first

responders can quickly request the appropriate

equipment or materials necessary to contain,

combat, or mitigate the effects of HazMat

involved in the incident.

Test personnel are evaluating the system’s

ability to improve response time to HazMat

incidents and to ensure that the appropriate

organizations and equipment respond to the

incident. They are also evaluating the system’s

ability to improve the accuracy of the

response—applying the appropriate treatment

based on a better knowledge of the materials

involved.

“Off the shelf” tech already exists – solves hazmat accdients   
 SAIC 3 (Science Applications International Corporation (SAIC), Submitted to:¶ U.S. Department of Transportation¶ ITS Joint Program Office¶ Federal Highway Administration, March 17, 2003, <http://ntl.bts.gov/lib/jpodocs/repts_te/13844.html>)

The tragic events of September 11, 2001, and the more recent events of war with Iraq during the early spring of 2003, resulted in a significant heightened level of concern from federal government officials and transportation industry members regarding the secure transport of hazardous materials (HAZMAT). These security issues focus on HAZMAT shipments as potential targets for terrorists. HAZMAT shipments through intermodal connectors, modes, and facilities are all prospective targets for domestic acts of terrorism, and pose a much greater concern to public safety than most other shipment types. HAZMAT shipments, especially fuels and chemicals, present an attractive target for terrorists due to the multiple points of vulnerability. These vulnerabilities exist at shipper, motor carrier, and shipment recipient facilities and shipment movement en route throughout the nation’s roadway infrastructure.

The Transportation Security Administration (TSA) and the Federal Motor Carrier Safety Administration (FMCSA) are seeking methods to reduce HAZMAT transportation security risks. Both agencies are proposing solutions to minimize those risks through a variety of proactive efforts. Current focus includes regulatory responses and industry outreach efforts to sensitize the HAZMAT industry to potential risks in their current HAZMAT shipment distribution chains.

Ninety-five percent of HAZMAT shipments are transported via motor carrier. Ideally, safeguards should be in place to help protect against the HAZMAT shipper, motor carrier and recipient, plus the surrounding community that would experience a direct and immediate negative economic impact following an incident. Secondary impacts may include business disruption to the transportation industry; continuing business restrictions on HAZMAT manufacturers; potential damage to financial markets; and general public pandemonium that is impossible to quantify.

Based on these concerns, after sponsoring an industry competitive procurement, FMCSA awarded a contract jointly funded with the U.S Department of Transportation’s Intelligent Transportation Systems Joint Program Office. The team is led by Battelle will test major technologies that now exist that can offer solutions to minimize security risks throughout the HAZMAT movement chain. Several off-the-shelf technologies that enhance HAZMAT security and transport safety will be deployed and tested by the Battelle Team under this Operational Test, including:

Wireless satellite or terrestrial communications (with global positioning systems [GPS]) provide for load/cargo positions and status updates readily assessable and visible to a dispatcher.

Panic buttons that provide real-time emergency alert message notification by the driver to the dispatcher.

Driver authentication accomplished by driver login via authorized user identification (ID) and password codes or through biometric login (fingerprint scan recognition).

Intelligent onboard computers (OBCs) can be integrated with wireless communications and remote vehicle operating systems to enable vehicle-disabling capabilities.

ITS tech solves accidents   
SADP 10 (School of Architecture, Design, and Planning, University of Kansas, Report on I-70 Corridor, June 2010, <http://www.sadp.ku.edu/sites/default/files/I-70-ITS-TechMemo10.pdf>)

Hazardous materials tracking is the responsibility of the U.S. DOT which requires shippers to

create a “shipping paper” identifying the material and its hazardous properties.16 These papers

provide the necessary information, including the nature of the hazardous cargo, to the carrier and

emergency responders; however these papers can be difficult to track in the event of an

emergency. New technology is making it easier to track these shipments using electronic

communication devices.

Various technologies can be incorporated into a system to track hazardous materials. 16 These

technologies include tracking technologies, panic buttons, driver and cargo authentication and

intelligent onboard computers.

 Tracking Technologies - Wireless satellite or terrestrial communications. These systems

track the location and status of drivers, vehicles and cargo by integrating Global

Positioning Systems (GPS) with two-way text communications.Geo-Fence Mapping Software - Software that creates a “virtual fence” around the

shipments intended route and automatically notifies dispatchers if the vehicle deviates

from that route.

 Trailer Tracking - Systems that monitor “connect and disconnect” events and track

changes in the position and location of the trailer.

 Panic Buttons - In-dash and wireless panic buttons. Relay real-time emergency alert

messages to dispatchers and provide for remote vehicle shutdown.

 Driver and Cargo Authentication - Global login. Monitor authorization status and

login/logoff activity.

 Biometric Identification - Systems which verify the identity of personnel using human

characteristics such as eyes, facial recognition, fingerprints or hand geometry.

 Electronic Supply Chain Manifest (ESCM) - Systems which encourage proper chainof-

control through the combination of biometric verification, smart cards, Internet

applications and on-board wireless technologies.

 Electronic Seals (E-Seals) - Systems using short-range wireless communications to

generate alerts if the seal on a shipping container is broken without proper authorization.

 Intelligent Onboard Computers (OBC) - Onboard computers can be configured to shut

down the engine should the satellite signal be broken, or if a message is sent from

dispatch indicating the vehicle has been stolen.

 Vehicle Disabling - Remote locking and unlocking. A system that requires the driver to

contact the dispatcher to remotely unlock the cargo door by sending a wireless message

to the device. This prevents unauthorized entry into the container.

Having the ability to track hazardous material shipments in real-time using electronic systems

reduces errors when shipments are transferred, improves the efficiency, security, speed, safety

and effectiveness of incident response efforts. Additionally, the use of electronic communication

devices increases the safety and efficiencies of shipping hazardous materials by:

 Improving communication to emergency responders;

 Reduce overall risk by reducing delays and diverted shipments;

 Reduce intermodal impediments by eliminating discrepancies in information associated

with the use of physical shipping papers;

 Reduce congestion and system reliability by using efficient electronic information

transfers;

 Enhancing the security of imported materials by increasing the completeness and

accuracy of information in shipping papers; and Reducing environmental impacts by improving information flow and speed in the event

of an emergency.17

ITS prevents accidents   
USDT 8 (United States Department of Transportation, Research and Innovative Technology Administration, intelligent transportation systems¶ Benefits, Costs, Deployment,¶ and Lessons Learned¶ U.S. Department of Transportation¶ Research and Innovative Technology Administration¶ 2008 Update, <http://ntl.bts.gov/lib/30000/30400/30466/14412.pdf>)

Roadways

A major goal of the ITS program is to improve safety and reduce risk for road users including

pedestrians, cyclists, operators, and occupants of all vehicles who must travel along a

given roadway. On the Nation’s roadways, vehicle crashes at horizontal curves and intersections

account for approximately 25 percent and 21 percent of fatalities, respectively. Nearly

13 percent of those killed in motor vehicle crashes are pedestrians and bicyclists, and more

than 1 percent of crashes occur at highway-rail crossings.154 Interstates and other freeway

ramp curves can be dangerous locations because drivers must perceive the point at which

to begin braking and slow down sufficiently to safely negotiate the ramp curve.

Road geometry warning systems warn drivers of potentially dangerous conditions that

may cause rollover or run-off-the-road crashes on ramps, curves, or downgrades, and

provide overheight warnings at tunnels and overpasses. Highway-rail crossing warning

systems can reduce the potential for collisions at railroad crossings including catastrophic

crashes involving school buses or hazardous materials carriers. Intersection collision warning

systems use sensors to monitor traffic approaching dangerous intersections and warn

vehicles of approaching cross-traffic via roadside or in-vehicle displays. Pedestrian safety

systems can adjust traffic signal timing to provide an appropriate WALK phase or activate

in-pavement lighting or roadside warning messages to alert drivers of pedestrians present.

Bicycle warning systems can detect cyclists on narrow stretches of roadway and provide

drivers with advanced notice when entering bridges and tunnels. In rural areas, animal

warning systems can detect large animals near the roadway, alert travelers, and deter

animals from crossing while traffic is present.

In addition to the ITS technologies profiled in this chapter, the Cooperative Intersection

Collision Avoidance Systems (CICAS) initiative, a major ITS initiative being conducted by

the U.S. DOT has the potential to enhance crash prevention and safety. Through CICAS, the

U.S. DOT is working with automotive manufacturers and State and local DOTs to develop

and test autonomous-vehicle, autonomous-infrastructure, and cooperative communication

systems that can help prevent crashes at intersections. For more information, visit the ITS

JPO’s Web site: www.its.dot.gov/cicas.

Findings

Benefits

Road geometry warning systems can improve safety on highway ramps or curves that

experience a high incidence of truck rollovers. Providing truckers with advanced notice

of excessive approach speeds can reduce truck speeds by up to 8.3 mi/h. Several years of

safety data collected at multiple sites show these systems can eliminate rollover crashes,

and the impacts are sustainable. Downhill speed warning systems have also proven effective

at mitigating risks to large trucks in areas with steep terrain. These speed advisory

systems have decreased truck crashes by up to 13 percent at problem sites in Oregon and

Colorado.155

A nationwide survey evaluating overheight/overwidth warning systems found that eight

states that deployed active infrared light or laser activated warning systems had fewer

overheight load strikes on infrastructure components.156 Although active warning systems

were found to be more effective than passive ridged crossbeam structures or overhead

suspended chain warning systems, human error was prevalent highlighting the need to

thoroughly consider driver perception and compliance prior to deployment.The need to reduce crashes at intersections has fostered considerable research to develop

and evaluate cost-effective countermeasures. Initial research suggests that most drivers

will respond to intersection collision warning systems and slow or stop appropriately.157

These systems are currently being designed to transmit warning messages to in-vehicle

systems and display warnings on roadside infrastructure.

#### Hazmat tech is here – just needs government application ATRI 4 (American Transportation Research Institute, To¶ Federal Motor Carrier Safety Administration¶ U.S. Department of Transportation, <http://www.fmcsa.dot.gov/documents/hazmat/fot/hmfot-final-report.pdf>)

The technologies selected for the FOT can be readily plotted on myriad continuums, such as:

􀂃 Level of market usage and acceptance (commonly to rarely used)

􀂃 Unit costs (low to high)

􀂃 Management costs (low to high)

􀂃 Ease-of-use (easy to challenging)

􀂃 Technology sophistication (simple to complex; low-tech to high-tech)

While none of the technologies tested would be described as prototypes, several have very

limited prior field usage outside of government applications. For example, the vehicle disabling

technology is not currently a commercially available product in the United States. However, it is

commercially available in other countries such as Brazil. In Brazil, the primary use for this

technology has been to stop or deter theft (either of the product or the entire vehicle). The legal

climate in Brazil is more conducive (than that of the United States) to the implementation of such

technologies at this time. Nevertheless, all the technologies represent the most logical

technology application for the particular threat and vulnerability based on a series of research

studies and field tests. These technologies are categorized by focus area in Table 17.At a high level, most of the tested technologies were well accepted by system users. In some

cases, this was based on an existing understanding and familiarity with a common marketplace

system such as wireless vehicle tracking. With other systems such as biometrics, there was an

acceptance that national security issues and programs (e.g., U.S. Patriot Act) made biometrics an

inevitable reality.

Based on qualitative research, it was extremely evident that different stakeholders within the

FOT had different perspectives according to their roles; opinions differed across technology

investment decision makers, day-to-day users, government regulators, and technology vendors.

For example, electronic seals seemed to have higher acceptance among carrier management than

among drivers.5.2.1 Biometrics

The use of fingerprints as an ID system was generally accepted from a security and policy

perspective. Nevertheless, biometric system design issues quickly caused driver frustration and

backlash. This should not be entirely surprising given that biometric usage in the transportation

sector is nearly non-existent. Considerably more resources and testing are needed to ensure that

biometrics are designed and applied in a logical and functional manner.

5.2.2 Wireless Vehicle Tracking and Communications

The trucking industry has a long history with wireless vehicle communications and asset

tracking, making this component of the FOT one of the most accepted and entrenched of the

applied technologies. The technical merits and characteristics of the different technologies that

make up this grouping are well understood.

Satellite systems, which include GPS, voice and text communications, and other satellite-based

functionalities, presently require good satellite coverage and the well known “line-of-sight”

condition (i.e., to be effective, they cannot be blocked by thick vegetation, tall buildings, or

tunnels). Therefore, vehicles can lose satellite signals in urban areas, underpasses, and, more

rarely, areas with a gap in satellite coverage. From a security standpoint, solutions to this

inherent problem are challenging since a conservative policy would be to initiate some action

whenever there is a loss of signal. An evolving solution is to utilize hybrid systems that

automatically switch between satellites and terrestrial systems based on signal strength and

availability.

Terrestrial systems also have technology-based limitations such as gaps in signal coverage in

lower density areas, signal interference, and proprietary/interoperability system issues.

5.2.3 Cargo Management

There were several different systems tested in the FOT that focused on identifying and/or

protecting the cargo and trailer. Intuitively, these seem to be the most effective and immediate

approach since the hazmat cargo itself is the primary concern from a terrorism standpoint. It is

interesting that these systems are the least developed and tested of all the systems, at least within

the trucking industry.

Electronic seals have received considerable attention over the last few years, with many of the

proposed benefits derived from military applications. However, outside of limited U.S. DOT

tests, wireless e-seals have little to no presence in the private sector transportation industry. One

reason may be the complexity and variability of the seals themselves; almost without exception,

each seal is based on a different proprietary system and/or “standard” making integration and

interoperability nearly impossible across different e-seal systems.

The second issue is cost. The lower-cost disposable seals typically cost between $3 and $15 per

seal. Even in a truckload environment where cargo access is less frequent, it is likely that several

seals would be required every day for each truck. If cargo security inspections at weigh stations and border crossings were to increase as expected, the value of disposable seals would be further

eroded.

The alternative is the reusable e-seal, one of which was tested in the FOT. Outside of common

issues generally associated with wireless devices (e.g., loss of signal, power management issues,

user-friendliness), the primary concern with reusable seals is their high unit cost. While the seal

itself may only cost $30 to $50, the requisite support system (e.g., seal readers), typically raises

the cost into the hundreds of dollars per truck. With well-documented operating margins of less

than five percent, the trucking industry would be hard-pressed to outfit the three million plus

trailers that operate on the U.S. transportation system.

5.2.4 Trailer Locks

Electronic trailer locks show some promise from a qualitative user standpoint since cargo theft

continues to be a leading problem for the trucking industry. But surprisingly, the Technology

Compendium discussed in Section 2.3 and Appendix C indicates that electronic trailer locks are

not well established in the industry. Dramatically different trailer configurations along with cost

issues can be cited as a likely explanation.

5.2.5 Electronic Freight Data

The Electronic Supply Chain Manifest provided the FOT participants with advanced encrypted

hazmat cargo data, which, in theory, should enhance security and cargo management

functionality. Participants generally agreed that supply chain management systems are essential,

but without tangible efficiency gains from the ESCM system, usage was limited. One potential

reason for the limited ESCM usage is that the companies recruited for the FOT did not have

frequent runs. Government stakeholders, on the other hand, are beginning to require advance

submission of electronic freight data, thus ensuring that some variation of an ESCM system will

continue. For example, the Department of Homeland Security (DHS) through U.S. Customs is

requiring a 4-hour advance notice for incoming international cargo shipments and the FHWA is

in the early stages of developing an electronic freight manifest project to look at potential

efficiencies and security enhancements of an international in-bound air cargo electronic freight

manifest system. Future iterations ought to expand the efficiency benefits through new services

and functionality and improve systems integration so full supply chain management benefits are

realized.

Competitiveness Advantage

ITS key to competitiveness

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

ITS could not have reemerged without dramatic advances in performance and costs of computer, sensor, and communication technologies. Equally, very powerful and highly sophisticated devices in electronics and semiconductors were available for processing, storage, and display functions, especially allowing for the small packaging and affordable cost which is an essential market requirement (Saxton, 1993: 11). Of course, the availability of advanced technologies itself might be a contextual factor that stimulated concerns for ITS. However, a more significant impetus was a widespread recognition that ITS technologies could be commercialized. There was a general perception that Europe, Japan, and the United States were racing to prepare for the international markets envisioned for ITS products. The motor vehicle and electronics industries would be two major producers or distributors of ITS-related products, but global competitiveness of the U.S. in the areas was too poor to recover without special support. As shown in Figure V-3, the trade deficit in both electrical products and motor vehicles rose constantly over time, except for the unusual sharp decline of the motor vehicle deficit in 1987. It was thought that European and Japanese ITS R&D initiatives might further limit the U.S. motor vehicle and electronics industries. While the U.S government barely supported ITS R&D during the 1970s and 1980s, the European and the Japanese governments provided strong and continuous help to the two ITS-related industries during the same period of time. Hence, global competitiveness considerations were a motivating factor for developing the U.S. program. French et al. (1994) clearly explain the growing national concern for the role of ITS technology in improving global competitiveness. The authors argue that the markets for ITSbased products and services would be significant and fast growing for national infrastructures and mobile products. They also contend that mobile ITS products, such as route guidance systems, data communications equipment, and intelligent cruise control, are 64 especially important to international competitiveness in the electronics and automobile markets

ITS is crucial to maintain U.S. competitiveness

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

The Interstate highway system, started in the 1950s, was being completed as the 1990s was approaching. At this turning point, Federal Highway Administration (FWHA) was looking for a new program area in which the Administration would be involved, and its approach should be to resolve emerging transportation issues, including congestion, energy and environment, safety, and productivity. In March 1990, U.S. DOT published the National Transportation Strategic Planning Study, which was a long-range, multimodal forecast to the year 2015 for transportation facilities and services. This excellent document provides comprehensive, but detailed, information on the conditions and trends concerning those transportation-related issues. It described the contexts and needs of DOT and FHWA precisely, and for this reason, we now discuss the five transportation issues most heavily explored by the study: congestion, energy, environment, safety, and productivity First, despite slower population growth, there were clear growth trends in some groups of population. The baby-boom generation, now middle-aged, was moving through its prime earning years. As this change leads to growth in personal travel and tourism, it put strong upward pressure on transportation demand. Furthermore, older people were projected to take an increasingly large part of the total population. Between 2010 and 2030, the 65 and over age group would grow eight times faster than the total population (1-7). It was expected to increase the importance of accessibility and convenience in transportation services. More importantly, overall population tended to concentrate in metropolitan areas, resulting in a significant congestion problem in those areas. Between 1980 and 1987, metropolitan areas grew twice as fast as non-metropolitan areas, accounting for 86 percent 69 of the Nation’s population growth. In 1987, half the population lived in the 37 metropolitan areas with a population of 1 million or more, and 25 percent of the population lived in the seven largest metropolitan areas (1-11). In result, travel on major urban highways increased by nearly 30 percent between 1983 and 1987. In 1987, traffic congestion occurred in nearly 65.5 percent of urban interstate peak-hour travel, compared to 54.4 percent in 1983. In 1987, due to the congestion problem, drivers and passengers in the largest urban areas wasted from 1.5 to 2 billion hours (10-18). Second, despite decreased use of oil in other sectors of the economy, oil use in transportation continued to grow without shift to alternative fuels. The transportation share of petroleum consumption expanded from 52 percent in 1970 to 62 percent in 1988 (3-3). In 1988, transportation demand, 10.4 million barrels per day, exceeded domestic production by 8 percent (S-4). Substantial imports were expected for transportation purpose alone. In particular, with decreasing non-OPEC oil production, OPEC output approached 85 percent of capacity. Hence, oil prices would increase sharply and fuel efficiency was urgently needed in the transportation area (3-5). Third, transportation was a major contributor to air pollution and other pollution. It accounted for 70 percent of carbon monoxide (CO), 33 percent of ozone-producing hydrocarbons, about 50 percent of nitrogen oxides (NOx), and 21 percent of suspended particulate (4-1). Despite a 24-percent growth in vehicle travel, transportation emissions were reduced by 38 percent for CO, 36 percent for HC, and 15 percent for NOx (4-5). However, transportation was still responsible for nearly 25 percent of U.S. and 5 percent of worldwide emissions of CO2, the greenhouse gas (4-9). Because the production of clean fuels was costly, conversion from conventional fuels would be slow (4-16). Furthermore, hazardous materials were transported with a continuing risk to the environment from accidental spills without adequate emergency response methods. All of these factor lead to growing needs for sustainable transportation. Fourth, highway fatality rates had continued to decline, but the number of accidents and fatalities was still unacceptable in 1988, accounting for 20.6 million accidents and 70 49,850 fatalities (8-1). Furthermore, it was uncertain that governmental safety programs would sustain the declining trends. According to a DOT’s study, people generally tended to decide whether to accept a particular safety measures by weighing the safety benefits against the costs such as trip time, loss of a business opportunity, or missed opportunity to see family members. Drivers would be reluctant to accept safety measures if they perceive that their benefits do not outweigh their costs. This was a reason why safety measures might not effectively protect the drivers from unnecessary or preventable risk. Hence, DOT continued to look for “the broadest possible options for fast, efficient, convenient, and economical movement of people and goods” (8-2). Finally, there was increasing criticism that infrastructure, including transportation infrastructure, was insufficient to meet the demands of future economic growth and development as well as current requirements (NCPWI, 1988: 1; Victor, 1992). According to the Congressional Budget Office, 5.5 per cent of all federal outlays was spent on public works in 1965 when construction on the interstate highway system was underway. However, it had steadily decreased since, falling down to 2.5 per cent in 1990 (Victor, 1992: 2717). Because the movement of people and goods was generally thought to be an integral part of economic activity, transportation might have a great impact on productivity in a national economy. **Inactive investment in infrastructure might be a fundamental cause of the decline in the competitiveness of the United States in the international economy**. In sum, the emerging transportation issues of the 1980s, such as congestion, energy and environment, safety, and productivity, brought about more mounting demands for effective highway policy than had been the case in “the era of the Interstate system.” There was a widespread recognition that, without major solutions, the worsening trend would continue beyond 1990. While transportation professionals attempted to find better answers to the emerging multiple problems, many of them believed that ITS would be an effective and efficient alternative that could attack the problems all together.

2AC AT: States CP

Implementation of ITS differs from region to region – absent federal investment, coverage will be isolated

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In contrast to the leaders, the United States lags in ITS deployment, particularly with regard to provision of real-time traffic information, progress to date on vehicle-to-infrastructure and vehicle-to-vehicle integration, adoption of computerized traffic signals, and maximizing the effectiveness of its already fielded ITS systems. While the United States certainly has pockets of strengths with regard to ITS in particular regions and applications—including use of variable rate highway tolling, electronic toll collection, certain advanced traffic management systems such as ramp metering, and an active private sector market in telematics and travel information provision—overall the implementation of ITS varies significantly by state and region, thus tending to be sporadic and isolated and not connected into a nationally integrated “intelligent transportation system.” As one illustration of U.S. challenges in ITS, the percentage of U.S. metropolitan areas delivering real-time highway travel time and highway travel speed information to the public in 2007 was, respectively, 36 percent and 32 percent, while for arterial roadways, only 16 percent of U.S. metropolitan areas disseminate real-time travel speed information and only 19 percent distribute real-time travel time data.

State and local governments fail at deploying ITS

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The GAO found “several barriers that limit the widespread deployment” of ITS at the state, regional, and local level in the United States. The study noted that state and local transportation officials often view other transportation investment options, such as adding a new lane to a highway, more favorably than ITS when deciding how to spend limited transportation funds. 151 Moreover, the GAO found that, unfortunately, “information on benefits does not have a decisive impact on the final investment decisions made by state and local officials.” This challenge is amplified as elected officials often find ITS investments less appealing than highway construction. The GAO study quoted Chicago- and San Francisco-area transportation officials lamenting that since ITS applications, “do not usually offer groundbreaking ceremonies which offer positive media attention,” politicians were generally not motivated to support ITS projects. 152 This challenge continues today. Both state highway administrators’ preference for traditional highway investments and lack of funding for ITS projects were apparent in the distribution of stimulus money as part of the American Recovery and Reinvestment Act (ARRA). Many states have not invested any ARRA funds in ITS. 153 As Kevin Lacy, State Traffic Engineer for North Carolina DOT explained the view of some state DOTs toward ITS, “The ITS industry is not as developed, still growing and often perceived as a little higher risk. So having strict time periods on cashing out has likely reduced opportunities for ITS projects using ARRA.” 154 Unfortunately, this perspective misses that there are many readily-available ITS technologies that can be deployed, that they offer superior benefit-cost returns, and also that ITS deployment can likewise stimulate economic and employment growth

2AC AT: Disads – Generic

ITS is inevitable internationally – many countries have already developed it

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South Korea will invest $3.2 billion in ITS deployment from 2008 to 2020, about $230 million annually, as part of the country’s ITS Master Plan. South Korea built its ITS infrastructure on a city-by-city basis, establishing four initial “ITS Model Cities” that implemented: 1) adaptive traffic signal control, 2) real-time traffic information, 3) public transportation management, and 4) speed violation enforcement in these model cities. 29 South Koreans have now deployed similar ITS implementations. 9,300 buses and 300 bus stops have deployed real-time bus location and status notification systems. South Koreans use T-money, an electronic money smart card (or mobile phone application) to make 30 million contactless transactions per day on public transit. The country’s Hi-Pass ETC system covers 50 percent of highway roads (expanding to 70 percent coverage by 2013) and is used by 31 percent of vehicles. Singapore was the first country in the world to introduce an electronic congestion pricing system in 1998 (and has actually had some form of congestion charging in place in its city center since 1975). The country generates and disseminates real-time traffic informa-tion through a fleet of 5,000 probe vehicles. Singapore has deployed adaptive computerized traffic signals nationwide, installed real-time bus status screens at most bus stops, and launched a national parking guidance system in April 2008. Singapore’s i-Transport system is at the cutting edge of predictive traffic flow modeling based on the use of historic and real-time traffic data.

2AC AT: Topicality – Transportation

ITS is the future of transportation development

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Information technology (IT) has transformed many industries, from education to health care to government, and is now in the early stages of transforming transportation systems. While many think improving a country’s transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in using IT. IT enables elements within the transportation system—vehicles, roads, traffic lights, message signs, etc.—to become intelligent by embedding them with microchips and sensors and empowering them to communicate with each other through wireless technologies. In the leading nations in the world, ITS bring significant improvement in transportation system performance, including reduced congestion and increased safety and traveler convenience. Unfortunately, the United States lags the global leaders, particularly Japan, Singapore, and South Korea in ITS deployment. For the most part, this has been the result of two key factors: a continued lack of adequate funding for ITS and the lack of the right organizational system to drive ITS in the United States, particularly the lack of a federally led approach, as opposed to the “every state on its own approach” that has prevailed to date.

AT: Brain Drain DA

#### SQ Solving Brain Drain Now Smith 12 (Mitch Smith, reporter for Inside Higher Ed, <http://www.insidehighered.com/news/2012/02/23/us-colleges-say-developing-world-partnerships-help-stop-brain-drain>)

WASHINGTON -- In an effort to combat the longstanding one-way flow of talented intellectuals out of the developing world, American universities are partnering with foreign institutions to train students to improve conditions in their home countries.¶ Paloma Mohamed saw the effects of “brain drain” when she returned to the University of Guyana to lead its communications studies center a few years ago after attending graduate school at Harvard University and the University of the West Indies. One of the center’s two faculty members had left for Britain, leaving 60 students to wait two years to graduate because there was no one to teach upper-level courses.¶ A South American nation bordering the Caribbean Sea, Guyana is roughly the size of South Dakota in terms of both land area and population.¶ Mohamed, who had promised she would one day return to teach in her native country, was charged with revitalizing a center using a 40-year-old curriculum and textbooks older than she was.¶ The foundering communications center at the national university underscored large-scale ineptitude in the country’s news media, where much of the nightly broadcasts were pirated and the rest looked amateurish.¶ Long interested in efforts to engage with his native Guyana, Ohio University communications professor Vibert Cambridge saw Mohamed's attempts to grow the national university's communications center as a natural opportunity for collaboration. Competing against four other American universities, Cambridge won a $300,000 grant through Higher Education for Development with funds from the U.S. Agency for International Development.¶ Mohamed redesigned the center’s curriculum, welcomed guest instructors from Ohio and sent her own faculty members to earn master’s degrees in Ohio with the understanding they’d return to the University of Guyana for at least five years. Ohio faculty concentrated their research on Guyana and graduate students gained teaching experience in the country.¶ Now enrollment is booming, and students are leaving the University of Guyana with the skills to work in the country’s media or attend graduate school.¶ But Cambridge, who is Guyanese-American, insists the benefits work both ways. Speaking with Mohamed on Wednesday at the Association of International Education Administrators conference, Cambridge said he was able to conduct field research for an upcoming book as part of the partnership and his students were able to learn about issues facing communicators in developing nations.¶ The project’s viability, Cambridge said, was rooted in that mutual benefit. The partnership allowed the South American university to grow while the U.S. institution offered new opportunities to its faculty and students.¶ Cambridge attributes that success to honest intentions, a clear agreement on how resources would be divided and his ties to both Mohamed (he served on her dissertation committee) and his homeland.¶ The Ohio-Guyana partnership is a departure from the trend of Western universities siphoning off a developing nation’s brightest minds. While those individuals might send money back or focus their research on their homeland, Mohamed said it perpetuates a gap in the educational system when no one is left to teach the next generation.¶ Mohamed said she is one of 10 Ph.Ds. among 300 University of Guyana instructors. Many students leave home because they can’t pursue an advanced degree in their own country, then never return.¶ To that end, Mohamed is working to offer a master’s degree in communication at her center and Cornell University gave graduate degrees to Ethiopian students working on water issues in their own country.¶ Cornell awarded 34 graduate degrees in integrated watershed management through a partnership with Bahir Dar University in Ethiopia. The courses were taught by Cornell faculty members and the degrees were the same a student would earn in New York, though the coursework was done entirely in East Africa.¶ Of the 34 students who earned the credential, 32 stayed home to work on managing the country’s water system. Most are either pursuing doctorates, teaching college classes or working with NGOs.¶ Bringing top-flight American programs and instructors to students elsewhere, Cornell engineering professor Tammo Steenhuis said, seems to decrease students' desire to move overseas. Cornell’s role in the program is now largely over, and degrees in the program are now awarded by Bahir Dar. But the goal – to create a new cadre of highly trained watershed scientists working to improve access to water in Ethiopia – seems to have been met.¶ Ohio has seen similar results in Guyana, and is now developing partnerships between the two universities’ medical, fine arts and engineering programs.¶ “You have to cultivate relationships,” Cambridge said. “For us, it was a wonderfully rich and empowering reciprocal engagement.”

#### Brain Drain increasing now Gibson et al 11 (John Gibson, David McKenzie, Policy Research Working Paper, The World Bank¶ Development Research Group¶ Finance and Private Sector Development Team¶ May 2011, <http://wwwwds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2011/05/24/000158349_20110524155759/Rendered/PDF/WPS5668.pdf>)

In absolute levels, skilled migration is increasing. However, skill levels in migrant-sending countries are also rising, and for the world as a whole, skilled migration rose at about the same pace as overall education levels in the sending countries in recent decades, so that the brain drain rate remained quite stable for long periods of time and may have even fallen in the past decade.¶ Between 1960 and 2010, the global migrant stock increased from 74 to 188 million, only slightly faster than world population growth, so that the share of the world‘s population who are international migrants increased only from 2.7 to 2.8 percent (UNDP, 2009). However, while the global migration rate has been quite flat, the migrant flow has increasingly been from less developed to more developed countries, with a reduction in within-region flows. The number of individuals migrating from the ―South‖ to the ―North‖ increased from 14 million in 1960 to 60 million in 2000 (Özden et al, 2010).2 At the same time, the percentage of migrants with tertiary education increased dramatically. Defoort (2008) uses data from six main OECD destination 8¶ countries to estimate that the proportion of adult migrants with tertiary education increased four-fold over 1975-2000. The increasing amount of South-North migration coupled with the increasing skill level of this migrant flow means that brain drain is increasing in absolute terms.¶ However, educational levels in developing countries have also been rising dramatically over the past decades. As a result, de Foort (2008) finds that the rate of high-skilled emigration (relative to the base of all tertiary-educated individuals) has been very stable at the global level over the period 1975-2000, with the educational level of the home workforce increasing at a similar rate to the increase in tertiary educated migrants. However, sub-Saharan Africa is an exception to this pattern – a region in which tertiary education growth remained low and did not offset the rise in skilled migration.Analysis of migration flows faces severe data constraints, and a full picture of brain drain trends during the 2000s will not emerge until after data are released from the 2010-11 round of global population Censuses. However, brain drain appears likely to have fallen in relative terms during this time. Tertiary enrolment rates have continued to grow dramatically, with gross tertiary enrolment rates for sub-Saharan Africa increasing from 3.9 percent in 1999 to 6.0 percent in 2009, those in South Asia increasing from 8.0 percent in 2000 to 11.4 percent in 2008, and those in Latin America and the Caribbean increasing from 20.9 percent in 1999 to 35.2 percent in 2007 (World Bank WDI and GDF global database [accessed November 22, 2010]). At the same time as stocks of tertiary-educated individuals have been rising in many developing countries, the intake of skilled workers has been quite flat over the first part of the decade in many OECD destination countries, and fallen in 2008-2010. For example, the United States H1-B visa program (the main temporary residence category for admitting skilled workers3) issued visas to an average of 130,000 workers a year over the 2000s, reaching a peak in 2007 at 154,000, and dropping in 2009 back to 110,000 (United States Department of State, 2011). It is worth noting how small this magnitude is – less than one skilled worker admitted per 1000 population.¶ 3

#### No impact – workers will invest in their home countries Gibson et al 11 (John Gibson, David McKenzie, Policy Research Working Paper, The World Bank¶ Development Research Group¶ Finance and Private Sector Development Team¶ May 2011, <http://wwwwds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2011/05/24/000158349_20110524155759/Rendered/PDF/WPS5668.pdf>)

Question 7: Do High-Skilled Workers Remit, Invest, and Share Knowledge Back Home?

The benefits that a sending country might receive from high-skilled immigration are usually listed in terms of return flows of income, investment and expertise from migrants back to the sending country. These are the kinds of benefits that underlie the claim by India‘s prime minister that modern India is benefitting from its high-skilled out-migration and the resulting global Indian diaspora. But how common are such benefits? As we have seen, brain drain rates are highest from countries with small populations and those experiencing political instability and poor prospects for career success. Thus while India‘s annual remittances have now reached $55 billion (World Bank, 2011) and India‘s high-skilled migrants have shaped the development of its impressive information technology sector (Saxenian, 2006), the experience of a country with a population of over one billion and a fast-growing economy may have few lessons to offer the small and/or unstable countries for which brain drain is at most an issue. New research offers a more mixed picture of the potential benefits of brain drain.Consider first remittances, the most visible channel through which migrants contribute to households back home. Global remittance data at the micro-level are not currently publicly available, so we use a database of 33,000 immigrants in 11 OECD countries put together by Bollard et al. (2010). In this sample, skilled migrants remit more than less-skilled migrants, with the average tertiary-educated migrant remitting about $1,000 per year. We take the 6,318 migrants in their sample with tertiary education who come from countries with at least 50 skilled migrants in the database. We then remove survey fixed effects, and then, in Figure 2, plot the proportion of tertiary educated migrants who remit against Gross National Income per capita in the sending country. There are two important results. First, for most sending countries, less than half of tertiary-educated migrants send remittances. Second, there is a strong negative correlation between income levels and the likelihood that skilled migrants remit. In this sample, the likelihood of remitting is significantly higher for countries with higher brain drain rates, but once we control for per capita income, this relationship is no longer significant. Both the incidence and the amount remitted appear to be even higher among the most highly-skilled migrants from countries with high levels of brain drain. Gibson and McKenzie (2010) report that between 68 and 93 percent of the developing country high-skilled migrants in their sample remit, with an average amount remitted of around $5,000. Clemens (2011) also finds an annual remittance level of about $5,000 in his survey of African physicians in the U.S. and Canada. Existing empirical evidence therefore does support the idea that high-skilled migrants remit, particularly back to lower-income countries, and that the level of these remittances can be sizeable relative to per capita income in their home countries. Less empirical evidence is available about the extent to which high-skilled emigrants invest or engage in knowledge flow or return investment, especially for the types of countries for which brain drain rates are highest. At the cross-country level, Kugler and Rapoport (2007) and Javorcik et al. (2011) find a positive relationship between the number of skilled migrants a country has in the United States and the level of foreign direct investment from the U.S. economy to that country. However, their dataset contains only two countries with population rates below one million, making it difficult to see whether this relationship holds in the smallest countries for which brain drain rates are highest. At the micro-level, Gibson and McKenzie (2010) find very low incidence rates of high-skilled migrants being involved in trade facilitation or investment in business start-ups in their home countries: they estimate a small country like Tonga or Micronesia might gain at most $500-$2,000 per high-skilled migrant from trade and foreign direct investment. This contribution is a positive one, but unlikely to have large effects on development. Reductions in the cost of air travel and improvements in information technology make it significantly easier for high-skilled migrants today to continue to stay in contact with people in their home countries. In principle this opens up many opportunities for knowledge flow. However, again the types of knowledge flow that occur back to large and vibrant economies are likely to differ from those to smaller countries where brain drain rates are higher. Gibson and McKenzie (2010) find the main forms of knowledge flow of high-skilled migrants from Ghana, Micronesia, Papua New Guinea, and Tonga are information about educational and work opportunities abroad, with few migrants providing advice to home country companies or governments.

#### Brain Drain good for countries Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

The effect most difficult to measure—but theoretically most likely to benefit¶ countries sending highly skilled workers—may be an increase in the incentive for¶ natives to invest in their own human capital. In theory, this can occur through four¶ mechanisms: (1) an increase in the domestic return to skills because of the relative¶ scarcity created by the brain drain; (2) the incentive effect of an increase in the¶ expected value of an individual's human capital investment if that individual has¶ migration as an option; (3) a reduction in the risk associated with the return on¶ individual human capital investment if migration serves as a labor market stabilizer;¶ and (4) an increase in the domestic demand for skilled labor because of increased ties¶ to foreign business and R&D activities.¶ The first mechanism is the improvement of labor market conditions for highly skilled¶ workers when emigration to other national labor markets reduces the domestic supply¶ of these workers. Wages and unemployment for highly skilled workers in¶ less-developed countries (with less-developed financial markets and entrepreneurial¶ infrastructure) may be particularly sensitive to oversupply. Other channels through¶ which migration leads to increased supply may, of course, offset this.¶ The second mechanism results from uncertainties that individuals might have about¶ their likely migration behavior.[3] When the expected foreign value of human capital¶ is much greater than the domestic value, even a small nonzero expectation of¶ migration may have an important effect on the expected value of a human capital¶ investment decision. Thus, the existence of a foreign demand for their skill may¶ influence even those with strong preferences against migration.¶ The third mechanism depends on whether the amount of emigration of highly skilled¶ labor from a country is related to current labor market conditions. A downturn in a¶ country's demand for highly skilled labor that causes more highly skilled workers to¶ leave might tend to reduce fluctuations in employment and salaries, thereby reducing¶ the risk associated with the human capital investment. The considerable investments¶ required for an individual to acquire higher skills might seem less worthwhile if the¶ labor market demand for those skills is volatile.[4] To some extent, this effect of¶ immigration as a labor market stabilizer may be offset by any instability caused by¶ return migration driven by changes in conditions in the receiving countries.[5]¶ The fourth mechanism, increasing domestic returns to human capital investment, is¶ simply the secondary effect on the demand for skills of the positive economic effects¶ discussed below. Indeed, a 1% increase in gross domestic product (GDP) due to¶ increased access to technology and foreign collaboration may increase demands for¶ skills more than a 1% increase in GDP due to factors like increased export¶ commodity prices. Exploiting knowledge usually implies an increasing demand for¶ higher skills.

#### Brain Drain key to science diplomacy Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

International migrants (other than refugees) seldom break all ties with their country¶ of origin. There is reason to believe that highly skilled migrants who have extensive¶ education and, often, work experience in their country of origin maintain contacts¶ with former colleagues and education institutions. These contacts may provide a¶ benefit for sending nations by facilitating the formation of international networks of¶ contacts and knowledge exchange, both with expatriate natives and with contacts that¶ returning expatriates nurtured while abroad. Some evidence for this is seen in figure¶ 1, which shows a positive 0.66 correlation between the log of the number of U.S.¶ doctorates received by those born in a foreign country and the percentage of that¶ country's internationally coauthored articles with the United States.[6]That contacts in graduate school may lead to research collaboration across borders is¶ not unexpected. The same effect is likely to be created by the international¶ movements of people employed by industries. Movement of workers between firms¶ has long been recognized as a powerful source of knowledge transfer—both of¶ technology and of more subtle forms of knowledge such as business practices and¶ networks of contacts—and the knowledge transfer is likely to be even more¶ significant when the firms are across national borders.

#### No Impact – workers return Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

An important (although not necessary) way for a sending country to benefit from the¶ flow of knowledge is for its natives to return after they have spent a period of time¶ outside the country either in school or working. Despite wage differentials and other¶ differences in opportunities, return migrations are common, even between developed¶ and less-developed countries.[7] To a great extent, this is unsurprising and reflects¶ the importance of cultural and family ties to migrants. Another factor that encourages¶ return migration is the temporary nature of the work permits that many countries use¶ as their primary method for allowing employers to recruit noncitizens. For example,¶ the most common visa the United States issues to highly skilled workers, the H-1B¶ visa, has a duration of 3 years, allows a single 3-year renewal period, and is not¶ formally part of any path to a permanent visa.[8]¶ Finn (2005) showed that slightly more than three-fifths of foreign students with¶ temporary visas who received U.S. S&E doctorates in 1998 were still working in the¶ United States 5 years later.[9] This implies that the other two-fifths left the United¶ States[10] with training received at a U.S. university and perhaps a postdoc position¶ or other postgraduate work experience. As shown in table 3, Finn (2005) found that¶ 5-year-stay rates varied by field of degree, ranging in 2003 from 36% in economics to¶ 70% in computer science and computer and electronic engineering.Also noteworthy is that for a given Ph.D. cohort, the stay rates shown in table 3 hold¶ reasonably steady for time since degree. However, data from another source, the¶ National Science Foundation's (NSF's) 1995 Survey of Doctorate Recipients (SDR),¶ suggest that even among those who do stay in the United States immediately after¶ graduation, many leave after a period of time. But others return after initially leaving,¶ thus producing the relatively steady estimates of the proportion in the United States¶ over the five-year period. A complex pattern of migration of this form would enhance¶ the role of foreign students in the knowledge networks between countries.[11]¶ Some of this migration pattern among Ph.D. holders is suggested by data from the¶ 1995 SDR. In that year, a special effort was made in collecting data for the SDR to¶ discover whether survey nonrespondents resided outside the United States. Table 4¶ presents estimates of foreign-born recipients of U.S. S&E doctorates working outside¶ the United States derived from the 1995 SDR. Because it is quite possible that other¶ nonrespondents whose locations were never discovered also resided outside the¶ United States, these should be considered lower bound estimates.¶ The SDR covers all those with S&E doctorates from U.S. schools who had plans to¶ stay in the United States immediately after receiving their degree.[12] Thus, the only¶ foreign-born doctorate recipients represented in the SDR are those with plans to stay¶ at the time of degree conferral. Among this group, about one-fifth of those who¶ graduated in the last three decades were identified as residing abroad; in the case of¶ graduates from the last 10 years, more than 4% had left the United States in the¶ previous 2 years.¶ In addition to knowledge transfers, the return of natives to a sending country also¶ brings a gain of human capital that may not have been developed had the migrants¶ stayed in their home countries. There are several reasons for this. Differences in the¶ availability or quality of particular areas of university instruction may have been a¶ reason for the original cross-border movement. Knowledge of unique technologies¶ may also be gained in formal employment. In addition, foreign employers and¶ educational institutions often finance both formal education and job-related training¶ to a considerable extent.

#### Drain good – supports economy of the country Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

In the general immigration literature, many studies have analyzed the effects of¶ having large populations of natives outside a country's border.[13] These include the¶ creation of new export opportunities for their home countries, the creation of¶ transnational social networks to facilitate business contacts and knowledge transfer,¶ and the value of remittances to relatives and institutions in their home countries. It¶ seems plausible that highly skilled migrants create the same type of opportunities,¶ albeit sometimes in different ways.¶ Lower skilled migrants often form part of the retail and wholesale infrastructure in¶ their new countries. Highly skilled migrants may be less likely to become retail or¶ wholesale managers but more likely to be involved in the purchase or selection of¶ technology products and services. For example, significant anecdotal evidence shows¶ that Indian migrants have played a key role in business partnerships and relationships¶ between U.S. and Indian technology firms.[14]¶ Remittances from highly skilled migrants may also be only a variation of the¶ phenomenon discussed in the general immigration literature.[15] Highly skilled¶ migrants are fewer in number than other migrants but often earn higher incomes. In¶ addition to giving gifts to relatives, highly skilled migrants may serve significant¶ financial or other roles as alumni of educational institutions in their home countries.

#### Brain Drain key to econ and research breakthroughs Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

Positive Effects for Receiving Countries¶ Many of the positive effects of high-skill migration for receiving countries are the¶ same as those experienced by sending countries: gains related to increases in¶ international collaboration and technology transfer, with the same implications for¶ increasing domestic productivity and developing global markets. In the case of the¶ United States, where relatively few native-born individuals migrate abroad for¶ employment, many of its global connections come from foreign scientists and¶ engineers. Both those who come to the United States to stay, and those who leave¶ after a period of school or employment, form part of a network between U.S. research¶ institutions and business and foreign institutions.¶ Increased Economic Activity and R&D¶ Even in a model of high-skill migration that does not include brain circulation,¶ receiving nations benefit from a brain gain. They experience an exogenous increase¶ in their stock of human capital, often including scarce or unique sets of skills that are¶ needed to overcome bottlenecks in production or research.¶ In the United States, highly skilled foreign-born workers make up a large part of the¶ total S&E-educated labor force (see table 6). In 2003, more than one-third of S&E doctorate holders are foreign born, ranging from about 10% of psychology doctorate¶ holders to 51% of doctorate holders in engineering and 57% in computer science. At¶ the bachelor's degree level, 15% of S&E degree holders are foreign born, ranging¶ from 7% of sociology/anthropology bachelor's degree holders to more than¶ one-quarter in physics/astronomy and electrical engineering.These estimates, and others shown in table 6 from the NSF SESTAT data file, are¶ underestimates of the total proportion of foreign-born scientists in the United States.¶ Because of the practical difficulties involved in tracking highly skilled migrants,¶ SESTAT data on the U.S. S&E labor force exclude individuals whose S&E degrees¶ were obtained from foreign educational institutions unless they were in the United¶ States as of the decennial census of 2000. This would exclude, for example, the¶ majority of individuals who entered the United States with an H-1B temporary visa in¶ the 3 years between 2000 and 2003. Based on a sample of H-1B workers, the U.S.¶ Immigration and Naturalization Service reported that 60% of H-1B visa recipients are¶ recruited outside of the United States and thus are more likely to hold foreign¶ degrees.[21]¶ Comparing 2003 SESTAT estimates of the percentage of foreign-born individuals in¶ S&E occupations with estimates from the 2000 census and the 2003 American¶ Community Survey (ACS) gives one indicator of the possible undercount (see table¶ 7). The 2003 SESTAT and 2000 Census estimates are similar, while the 2003 ACS¶ shows a higher proportion.[22] The ACS proportion of foreign-born doctorate holders¶ in S&E occupations was 3.9 percentage points greater than that reported in NSF's¶ 2003 SESTAT database. Because SESTAT microrecords include a representative¶ sample of individuals with new U.S. S&E degrees (both foreign born and native), the¶ most likely explanation for these differences is the continuing entry in the early 2000s¶ of large numbers of scientists and engineers with foreign degrees.[23]

#### Brain Drain key to research breakthroughs Regets 7 (Mark C. Regets, (Division of Science Resources Statistics, National Science¶ Foundation, June 2007, <http://www.nsf.gov/statistics/srs07203/pdf/srs07203.pdf>)

Knowledge Flow and Collaboration

As shown in figure 1 and discussed earlier, there are strong reasons to believe that¶ international migration leads to increased international collaboration and transmission¶ of knowledge. For the United States, an increased connection to the rest of the world¶ has always been a benefit of having large numbers of foreign students and large¶ numbers of highly skilled immigrants.¶ This factor may become even more important as the rest of the world continues to¶ expand its R&D capacity. U.S. R&D spending as a share of the global total declined¶ during the 1990's and reached 36% in 1993, down from about 40% early in the¶ decade (NSB 2006).¶ Increased Enrollment in Graduate Programs¶ Increased enrollment is the other side of concern about displacement of natives in¶ graduate programs. In the United States, the availability of foreign students may¶ allow many graduate departments to expand or maintain graduate programs. In other¶ cases, foreign students may enable elite programs to maintain very high standards by¶ allowing the programs to choose among the best of both foreign and native¶ applicants.¶ Graduate programs are important sources of new research and knowledge in their¶ own right, with students providing labor for research and teaching both informally¶ and through relatively low-paid research and teaching assistantships. This graduate¶ student labor may provide a benefit to receiving countries, even if foreign students¶ leave immediately after graduation and play no part in later knowledge networks.¶ In addition, colleges and universities receive some direct financial benefits from¶ foreign students in the form of tuition and fees. Data from the Institute for¶ International Education (IIE) show 81.8% of undergraduate international students in¶ the United States had personal and family funds as their primary source of support in¶ the 2003–04 academic year. At the graduate level, IIE shows 51.6% with personal¶ and family funds as their primary source of support.[24]

2AC AT: Nanotechnology Bad – Environment

Nanotech solves the environment – molecular disassembly, purification and pollution

Bryan Bruns, PhD and one of the leading experts on nanotechnology, 2000, http://www.cm.ksc.co.th/~bruns/opennan2.htm, “Nanotechnology and the Commons: Implications of Open Source Abundance in Millennial Quasi-Commons” ; AB

Elementary recycling. The ability to precisely control the assembly of matter at the molecular level also implies the capacity to disassemble materials, purify air and water, clean up pollution and possibly transform waste dumps into sources of valuable materials. Most recycling, of glass, paper or plastic for example, currently goes on at the chemical level of complex molecules and bulk materials. The presence of undesired elements and compounds often makes recycling difficult or uneconomic. Nanotechnology could make it easier to extract and reuse desirable atoms and compounds, and sort out temporarily unneeded elements for storage or use elsewhere. Properly deployed, nanotechnology could be a green technology, reducing the need for environmentally damaging resource extraction, enabling sustainable resource availability, and contributing to environmental restoration and regeneration.28

2AC AT: Nanotechnology Bad – Water

Nanotechnology solves water purification

Bryan Bruns, PhD and one of the leading experts on nanotechnology, 2000, http://www.cm.ksc.co.th/~bruns/opennan2.htm, “Nanotechnology and the Commons: Implications of Open Source Abundance in Millennial Quasi-Commons” ; AB

From flow to stock. Water purification offers an example which can be used to explore possible implications of using nanotechnology for purification, and consequent changes in resource costs. Carbon nanotubes might not only enhance water purification technologies to the point where they far outcompete reverse osmosis or distillation in arid areas, but even become preferable options for water treatment in humid regions, at least for any place not too distant from the sea.29 Water is normally managed as a flow resource, used once and then passed on, whether quickly along a stream or more slowly through recharge and extraction in aquifers. Rivers and seas tend to be treated as sinks, into which water can be dumped after use. Tertiary wastewater treatment plants already can yield water with higher quality than the original sources used for urban water supplies. Many of the innovations in reducing industrial water use involve closing cycles, reusing water many times, or even indefinitely, with only occasional replenishment to compensate for minor losses such as evaporation. Fully implementing closed systems for urban water supply would likely face opposition due to attitudes about cleanliness and purity, especially for drinking water. A change might be more feasible with systems operating on "graywater" principles, distinct from water used for cooking, washing and bathing. Applying closed-cycle approaches to industrial and domestic water supply would mean that water in such systems would be managed primarily as a resource stock, rather than a transient flow. If implemented widely, such changes might dramatically reduce dependence of cities on upstream water sources. On the one hand this might reduce pressures to acquire new water sources, while on the other hand it might reduce the interest of downstream users in supporting improved watershed management upstream. Technological change would not only expand the envelope of technical possibilities, but could lead to changes in key characteristics shaping how the resource is managed, in this case, a shift from management of one-way resource flows to management of recycled resource stocks.

2AC AT: Nanotechnology Bad – Agriculture

Nanotech solves agriculture

Task Force on Science, Technology, and Innovation, UN Millenium Project, 12/17/05, “Innovation: applying knowledge in development” http://www.unmillenniumproject.org/documents/Science-part2.pdf

Cost-effective agricultural applications of nanotechnology could decrease malnutrition, and childhood mortality, in part by increasing soil fertility and crop productivity. Crop health can be monitored using nanosensor arrays. Nanosensors can raise the efficiency of crop monitoring activities. Sensors applied to the skin of livestock or sprayed on crops can help detect the presence of pathogens. Nanoporous materials such as zeolites, which can form well- controlled stable suspensions with absorbed or adsorbed substances, can be employed for the slow release and efficient dosage of fertilizers for plants and of nutrients and drugs for livestock.

2AC AT: Nanotechnology Bad – Proliferation

Prolif will be slow and cautious.

Waltz, Sagan, and Betts, 7 -- \*Emeritus Professor of Political Science at UC Berkeley and Adjunct Senior Research Scholar at Columbia University, past President of the American Political Science Association, and a Fellow of the American Academy of Arts and Sciences. \*\*Professor of Political Science at Stanford. \*\*\*Ph.D. Harvard. Specialist on national security policy and military strategy (Kenneth, Scott, Richard. “A NUCLEAR IRAN: PROMOTING STABILITY OR COURTING DISASTER?” Journal of International Affairs, Spring/Summer2007, Vol. 60 Issue 2, p135-150, 16p. Ebsco)

First, nuclear proliferation is not a problem because nuclear weapons have not proliferated. "Proliferation" means to spread like wildfire. We have had nuclear military capability for over fifty years, and we have a total of nine militarily capable nuclear states. That's hardly proliferation; that is, indeed, glacial spread. If another country gets nuclear weapons, and if it does so for good reasons, then that isn't an object of great worry. Every once in a while, some prominent person says something that's obviously true. Recently, Jacques Chirac [president of France] said that if Iran had one or two nuclear weapons, it would not pose a danger. Well, he was right. Of course, he had to quickly retract it and say, "Oh no, that slipped out, I didn't know the microphone was on!" Second, it doesn't matter who has nuclear weapons. Conversely, the spread of conventional weapons makes a great deal of difference. For instance, if a Hitler-type begins to establish conventional superiority, it becomes very difficult to contain and deter him. But, with nuclear weapons, it's been proven without exception that whoever gets nuclear weapons behaves with caution and moderation. Every country--whether they are countries we trust and think of as being highly responsible, like Britain, or countries that we distrust greatly, and for very good reasons, like China during the Cultural Revolution--behaves with such caution.

2AC AT: Nanotechnology Bad – Bioterrorism

Nanotech solves Bioterrorism and Bioweapons by creating early warning systems and technology for rising threats.

Michael Berger 2007(“Nanotechnology barcodes to quickly identify biological weapons”, Nano Werk, "Metallic Striped Nanowires as Multiplexed Immunoassay Platforms for Pathogen Detection", writer for Nano Werk, http://www.nanowerk.com/spotlight/spotid=1585.php)

In an effort to detect biological threats quickly and accurately, a number of detection technologies have been developed. This rapid growth and development in biodetection technology has largely been driven by the emergence of new and deadly infectious diseases and the realization of biological warfare as new means of terrorism. To address the need for portable, multiplex biodetection systems a number of immunoassays have been developed. An immunoassay is a biochemical test that measures the level of a substance in a biological liquid. The assay takes advantage of the specific binding of an antigen to its antibody, the proteins that the body produces to directly attack, or direct the immune system to attack, cells that have been infected by viruses, bacteria and other intruders. Physical, chemical and optical properties that can be tuned to detect a particular bioagent are key to microbead-based immunoassay sensing systems. A unique spectral signature or fingerprint can be tied to each type of bead. Beads can be joined with antibodies to specific biowarfare agents. A recently developed novel biosensing platform uses engineered nanowires as an alternative substrate for immunoassays. Nanowires built from sub-micrometer layers of different metals, including gold, silver and nickel, are able to act as "barcodes" for detecting a variety of pathogens, such as anthrax, smallpox, ricin and botulinum toxin. The approach could simultaneously identify multiple pathogens via their unique fluorescent characteristics. "The ability to miniaturize and adapt traditional bench-top immunoassay protocols to a fully automated micro-or nano-fluidic chip holds tremendous promise to enable multiplex, efficient, cost-effective and accurate pathogen sensing systems for both biodefense and medical applications," says Jeffrey B.-H. Tok, a researcher at Lawrence Livermore National Laboratory (LLNL). The team, led by LLNL and including researchers from Stanford University, the UC-Davis Center for Biophotonics and Nanoplex Technologies, used multi-striped metallic nanowires in a suspended format to rapidly identify sensitive single and multiplex immunoassays that simulated biowarfare agents ranging from anthrax, smallpox and ricin to botulinum. The entire assay can be performed within 3–4 h, thus making it feasible to be employed on a rapid diagnostic platform. The core of this portable nanotechnology bioweapon-recognition system consists of two parts: Nanowires with a diameter of about 250 nm and a length of about 6 µm are electrochemically formed and then layered with bands of silver, gold and nickel to produce patterns that are similar to the ubiquitous barcodes found on products worldwide. The other part is an assortment of antibodies, which are essentially glued to the nanowires. Each type of pathogen calls for a unique antibody which is attached to the nanowires each antibody type with its unique "barcode". The reflection pattern and fluorescence from each stripe sequence can later be clearly recognized, similar to a barcode on a retail product. "In the end you will have a pool of various striped nanowires, each of which will have a unique antibody assigned to it, which is to detect for that particular pathogen," Tok explained. To identify pathogens, the barcoded, antibody-carrying nanowires are floated in a neutral liquid called an assay buffer, into which samples of suspected pathogens are injected. If an antigen associated with a pathogen meets its corresponding antibody, the two will join, creating a nanowire/antibody/antigen sandwich that will fluoresce, or glow, under a special light. "An important advantage of the system" Tok said, "is that many kinds of barcoded antibodies can be mixed together in the assay buffer liquid, which can be used over and over. In theory, we could interrogate for as many as 100 different striped nanowires in one single snapshot, which makes the analysis very fast." The system not only applies to biowarfare agents, but could also be used during an outbreak of an infectious disease. Ongoing work at LLNL is focused on incorporating the assay onto a microfluidic device to allow for a portable biosensing system for biological warfare agents. The platform will ultimately enable an affordable and portable multiplex biodetection system for both first responders and clinicians such that the identity of the infectious agents can be accurately detected and confirmed, thus facilitating point-of-care applications.

**Even if nanotech can’t prevent bioterror, it’ll mitigate the impact**

**Berry** 20**02** (Mark Berry is a writer for the K-State Prospectives, Spring 2002, “Nanotechnology can fight terrorism” accessed 7/11/10 https://www.k-state.edu/media/webzine/0101/nanotechnology.html aes)

"They are of use in protecting soldiers and civilians from chemical warfare and biological warfare," he said. "Since the terrorist attacks, a lot more attention has been focused on our company, mainly from the government but also from places like fire departments and those who would be a first responder in the event of an attack." Nanoparticles have a variety of uses. Klabunde said the company is working on nanoparticles that would stop biological warfare weapons such as germs, bacteria and spores like anthrax. Nanoparticles could be used to protect crops and livestock against bioterrorism. They come in a dry powder, which detoxifies chemicals it comes into contact with. It can be sprayed, fogged or used in an air filter. "They could be for the military, to protect from chemical warfare or it could be used in a hotel to protect from cigarette smoke," Klabunde said. Nanoparticles are tiny. For example, one could fit as many nanoparticles into a grain of sand as one could fit grains of sand into a one-kilometer cube. They aren't made from anything exotic, but from simple salts like magnesium oxide and calcium oxide, better known as lime. It's their size that gives them such unusual properties. Nanoparticles are bigger than atoms, but much smaller than objects we can see. It's at this mid-sized level where elements do strange things. Gold, for example, looks shiny and yellow to us. But at the nano-level, it turns purple. It's melting point changes and it forms crystals. Increase or decrease the size of a nanoparticle, and its properties change all over again. "That's the whole key to why nanoparticles are so hot," Klabunde said. "These little particles change change their stripes with size change." Klabunde said the nanoparticles do a better job of cleaning up toxins than larger chemicals, partly because of their small size. After all, a pound of sand absorbs more water than a one-pound rock, because the surface of each grain of sand can touch the water. Nanoparticles, with their much smaller size, are even more reactive. Nanoparticles also have a different shape than ordinary chemicals. Like a many-faceted jewel, they have many edges and corners that allow it to latch onto toxic chemicals and nullify them. Military lab experiments have proven that the nanoparticles created by Nanoscale Materials work, Klabunde said. The company has a small plant now, but it's not big enough to mass-produce nanoparticles. He said they plan to eventually build a factory large enough to be able to produce large amounts for their clients. Klabunde started the company in 1995, with the help of Ron Sampson and the Mid-America Commercialization Corporation, based in Manhattan. Klabunde, university distinguished professor of chemistry, is the company's main consultant. The company recently gained a new board chairperson, K-State alumnus Bill Sanford. Sanford started his own company, Steris Corporation, about 20 years ago. When he sold it recently, it was worth $2 billion on the stock market. Nanotechnology is a new science, but it has already sparked predictions of what it will do in the next 10 to 20 years — computers that are driven by light, improved refrigerators and better batteries are a few. With the whole periodic table of elements to work with, Klabunde said, there are many possibilities for future chemical nanoparticles. "Right now, we're concentrating on the chemical properties. That's where our expertise is and we'll do that for the next few years. If the company grows, we'll probably expand out into electronic materials, but we've got to focus on what we're good at right now," Klabunde said.

2AC AT: Nanotechnology Bad – Terrorism

Nano developments provide surveillance systems that solve terror

NanoTechWire ‘5 [“Nanotechnology breakthrough by Imperial College will help the war against terrorism,” 8/26/05, http://nanotechwire.com/news.asp?nid=2254]

Ingenia Technology Limited today launches an exciting breakthrough proprietary technology, developed by Imperial College London and Durham University - the Laser Surface Authentication system (LSA). The LSA system recognises the inherent 'fingerprint' within all materials such as paper, plastic, metal and ceramics. The LSA system is a whole new approach to security and could prove valuable in the war against terrorism through its ability to make secure the authenticity of passports, ID cards and other documents such as birth certificates. This technological breakthrough has been masterminded by Professor Russell Cowburn, Professor of Nanotechnology in the Department of Physics at Imperial College London. Every paper, plastic, metal and ceramic surface is microscopically different and has its own 'fingerprint'. Professor Cowburn's LSA system uses a laser to read this naturally occurring 'fingerprint'. The accuracy of measurement is often greater than that of DNA with a reliability of at least one million trillion. The inherent 'fingerprint' is impossible to replicate and can be easily read using a low-cost portable laser scanner. This applies to almost all paper and plastic documents, including passports, credit cards and product packaging. As well as the security implications, the technology can be applied to commercial applications, particularly packaging. For example, in the case of pharmaceuticals, up to 10% of all pharmaceuticals are counterfeits either containing little or no active ingredients. They can be easily identified with this new technology. Inspection agencies and customs controls could use the technology to confirm the identity of imported goods and prevent counterfeit. This could potentially save millions through the avoidance of fraud and reduce the flow of funds to would-be terrorists. The nearest comparisons to this technology are: barcodes, holograms and watermarks. The main difference is that these products are overt, and therefore more liable to abuse, whereas Professor Cowburn's is covert (invisible to the naked eye). Also Professor Cowburn's technology is resistant to damage and cannot be copied. The LSA system has been brought to market by Ingenia Technology Limited, a London-based company which deploys nanoscience to create secure systems. "Our findings open the way to a new and much simpler approach to authentication and tracking. This is a system so secure that not even the inventors would be able to crack it since there is no known manufacturing process for copying surface imperfections at the necessary level of precision. "This system can be a powerful weapon against fraud, terrorism and identity theft," said Professor Cowburn.

Nano solves terrorism – intelligent sensors and the ability to find wmds

**Quain 2004** [John, “Homeland Security Gets Small”, PC Magazine, 1/20, asp//wfi-tjc]

Ultimately, fighting the war on terrorism may have less to do with giant aircraft carriers and more to do with atomic-scale detection and prevention systems. Nanotechnology, which is expected to transform everything from computer processors to drug delivery systems, may also be the key to homeland security, argues a new book. In Nanotechnology and Homeland Security: New Weapons for New Wars (Prentice Hall, 2003), Mark A. Ratner, a professor of chemistry at Northwestern University and a noted expert in molecular electronics, and his son Daniel Ratner, a high-tech entrepreneur, claim that current research in nanotechnology will lead to intelligent sensors, smart materials, and other methods for thwarting biological and chemical attacks. "The number-one thing," says Daniel Ratner, "is going to be smart sensors. These could be immensely useful in finding weapons of mass destruction, for example. Today, you need a lab, and it takes days to analyze samples. In the future, a lab on a chip with nano-based sensors could give you a result in seconds." Such devices could also protect seaports by scanning all incoming shipping containers. Like reusable litmus paper, nanodot particles could instantly change color upon detecting the presence of anthrax DNA strands. And when sensors aren't enough, nanotechnology could be used to minimize the effects of terrorist attacks. "There are products coming for explosive mitigation," explains Daniel Ratner. "One is a blast-retardant foam that acts like an airbag for buildings and could be used in future construction." While the authors believe nanotech research will be essential to homeland security, Daniel Ratner says, "The biggest advances are still three, five, and up to ten years away."

Nano key to counterterrorism – sensors can detect and prevent WND attack, hijacking and mitigate damage

**Ratner** (executive and author) **2004**

[Dan, “It’s a Small World After All”, USA Today, May, asp/]

Nanotechnology not only promises to be a great economic driver, but will address, one of the U.S.'s major concerns--homeland security. After the Sept. 11, 2001, terrorist attacks, American citizens rightfully are apprehensive about their safety. Nanotechnology, while not the ultimate solution, offers many options that can make terrorist plots much more difficult to implement as well as mitigating the impact of any attacks that do take place. For instance, if you travel through an airport, you are subjected to invasive, but ultimately very limited, security. Metal detectors and X-rays are somewhat effective in finding guns and knives; swab tests can identify certain types of explosives; and canine teams sometimes can root out bombs, drags, or other contraband. However, several modes of explosives (including those often employed against Israel) are very difficult to detect using current swab tests, as are various chemical and biological weapons. Viral DNA does not have a detectable scent and many chemical weapons are odorless. On a nanoscale, however, the picture is quite different. For example, DNA's tendency to bind only to certain complementary DNA for biotoxins--as well as the shape and geometry of individual molecules used for chemical weapons--makes detection not only possible, but quick, easy, and accurate. Companies such as Nanosphere, Inc., Northbrook, Ill., already have sensors the size of large laptop computers to detect anthrax and other toxins. These are just the beginning. Using another technique called lab-on-a-chip, tests soon will be integrated onto a single device that will be able to carry out hundreds, thousands, or even hundreds of thousands of tests simultaneously, with a trigger limit as low as several dozen molecules of bioagent--many times more precise than any canine. These screening tests are useful in more than airports. They could be added to postal-sorting facilities, container ports, water-pumping stations, even the air-handling systems of high-rise buildings. They will give early warning of threats while it still is possible to intercept a potential attack. They also have dual-use applications--a sensor that can detect viral DNA at an airport can do so in a doctor's office, allowing near instantaneous point-of-care diagnosis for anything from cancer to influenza. Sensors, though, are not the only way in which nanotechnology will enhance homeland security. Once an incident such as a terrorist attack, massive industrial accident, or natural disaster--the effects can be very similar--has occurred, the damage must be mitigated. For example, the collapse of the World Trade Center's Twin Towers occurred not because of the impact of the jetliners, but because the extreme heat of burning jet fuel weakened the steel that supported the structures. The development of nanoengineered materials combining the strength and flexibility of steel with the heat-resistant properties of ceramics is underway. Such materials not only would resist burning jet fuel, but when combined with nanotech fire safety glass and other advanced materials, could make a building highly resistant to explosives and fire. Protection against chemical and biological weapons is vital as well. Gas masks and water filters usually operate either by adsorbing a hostile chemical or by microfiltration, which involves channeling air or water through a sieve too fine for bacteria to penetrate. Before nanotechnology, the adsorbents available for this purpose (such as activated charcoal or carbon, in use since World War I) were effective on a fairly small class of chemical threats, and microfiltration, while effective against many bacteria, is not fine enough to filter out viruses since they are much smaller.

2AC AT: Nanotechnology Bad – Arms Race/ War

**Nanotech is humanity’s final arms race – the winner wins it all.**

Marlow, 2004(John Robert, Interview on the Superswarm Option Nanotechnology Now, February, John is a novelist, freelance journalist, and screenwriter with a strong interest in advanced/disruptive technologies. Nano is his first novel, http://www.nanotech-now.com/John-Marlow-Superswarm-interview-Feb04.htm)

As stated in the Nano novel, Marlow's Second Paradox is this: "Nanotechnology must never be developed, because it is too dangerous a thing to exist; nanotechnology must be developed-because it is too a dangerous a thing to exist in the hands of others." The first rationale-Bill Joy's relinquishment option-will be ignored. The second will drive the race for nanosuperiority. The first nanopower will, if it plays its cards right, remain unchallenged for the foreseeable future-assuming there remains a future to foresee. This is so because it will be possible to use the technology itself to prevent all others from deploying it, or to simply annihilate all others. In the entire history of the human race, there has never been such a prize for the taking, and there likely never will be again. We are embarked upon what is quite possibly [hu]Mankind's final arms race. Caution may not be a factor, because the losers in the nanorace will exist only at the whim of the winner, and many will see themselves as having nothing to lose, and the world to gain. Consider: China holds third place among nations for nanotech patents. Consider also, from Gannett News Service (February 20, 2000): "Chinese military specialists urge the development of 'magic weapons' that would allow an 'inferior to defeat a superior enemy.' The report quotes General Pan Jungfeng as calling the United States 'the enemy.' " Draw your own conclusions. Given this situation, these facts, the occasional incompetence of governments and of militaries in particular, and human nature itself-the earth may well be doomed. This is the way the world ends.

Nanotech is key to peace and infinite wealth

Drexler (leading nano expert, Foresight Insitute) 86 [K. Eric, Engines of Creation, foresight.org //wfi-tjc]

This, then, is the size of the future's promise. Though limits to growth will remain, we will be able to harvest solar power a trillion times greater than all the power now put to human use. From the resources of our solar system, we will be able to create land area a million times that of Earth. With assemblers, automated engineering, and the resources of space we can rapidly gain wealth of a quantity and quality beyond past dreams. Ultimate limits to lifespan will remain, but cell repair technology will make perfect health and indefinitely long lives possible for everyone. These advances will bring new engines of destruction, but they will also make possible active shields and arms control systems able to stabilize peace. In short, we have a chance at a future with room enough for many worlds and many choices, and with time enough to explore them. A tamed technology can stretch our limits, making the shape of technology pinch the shape of humanity less. In an open future of wealth, room, and diversity, groups will be free to form almost any society they wish, free to fail or set a shining example for the world. Unless your dreams demand that you dominate everyone else, chances are that other people will wish to share them. If so, then you and those others may choose to get together to shape a new world. If a promising start fails - if it solves too many problems or too few then you will be able to try again. Our problem today is not to plan or build utopias but to seek a chance to try

Threats from nanotech WMD are inevitable with any development – deterrence is key to prevent escalation

Elbridge A. Colby is an adjunct staff member at the RAND Corporation and is a member of the International Institute of Strategic Studies and an expert adviser to a government commission on strategic issues, June July/ 2008, http://gees.org/documentos/Documen-03070.pdf, “Expanded Deterrence”; AB

We are facing a threat that is catastrophic in its scale. 1 The damage that even a single attack with weapons of mass destruction would wreak could run into the millions of lives, and do egregious damage to American economic, political, and social structures. There is no graver threat to the United States. This threat is only going to get more serious. The progress of technology and the increasing interconnectedness of global systems are driving both productive and destructive power down, to lower and lower levels of agency, and outwards, to the fringes of society. Accelerating advances in computing, biotechnology, nanotechnology have democratized destructive power — up to the point at which a single individual may have the power to do enormous damage. 2 Today we see this peril most plainly in the justified fears about the use of the first and greatest absolute weapon — the nuclear bomb. But the threat of biological and biotechnological weaponry, powered by the highly diffused and swiftly advancing progress of the life sciences, may be even graver. Similar dangers are growing in the fields of nanotechnology, computing, and the like. The proliferation of massively destructive technologies can and should be retarded, but it cannot be prevented. We must accept both that the threat is very real and that it cannot be “solved,” only managed. The United States has begun to respond to this grave threat through a “layered defense” that includes military, intelligence, diplomatic, political, public diplomacy, homeland defense, and humanitarian components. This policy commendably seeks to integrate all elements, hard and soft, of American and allied power to stave off disaster. And all elements of this layered defense are important in preventing attacks, including efforts to stem proliferation and “soft power” strategies designed to address real root causes of terror. Proliferation of massively destructive technologies cannot be prevented. It cannot be “solved,” only managed. Unfortunately, the current policy is insufficient. Prevention and defense, while clearly central, cannot alone address our problem. An attempt to prevent the proliferation of all potentially catastrophic technologies or to build effective defenses against them would be far too costly, both in terms of resources and political capital. More important, the advent of the nuclear weapon and now, in its wake, of comparably destructive technologies has finally decided the age-old struggle between offense and defense in favor of the former. It is not that defense cannot be effective; it is that, given the destructive power of the weapons in question, defense must be perfect. And no policy of prevention and defense can promise that. Toleration is another critical element in our response. We balance the needs of a free society that can produce and distribute goods and ferry people efficiently against the costs of car accidents, plane and train crashes, and pollution. But, obviously, any significant incidence of catastrophic attacks cannot be tolerated, certainly not if we wish to maintain our society as we currently enjoy it. Another pillar is the positive incentive structure associated with sociable behavior. The forces of habit, social conformity, ritual, and morality suffice to draw most people into the system. Unfortunately, terrorists are precisely those who are not susceptible to these positive incentive structures. While any effective counterterrorist or counterinsurgency strategy must include carrots, there is invariably a group of those resistant to any reasonable offers. Furthermore, some contests are zero-sum and therefore there may be an irresolvable tension between what some of our opponents want and what we can give. Likewise, direct deterrence against terrorists is an important tool, and is the cornerstone of law and order both in the domestic and international contexts. But, as many have pointed out, terrorists are hard — and sometimes impossible — to deter directly. Clearly, people willing to kill themselves in order to conduct terrorist attacks are unlikely to be deterred by direct threats. While these approaches are substantially effective, they leave a major gap in our ability to prevent catastrophic terror attacks. We can be neither omniscient nor omnipotent, and therefore prevention and defense are limited in a world where destructive power is spreading downwards and outwards. We cannot tolerate catastrophic attacks in a world of weapons of mass destruction. We cannot hope to convince all terrorists to behave through positive incentives when some are fanatics, cultists, or simply pursuing objectives the U.S. can never concede. And we cannot rely on direct deterrence when many are willing to sacrifice their very lives in pursuit of their aims. Our traditional approach to the problem is therefore insufficient to meet the danger. Expanding deterrence If there can be no escape from the presence of terror, then we must respect and adapt to it. The best approach to this threat would involve shifting the burden for preventing catastrophic attacks onto those who have the capability and moral responsibility to prevent them — effectively expanding deterrence. In doing so we would be engaging the assistance, through a combination of threats and incentives, of those whom a more narrow vision would consider unimplicated. This expansive but carefully and reasonably defined category would encompass not only those directly involved in a terror plot, but those individuals, governments, or other entities whose material support, cooperation, complicity, or gross negligence enabled an attack. (These terms, while they would need to be defined more specifically in a formal policy, have settled meanings in American law that could, with some modifications, be transferred to the international arena. ) This posture would strongly incentivize those with the capability to act to do so, since gross negligence or complicity would incur retaliation (not necessarily, it should be emphasized, violent in nature). And our demands would be reasonable, because all we would be asking for is active assistance in preventing catastrophic attacks from those who, despite their own involvement — active or passive — in such attacks, benefit from the restraint of our current, excessively narrow posture. Willful inaction in the face of catastrophic threats against the United States is permitted to pass with impunity. n effect, we would simply be bringing to bear the real correlation of factors, matching accountability with responsibility and capability. In today’s anachronistic and unbalanced system, willful inaction in the face of catastrophic threats against the United States is permitted to pass with impunity, despite our clear capability and moral grounds to increase the costs of such disastrously harmful behavior. An expanded framework of deterrence would rebalance the calculus of threats and duties to match obligation with responsibility, backed by the threat of credible retaliation. This policy is necessary, moral, and hardly newfangled. The threat posed by a catastrophic attack is so great that we cannot allow any reasonable effort to go unpursued in the attempt to frustrate one. The people of the United States should not be the ones most concerned about a wmd attack on the homeland. Rather, the people most afraid of such an event should be those who have the ability and the moral responsibility to frustrate it. The policy would reset the conceptual parameters for accountability for frustrating such strikes and, in the event of an attack, broaden those understood to be appropriate targets of retaliation. Its ultimate object would be to inspire among the complicit and the negligent a considerably greater fear of American wrath, a fear that would outweigh whatever combination of fear and affection our terrorist enemies are able to inspire

2AC AT: Nanotechnology Bad – Grey Goo

Fears of ‘grey goo’ are outlandish and based on dated information

Center for Responsible Nanotechnology, 2003 (“Grey Good is a Small Issue” December 13, http://crnano.org/BD-Goo.htm)

Fear of runaway [nanobots](http://crnano.org/BD-Nanobots.htm), or “grey goo”, is more of a public issue than a scientific problem. Grey goo as a result of out of control nanotechnology played a starring role in an article titled "[The Grey Goo Problem](http://www.nytimes.com/2003/12/14/magazine/14GRAY.html%20\%20_blank)" by Lawrence Osborne in today's [*New York Times Magazine*](http://www.nytimes.com/pages/magazine/index.html%20\%20_blank). This article and other recent fictional portrayals of grey goo, as well as statements by scientists such as [Richard Smalley](http://crnano.org/Debate.htm), are signs of significant public concern. But although biosphere-eating goo is a gripping story, current [molecular manufacturing](http://crnano.org/crnglossary.htm%20\%20Molecular) proposals contain nothing even similar to grey goo. The idea that nanotechnology manufacturing systems could run amok is based on outdated information. The earliest proposals for molecular manufacturing technologies echoed biological systems. Huge numbers of tiny robots called “[assemblers](http://crnano.org/crnglossary.htm%20\%20Assembler)” would self-replicate, then work together to build large products, much like termites building a termite mound. Such systems appeared to run the risk of going out of control, perhaps even “eating” large portions of the biosphere. Eric Drexler warned in 1986, “We cannot afford certain kinds of accidents with replicating assemblers.” Since then, however, Drexler and others have developed models for making safer and more efficient machine-like systems that resemble an assembly line in a factory more than anything biological. These mechanical designs were described in detail in Drexler's 1992 seminal reference work, [*Nanosystems*](http://www.foresight.org/Nanosystems/toc.html%20\%20_blank), which does not even mention free-floating autonomous assemblers. Replicating assemblers will not be used for manufacturing. Factory designs using integrated nanotechnology will be much more efficient at building products, and a [personal nanofactory](http://crnano.org/bootstrap.htm) is nothing like a grey goo nanobot. A stationary tabletop factory using only preprocessed chemicals would be both safer and easier to build. Like a drill press or a lathe, such a system could not run wild. Systems like this are the basis for responsible molecular manufacturing proposals. To evaluate Eric Drexler's technical ideas on the basis of grey goo is to miss the far more important policy issues created by general-purpose nanoscale manufacturing. A grey goo robot would face a much harder task than merely replicating itself. It would also have to survive in the environment, move around, and convert what it finds into raw materials and power. This would require sophisticated chemistry. None of these functions would be part of a molecular manufacturing system. A grey goo robot would also require a relatively large computer to store and process the full blueprint of such a complex device. A nanobot or nanomachine missing any part of this functionality could not function as grey goo. Development and use of molecular manufacturing will create nothing like grey goo, so it poses no risk of producing grey goo by accident at any point.

‘Grey Goo’ is science fiction – nanotechnology can be built without self replicating. Their authors are just fear-mongering.

Institute of Physics, 2004 (“Nanotechnology pioneer slays “grey goo” myths” July 6, http://www.iop.org/EJ/news/-topic=763/journal/0957-4484)

Eric Drexler, known as the father of nanotechnology, today (Wednesday, 9th June 2004) publishes a paper that admits that self-replicating machines are not vital for large-scale molecular manufacture, and that nanotechnology-based fabrication can be thoroughly non-biological and inherently safe. Talk of runaway self-replicating machines, or “grey goo”, which he first cautioned against in his book Engines of Creation in 1986, has spurred fears that have long hampered rational public debate about nanotechnology. Writing in the Institute of Physics journal Nanotechnology, Drexler slays the myth that molecular manufacture must use dangerous self-replicating machines. “Runaway replicators, while theoretically possible according to the laws of physics, cannot be built with today’s nanotechnology toolset,” says Dr. Drexler, founder of the Foresight Institute, in California, and Senior Research Fellow of the Molecular Engineering Research Institute (MERI). He continued: “Self-replicating machines aren't necessary for molecular nanotechnology, and aren’t part of current development plans.” The paper, Safe Exponential Manufacturing by Chris Phoenix, Director of Research of the Center for Responsible Nanotechnology, (CRN) and Dr. K. Eric Drexler, also warns that scaremongering over remote scenarios such as “grey goo” is taking attention away from serious safety concerns, such as a deliberate abuse of the technology. Phoenix said: “Runaway replication would only be the product of a deliberate and difficult engineering process, not an accident. Far more serious, however, is the possibility that a large-scale and convenient manufacturing capacity could be used to make powerful non-replicating weapons in unprecedented quantity, leading to an arms race or war. Policy investigation into the effects of molecular nanotechnology should consider deliberate abuse as a primary concern, and runaway replication as a more distant issue.”

The scientist who first promulgated the ‘grey goo’ theory has since rejected – self replicating nanobots are only possible in Michael Chriton’s novels

Kalaugher, 2004 (Liz, Northwestern University, “ Grey Goo and Other Scary Stories” June 9, http://www.discovernano.northwestern.edu/affect/societalimpact/scarystories)

In 1986, Dr. Eric Drexler published his book entitled *Engines of Creation*. The book included Drexler’s fears about the future of nanotechnology and vividly described the possibility of miniature devices called “nanobots,” capable of reproducing themselves and eventually taking over the planet. He labeled the resulting mess “grey goo” and the notice generated a great deal of fear (not to mention subject matter for a number of science fiction writers). Since then, researchers have learned enough about nano-manufacturing to declare the grey goo scenario “obsolete.” In a 2004 interview, Eric Drexler stated, “Updated molecular manufacturing concepts…make fears of accidental runaway replication - loosely based on my 1986 grey goo scenario - quite obsolete. Chris Phoenix [of the Center for Responsible Nanotechnology] and I wrote the paper to counter the main threat posed by grey goo, which is that all the hype diverts attention from more important issues - research directions, development paths, and the role of advanced nanotechnologies in medicine, the environment, the economy, and in strategic competition.” About the time that the “nanobots” story was cooling off, Michael Crichton’s science fiction thriller *Prey* was released in bookstores. In Crichton's book, miniature devices called “nano-robots” capable of reproducing themselves, eventually take over the world. Sound familiar? Although the story is about as possible as the story lines from Crichton’s other works like *Jurassic Park*, there are just enough scientific facts sprinkled into the story to make it sound somewhat plausible. While there are still many unknowns surrounding nanotechnology, it’s important to separate the science fact from the science fiction. The majority of nanotechnology research focuses on issues other than nanobots, and specifically the design of new materials with properties that derive from their size and composites, and which can be used to make a positive impact in fields ranging from medicine to energy conversion and storage.

2AC AT: Nanotechnology Bad – Economy

Nanotech is key to the economy – commercialization capital

Scott Rickert, PhD and former professor at Case Western Reserve University, 10/12/11, http://www.industryweek.com/emerging-technologies/nanotechnology-us-economy-and-you, “Nanotechnology, the U.S. Economy And You”; AB

I witnessed an American revolution catch fire in Boston, and I feel like a latter-day Paul Revere. "The nanotech economy is coming, the nanotech economy is coming!" and that's good news for the U.S. -- and you -- because we're at the epicenter. The scene of the revolution I'm talking about was the Nanomanufacturing Summit and Annual NanoBusiness Conference in Boston. There, 250 nanotechnology leaders from science, business and government gathered to take stock and look ahead. What did I see at the revolution? Three crucial transformations coming together to reshape business and the economy. Nanotechnology commercialization is a fact. Nanotechnology will lead the U.S. out of the economic slump and into global strength. Private and public sectors are working together to make sure that happens. Let's start with commercialization. Ten years ago, when I walked into the inaugural version of this conference, I was one of the few with money-making nanotechnology products on the market. This time? The sessions were packed with executives from multi-million dollar businesses, and the chatter was about P&L as much as R&D. Nano-companies are defying Wall Street woes and going public. And even academics were talking about business plans, not prototypes. What triggered the change? The virtually infinite platform of nanotechnology is now powering scores and scores of vertical markets through partnerships, customer relationships and licensing. It's now widely accepted as the strong, innovative link in existing -- and profitable -- supply chains. In fact, for many large companies, nanotechnology is now simply business as usual. Folks like Lockheed Martin, GE and others, who at one time needed to troll these conferences for emerging technology, now simply buy "off-the-rack." Nanotechnology is, quite simply, the new normal in manufacturing. That capability is the driver that is taking the U.S. out of the economic doldrums and into global strength. As I noted in a keynote address to the conference, one country -- our country -- accounts for about 35% of the global nanotechnology markets. That's 35% of a $1.6 trillion market by 2013. The reason? Nanotechnology equals complexity. It demands high-level knowledge and a pool of skilled knowledge-workers. We've got it here. Dollar-a-day hands simply can't get the job done. Nanotechnology will continue to be the lever that moves the manufacturing world, so instead of exporting jobs, America will be exporting nano-enabled products. Dozens of companies from Europe, Asia and the Middle East were at the conference. Their goal was tapping into the American know-how for making science into business. Some were there to buy. Some were looking to invest. More than a few were making plans to set up facilities in America, to be close to the nanotech centers of power. And others were simply trying to learn our go-to-market strategies to help inform their own. Our government leaders joined the Boston nano-revolution, too. Representatives from Congress, The White House, regulators and funders were visible and vocal. They know innovation is the key to rebuilding the economy and that the U.S. has an undeniable edge. What other technologies have the depth of unexplored potential? What other platform can support so many product verticals? Nanotechnology is the core of the new economy, led by savvy entrepreneurs who are ready to run, and Washington is committed to supporting sensible regulation and smart investment.

Nanotech key to economy and competitiveness – it’s the new industrial revolution

Shapira, a Professor with the School of Public Policy at Georgia Institute of Technology, is a leading expert on technology and innovation processes and policies and their impacts on economic and regional development and industrial competitiveness and Porter, an emeritus professor in industrial and systems engineering and in public policy at Georgia Tech, “Nanotechnology: Will It Drive a New Innovation Economy for the U.S.?”; http://www.pewtrusts.org/events\_detail.aspx?id=49832; AB

The current economic downturn highlights the importance—and challenges—of building a new 21st century innovation economy for America. To move beyond the current crisis, we need to retain and create advanced manufacturing and knowledge-intensive jobs, invest in green science and engineering research, and ensure the competitiveness of U.S. technology-based industries and workers. Nanotechnology - which some scientists and business leaders hail as ushering in the next technology-driven Industrial Revolution - promises to be one of the critical foundations for this new innovation economy. Nanotechnology is still early in its development cycle, although a variety of nano-enabled products are already on the world market in clothing, cosmetics, washing machines, and sports equipment. Numerous novel nanotechnology applications with more radical capabilities and implications are foreseen across the economy, including in aerospace, construction, electronics, environment, medicine, and security.

2AC AT: Colonization Bad – Weaponization

1.) Military, technical and political factors prove weapons not inevitable

Nina Tannenwald is an PhD @ Cornell, Associate Research Professor at Brown University's Watson Institute for International Studies, April 2003, http://www.cissm.umd.edu/papers/files/tannenwald.pdf, “ Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space”; AB

What accounts for the lack of an arms race in space so far? Explanations emphasize a set of military, technical, political, organizational, and ideational factors. According to Paul Stares, the explanation lies in the "convergence of national interests, military disincentives and technical constraints, which were buttressed at important times by formal agreements." U.S. policymakers recognized that space weapons offered few military advantages. They faced serious technical constraints, and also wanted to project a "peaceful" image of the U.S. space program. Organizational factors reinforced these considerations, as the Air Force interest in space declined for a lengthy period in the 1960s and 1970s. Other explanations emphasize the common interest of the superpowers in avoiding an ASAT race. Both the United States and the Soviet Union recognized the mutual benefits of reconnaissance satellites and reached a "tacit" agreement to refrain from developing weapons to counter them. Satellites provided mutual reassurance and thus strengthened the system of stable nuclear deterrence. As Stares emphasizes, the practice of keeping space free of weapons has been reinforced over the years by formal agreements (e.g. the 1963 UN resolution banning weapons of mass destruction from space, later codified in the Outer Space Treaty; and the ABM treaty). The international community has repeatedly reaffirmed support for the nonweaponization norm in numerous UN resolutions and diplomatic statements.

2.) Deterrence checks space weapons

Michael Krepon, is the co-founder of the Henry L. Stimson Center, a Diplomat Scholar at the University of Virginia, February–March 2008, http://www.carnegieendowment.org/files/SurvivalTellis.pdf, “China’s Military Space Strategy: An Exchange”; AB

US military guidance calling for space superiority does not foreclose hit-to-kill ASATs, but the Pentagon prefers to use temporary and reversible effects in space warfare. But once this Pandora’s Box is opened, and the first satellite in military history is attacked in combat, not everyone may choose to fight by Marquis of Queensbury rules. Asymmetric warfare applies in space, no less than on the ground. Because every spacefaring nation can lose badly in the event that vulnerable and essential satellites are damaged or destroyed, a rudimentary form of deterrence against satellite warfare existed during the Cold War. It continues to exist today. Deterrence of satellite warfare was far simpler and less expensive than nuclear deterrence because so much latent capability existed to harm satellites. Dedicated ASAT tests weren’t needed; they were kept to a minimum because they were provocative and dangerous.

1AR AT: Colonization Bad – Weaponization

More reasons why no weaponization:

1.) Political deadlock- No backing for space weapons

Nina Tannenwald is an PhD @ Cornell, Associate Research Professor at Brown University's Watson Institute for International Studies, April 2003, http://www.cissm.umd.edu/papers/files/tannenwald.pdf, “ Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space”; AB

Although SPACECOM and its supporters aggressively assert their views, advocates of weapons in space may be in the minority, even in the Pentagon. As many observers recognize, the interests of the United States in space are much broader than SPACECOM presents. U.S. testing and deployment of orbital weapons could make using space for other military and commercial purposes more difficult. Many in the military, especially those involved in crucial military support activities, are quietly aware of this, as are officials at NASA and the international space station, and their supporters in Congress. Congressional support for antisatellite (ASAT) programs does not appear to be deep or widespread. Serious questions remain as to whether the threats to U.S. assets in space are really as great as SPACECOM argues, and whether, even if the threats were real, expensive and difficult space-based weapons would really be the most effective way to deal with them. In many cases, those wishing to hurt the United States will likely find it much easier, and more effective, to attack terrestrial targets.

2.) National interest- International consensus of no weapons

Nina Tannenwald is an PhD @ Cornell, Associate Research Professor at Brown University's Watson Institute for International Studies, April 2003, http://www.cissm.umd.edu/papers/files/tannenwald.pdf, “ Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space”; AB

Most tellingly, the Department of Defense’s Nuclear Posture Review, portions of which were leaked in March 2002, reportedly advocates the use of space-based assets to enhance conventional and nuclear strike capabilities. In October 2002, SPACECOM merged with the U.S. Strategic Command, which controls U.S. nuclear forces, to create a single entity responsible for early warning, missile defense, and long-range strikes. 17 The Pentagon has requested $1.6 billion dollars over FY 2003-2007 to develop space-based lasers and kinetic kill vehicles to intercept and destroy ballistic missiles (as well as to destroy satellites). 18 Providing further evidence of high-level support for the global engagement strategy, the Bush administration’s decision to withdraw from the 30-year old Anti-Ballistic Missile (ABM) Treaty appeared to be less a necessary move driven by technical needs of missile defense testing (since much testing could be done within the terms of the treaty, and deployment of a feasible system is not imminent) than a symbolic move to sweep away inconvenient legal obstacles to U.S. power projection in space. 19 This vision of national dominance, the rest of the world, and especially China, contends, is incompatible with the established legal regime in space. 20 The international community has for over forty years repeatedly reaffirmed that space should be preserved for peaceful purposes, should be available to all, and should be weapon-free. Hence the relevant options appear to reduce to two: an active contest over national superiority in space, or an elaborated legal regime that would undoubtedly be designed to prevent decisive predominance in space by any one country, the United States in particular. 21

3.) Perception of Primacy- rhetoric is just a hedging strategy

Michael Krepon, is the co-founder of the Henry L. Stimson Center, a Diplomat Scholar at the University of Virginia, February–March 2008, http://www.carnegieendowment.org/files/SurvivalTellis.pdf, “China’s Military Space Strategy: An Exchange”; AB

I rest my case by citing as evidence the behaviour of the George W. Bush administration, which has not been shy about utilising American military superiority and about taking significant risks in pursuit of presumed security interests. Even the Bush administration -- and even after the Chinese ASAT test -- has refrained from undertaking the offensive ASAT programmes endorsed by Tellis. Notwithstanding existing US Air Force guidance and the Rumsfeld Commission’s recommendations, the Pentagon has so far confined its testing in space to the demonstration of multipurpose technologies that fall far short of dedicated ASATs. The United States, like China and Russia, is pursuing a hedging strategy in the event that the norm against harming satellites in crises or warfare is broken.

4.) Alternate Motives- More likely to attack US infrastructure

Karl P. Mueller, is a political scientist with the RAND Corporation, specializing in air and space strategy and other defense policy issues, March 27th 2002, http://isanet.ccit.arizona.edu/noarchive/mueller.html, “Is the Weaponization of Space Inevitable?”; AB

Attacking satellites is difficult, at least compared to attacking most sorts of terrestrial civilian targets.[28] It certainly can be done, but crippling or destroying a small object several hundred miles overhead moving at 17,000 miles per hour (to say nothing of satellites at higher altitudes) is vastly more challenging than doing comparable damage to targets such as ships, airliners, bridges, dams, pipelines, computer networks, office buildings the list could go on almost indefinitely. That such targets are not attacked on a regular basis is due mainly (at least until recently) to the very small numbers and limited capabilities of serious terrorists, not to any great degree of protection for these assets. Increased defensive measure since 11 September 2001 have done little to alter the relative difficulty of attacking space and terrestrial targets. Even if an enemy did want to disrupt the use of American satellites, attacking their ground communications stations and launch facilities might be far more effective than striking satellites in orbit, as well as much easier.

5.) Cost Benefit Analysis- Space weapons aren’t strategic

Frank Klotz, a former United States Air Force lieutenant general who last served as the commander of Air Force Global Strike Command, January 1999, “Space, Commerce, and National Security”; AB

While legally banning antisatellite systems or activities associated with their use would not appear to add much value at the moment, it may be possible for nations to mutually refrain from activities that might be construed as threatening to the satellites of others. Such undertakings are not without precedent. When it has been within their general interests, nations have held back from employing certain weapons and engaging in certain activities during wartime, even in the absence of specific agreements. For the most part, the major powers avoided the use of chemical weapons during the Second World War. None of the nuclear states have employed their nuclear arsenals in military conflicts since the attacks on Hiroshima and Nagasaki in August 1945. Gven the cost of developing weapons in space and the ramifications of attacking a satellite and thereby inviting some sort of retaliation (either against one's own space systems or elsewhere), nations might conclude that the long-term costs are not worth the potential gains. As long as such mutual restraint is exercised, it may be possible for the space powers to uphold the principle of unfettered access to space without the need to actually employ antisatellite weapons either to deter or defend against their use by others.

6.) Budget- not economically feasible to develop weapons

Don Wilkerson, Lieutenant Colonel in the USA, March 15th 2008, http://www.dtic.mil/cgibin/GetTRDoc?Location= U2&doc=GetTRDoc.pdf&AD=ADA482300, “Space Power Theory: Controlling The Medium Without Weapons In Space”; AB

It is difficult to support Oberg’s prognostication that weapons in space are inevitable for the U.S. in the 21st Century. The extensive cost of current space programs like Global Positioning System (GPS), Space-Based Infrared System (SIBIRS), the Rapid Attack Identification Detection Reporting System (RAIDRS) and Space Based Radar (SBR) along with numerous service military programs competing7 within a limited defense budget, it is highly unlikely that the U.S. government will make more funding available for space weapons when the currently perceived threat can be mitigated using existing cost effective capabilities. The August 2006 U.S. National Space Policy states that its primary objective is to ensure that the U.S. maintains and enables free access to and the use of space for peaceful purposes. The policy mandates that the U.S. will pursue programs and capabilities to ensure space assets are protected since they are vital to our national security and economic interests. 1

2AC AT: Colonization Bad – Debris

Status quo solves debris- solar activity

New Scientist, 1/25/12, http://www.newscientist.com/article/dn21386-hyperactive-sun-clears-space-junk--for-now.html, “Hyperactive sun clears space junk – for now”; AB

Low Earth orbit just got a free spring-clean, thanks to the sun. It turns out that increased solar activity in recent years has removed some of the satellite debris that clogs this region, making it temporarily safer for other satellites and astronauts. The sun will hit an 11-year peak in its activity – the solar maximum – in 2013. As this approaches, small increases in solar radiation warm the outer layer of Earth's atmosphere, called the thermosphere, forcing it to expand into space. This places atmospheric molecules in the path of low orbiting debris, which brake their orbital velocity

EDDE solves

Desh RajSharma, writer for the green diary, 8/18/2010 “DARPA to clean up space debris with a gigantic space net, http://www.greendiary.com/entry/darpa-to-clean-up-space-debris-with-a-gigantic-space-net/”

The U.S., Russia and China are the three big space powers that have polluted Earth’s orbit with 93 percent of all space debris. Now, cleaning up dead satellites and other correlated space junk has gone easier said than done. The US Defense Advanced Research Projects Agency (DARPA), however, is planning to create the Electrodynamic Debris Eliminator (EDDE) to scoop up the satellites. EDDE will be a huge garbage cleaner with 200 nets, like butterfly nets, and will collect garbage in low-earth orbit. The EDDE will either fling the garbage into the South Pacific or deliver the objects closer to Earth where it will keep orbiting and will eventually decay. Another option includes reusing space debris to build a variety of useful structures, like future space stations or satellites. The creators believe that the contraption could serve a sinister purpose, i.e. removing a working satellite from orbit. With a text flight planned for 2013, a whole fleet of EDDEs could be seen carrying out space debris cleanup by 2017.

2AC AT: Colonization Bad – Disease

Quarantines solve

UPI ‘7, quotes Cassie Conley, Planetary Protection Officer and Ph.D. in plant biology (“Mars spacecraft sterilized before launch”, August 6, http://www.upi.com/Science\_News/2007/08/06/Mars-spacecraft-sterilized-before-launch/UPI-82121186415086/#ixzz1PTeAwhDN)

In addition to worrying about sending microorganisms to Mars, NASA officials also are concerned about the samples Phoenix collects. “If we’re bringing samples back to Earth, we don’t want to bring back something like the Andromeda Strain,” said NASA’s Cassie Conley, referring to the Michael Crichton novel in which a space pathogen causes a terrestrial outbreak. Conley says samples of Martian soil will be treated as if they were more dangerous than the Ebola virus at the Planetary Protection unit’s research facility at the Jet Propulsion Laboratory in California.

Space exploration solves effective vaccines which solves epidemics

NASA no date “Attacking from Above & Below - Space-Based Fight Against Disease”

http://weboflife.nasa.gov/currentResearch/currentResearchGeneralArchives/attackFromAbove.htm

Penicillin, one of the most important discoveries in medical history, was found purely by accident. Today, with the furious scramble to treat and cure diseases ranging from malaria to AIDS, drugs are engineered rather than stumbled upon. As important as treatment is to the victims of disease, the ability to track and predict outbreaks can help prevent entire populations from ever succumbing to a given illness. Surprisingly enough, space exploration has resulted in new ways to fight disease at both the drug development and epidemiological levels. A Green Thumb for Space Crystals For the most part, drugs are not so much "discovered" anymore. They are designed. Scientists can now target a specific protein of a pathogen–be it bacterial or viral– to maximize a drug’s effectiveness while at the same time minimizing possible side effects. This method, known as rational drug design, has one major downside. The exact structure of the target protein must be determined, down to the last molecule. To uncover this molecular structure, scientists use x-ray crystallography. A crystal of the protein is bombarded with x-rays to produce a pattern which, much like a fingerprint, reveals the identity of the protein’s atomic structure. But to get an accurate pattern, the crystal must be as free of imperfections as possible. Growing such crystals can be extremely difficult, even impossible, on Earth because gravity causes the crystals to settle on top of one another resulting in structural flaws. So, how do you grow crystals without gravity getting in the way? This is where NASA has been able to help out. In the microgravity of space, the 3-dimensional structures of crystals can form flawlessly and achieve larger sizes. Protein crystals grown on Space Shuttle missions provide scientists with up to 40% more information than crystals grown on Earth. In fact, NASA missions have led to the discovery of 30 protein structures and several novel drugs that are in various stages of clinical trials. Close to completion is a treatment for T-cell lymphoma, an aggressive form of cancer. Drugs to treat psoriasis and rheumatoid arthritis are also on the way. Potential treatments or cures for diseases ranging from influenza to diabetes are being developed based on protein structures. Many of these target protein structures could not have been determined without the help of crystals grown in space.

2AC AT: Colonization Bad – Ozone

Alt cause - nitrous oxide

Peter Spotts, Christian Science Staff, 8-27-2009, “The next major threat to the ozone layer: nitrous oxide,” Christian Science Monitor,http://www.csmonitor.com/Environment/2009/0827/the-next-major-threat-to-the-ozone-layer-nitrous-oxide

A colorless, sweet-smelling gas with a long history as a medical and dental anesthetic is the next big threat to Earth's protective ozone layer, according to new research. As rocket launches increase, ozone layer could feel the heat Greenhouse gas concentrations reach record levels, will linger for decades, new report finds Topics Environmental Issues and Protection Earth Science Nature and the Environment Sciences Climatology Global Climate Change Science and Technology The culprit: nitrous oxide. Its role in destroying ozone has long been recognized, as well as its role as a heat-trapping greenhouse gas. But the new study puts nitrous oxide's ability to deplete ozone into numbers comparable to those used for other ozone-depleting gases covered by the 1987 Montreal Protocol. Nitrous oxide's ozone-depleting clout per pound of gas is comparable to that of a group of chlorine-based gases, HCFCs, that currently are scheduled to be phased out by 2013 under the protocol. And each molecule of nitrous oxide remains in the atmosphere for about 100 years, giving it a lifetime comparable to the compounds covered by the Montreal Protocol.

Space launches don’t disrupt the ozone

NASA 8 NASA, 2-24-2008, Federal Government agency dedicated to space policy, “Space Shuttle and International Space Station,” NASA Kennedy Space Center Frequently Asked Questions, http://www.nasa.gov/centers/kennedy/about/information/shuttle\_faq.html

Q. Is it true that launching the Space Shuttle creates a local ozone hole, and that the Space Shuttle releases more chlorine than all industrial uses worldwide? A. No, that is not true. NASA has studied the effects of exhaust from the Space Shuttle's solid rocket motors on the ozone. In a 1990 report to Congress, NASA found that the chlorine released annually in the stratosphere (assuming launches of nine Shuttle missions and six Titan IVs -- which also have solid rocket motors -- per year) would be about 0.25 percent of the total amount of halocarbons released annually worldwide (0.725 kilotons by the Shuttle 300 kilotons from all sources). The report concludes that Space Shuttle launches at the current rate pose no significant threat to the ozone layer and will have no lasting effect on the atmosphere**.** The exhaust plume from the Shuttle represents a trivial fraction of the atmosphere, and even if ozone destruction occurred within the initial plume, its global impact would be inconsequential. Further, the corridor of exhaust gases spreads over a lateral extent of greater than 600 miles in a day, so no local "ozone hole" could occur above the launch site. Images taken by NASA's Total Ozone Mapping Spectrometer at various points following Shuttle launches show no measurable ozone decrease.

Rockets have extremely minimal effect on ozone layer.

Ross and Zittel, 00 [Martin Ross, Paul Zittel, staff writers for aerospace corporation magazine, http://www.aero.org/publications/crosslink/summer2000/01.html]

Space transportation, once dominated by government, has become an important part of our commercial economy, and the business of launching payloads into orbit is expected to nearly double in the next decade. Each time a rocket is launched, combustion products are emitted into the stratosphere. CFCs and other chemicals banned by international agreement are thought to have reduced the total amount of stratospheric ozone by about 4 percent. In comparison, recent predictions about the effect on the ozone layer of solid rocket motor (SRM) emissions suggest that they reduce the total amount of stratospheric ozone by only about 0.04 percent. Even though emissions from liquid-fueled rocket engines were not included in these predictions, it is likely that rockets do not constitute a serious threat to global stratospheric ozone at the present time. Even so, further research and testing needs to be done on emissions from rockets of all sizes and fuel system combinations to more completely understand how space transportation activities are affecting the ozone layer today and to predict how they will affect it in the future.

Rockets only contribute a very small amount to ozone depletion, if anything.

Nina Rastogi, writer for slate.com, 11-17-09, “What's the environmental impact of going into space?”, http://www.slate.com/id/2235644/

There's a simple reason why we hear a lot more about cars, ships, and planes than we do about rocket ships: There are lot more of them. Each flight into space does have a small impact on the planet it leaves behind, but—for the moment, at least—these launchings are very rare. Only a couple of rockets blast off ev ery week around the world. As a result, space travel doesn't register on most environmentalists' radars. One issue that might deserve some attention has to do with the depletion of stratospheric ozone, a topic we discussed a few months back. Rocket engines emit reactive gases that cause ozone molecules to break apart. They also discharge microscopic particles of soot and aluminum oxide, which may increase the rate at which those gases wreak havoc. Each variety of rocket propellant delivers its own blend of ozone-depleting substances: Solid propellants, for example, are more damaging than liquid ones, though exactly how much is unclear. Engine design matters, too. To make matters worse, spacecraft dump some of these pollutants directly into the upper and middle stratosphere, where they can start causing damage immediately. Despite all this, spacecraft contribute very little to the global ozone problem. In a recent paper on the topic, researcher Martin Ross and three co-authors estimated that rocket launches are responsible for roughly 1 percent of the total ozone depletion that can be attributed to human causes. That percentage may rise, however, as more traditional pollutants, like CFCs, start to fade from the atmosphere (thanks to the 1987 Montreal Protocol). At the same time, the number of launches—for purposes of exploration, tourism, and space-based solar power (PDF)—is expected to increase. One of the study's co-authors has been quoted as saying, "If left unregulated, rocket launches by the year 2050 could result in more ozone destruction than was ever realized by CFCs."

International cooperation ensures enduring closing of the ozone hole.

GGZ 11 [Alex, Founder and Primary contributor to Go Green Zine, 6/19/11 **, “**Depletion of the ozone layer over Antarctica is a thing of the past” <http://www.gogreenzine.com/depletion-ozone-layer-antarctica/>]

Depletion of the ozone layer above Antarctica may now be in reversal. Researchers in Australia believe they have detected a shrinking of the ozone hole a full decade before they expected to. Thanks to the Montreal Protocol in 1989, an international decision to curb production of ozone depleting chemicals, the ozone layer now appears to be recovering. Under the Montreal Protocol, the use of chlorofluorocarbons (CFCs), a once popular refrigerant and major contributor to the depletion of the ozone layer, was completely banned. While this does seem to be good news, not all scientists are convinced by the data. In addition, the Arctic recently experienced a thinning of the ozone layer. The ozone layer is important because it helps to minimize UVB radiation, sunburns and skin cancer. Recently, it was discovered that whales were getting extreme sunburns due to ozone layer depletion. The ozone layer is not expected to fully recover until the year 2070. However, the progress made in addressing this problem proves that international cooperation in tackling a global environmental issue can yield very positive results.

Ozone layer will recover fully by 2048 despite intervening factors.

**Firth 10** [Niall, 9/21/10, UK daily mail, “[Ozone layer 'is no longer disappearing and will return to full strength by 2048', says UN report](http://www.dailymail.co.uk/sciencetech/article-1313599/Ozone-layer-longer-disappearing-return-strength-2048.html)”, <http://www.sott.net/articles/show/215411-Ozone-layer-is-no-longer-disappearing-and-will-return-to-full-strength-by-2048-says-UN-report>

The ozone layer is no longer disappearing and could be back to full strength by the middle of this century, UN scientists have confirmed. The phasing out of nearly 100 substances once used in products like refrigerators and aerosols has stopped the ozone layer being depleted further, although it is not yet increasing, according to a new United Nations report released last week. Comment: This was the forerunner to man-made global warming. They tried to convince us that the ozone layer was disappearing because of people's fridges. Now that the ozone layer has replenished itself, they can tell us that their measures to control our choices were successful and thus play the same game with 'global warming' aka man-made climate change. Temperatures are plummeting in time for them to congratulate themselves on successfully "reducing carbon emissions." This self-styled "success" will spur them on to increase the draconian measures until millions, if not billions more, are starving and freezing to death. The models used to produce these results are entirely self-referencing; very little empirical measurements taken from the real world are actually used in the production of these reports, which are thinly disguised policy documents masquerading as scientific discovery. And it claimed that international efforts to protect the ozone layer has averted millions of cases of skin cancer worldwide. The ozone layer outside the polar regions is projected to recover to pre-1980 levels by 2048, although the annual springtime ozone hole over the Antarctic is not expected to recover until 2073. Ozone in the stratosphere is important because it absorbs some of the Sun's dangerous ultraviolet radiation. The report, published jointly by UNEP and the UN World Meteorological Organization (WMO) is the first comprehensive update in four years on the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol phasing out chemicals which accelerate both ozone layer damage and climate change. 'It (the Protocol) has protected the stratospheric ozone layer from much higher levels of depletion by phasing out production and consumption of ozone depleting substances,' said the report. The report was written and reviewed by 300 scientists and launched on the UN International Day for the Preservation of the Ozone Layer. Given that many substances that deplete the ozone layer are also potent greenhouse gases, the Montreal Protocol 'provided substantial co-benefits by reducing climate change,' it added. In 2010, reductions of ozone-depleting substances as a result of the Protocol, were five times larger than those targeted by the Kyoto Protocol, the greenhouse emissions reduction treaty. 'Without the Montreal Protocol and its associated Vienna Convention atmospheric levels of ozone-depleting substances could have increased tenfold by 2050,' Mr Steiner said. 'This in turn could have led to up to 20 million more cases of skin cancer and 130 million more cases of eye cataracts, not to speak of damage to human immune systems, wildlife and agriculture.'

The ozone layer is rebuilding itself because of better detection and international protocol.

**India Express 11** [News channel in India, 5/17/11, IE, “Ozone hole over Antarctica on the road to recovery” <http://www.indianexpress.com/news/ozone-hole-over-antarctica-on-the-road-to-recovery/791986/>]

Researchers in Australia have claimed that the hole in the ozone layer over Antarctica is on the road to recovery, 22 years after the Montreal Protocol to ban chlorofluorocarbons (CFCs) and related ozone-destroying chemicals came into force. The team is the first to detect a recovery in baseline average springtime ozone levels in the region. "I think this is the first convincing observationally-derived evidence of the ozone rebound," the Nature quoted Adrian McDonald, an atmospheric scientist at the University of Canterbury in Christchurch, New Zealand, as saying. "It's the first where the statistical significance is high enough, and you can see the pattern well enough, that you feel comfortable in believing it," added McDonald. The results of Murry Salby, an environmental scientist at Macquarie University in Sydney, Australia, revealed a fast decline in ozone levels until the late 1990s, then a slow rebound that closely matches what theoretical calculations had predicted, said David Karoly, a climate scientist at the University of Melbourne, Australia. "It is the sort of result that was expected, but is the first to provide detection of an increase in Antarctic ozone levels," he said. Salby's data reveal that average springtime Antarctic ozone levels have already recovered by 15 percent since the late 1990s. However, projecting forward, natural weather-related fluctuations mean that even as late as 2085, ozone will still drop below 1980 levels for at least one year in every 10.

The ozone hole is closing because of increased international focus on recovery. This will endure and overwhelm effects of rocket launches.

Stephen 11 [David, 6/26/11, Ground Report, “Ozone layer recovery”, <http://www.groundreport.com/Health_and_Science/Ozone-Layer-Recovery/2939809>]

Away from the theory that depleted parts of the Ozone Layer will be naturally repaired in the middle of the 21st century, a developing research work on [Ozone Hole Recovery](http://stephaz.webs.com/ozoneholerecovery.htm) presents an artificial solution before the datemark. The ozone layer is a space of gas found in a layer of the Earth atmosphere, the stratosphere, 19-48km above sea level. Photochemical reactions involving ozone gas at the ozone layer helps to protect planet Earth from dangerous Ultraviolet radiations. Some gas molecules released in substances used by humans once at the ozone layer react with ozone molecules forming compounds that cannot protect against harmful Ultraviolet radiations, making the amounts of useful ozone molecules reduced. This lead to what was observed many years back as depletion in part of the ozone layer fondly called the ozone hole. Since this threatened man and the environment, nations agreed to reduce the use of substances having gas molecules that are threat to the ozone layer; this made ozone layer protection important till date. For factors and conditions of the ozone layer, scientists have posited natural recovery of lost ozone molecules and fade out of harmful gases in use and at that level to about 50years time. This has turned the focus to protection from here than recovery from there.

International CP

Perm do both

Only US solves – best ITS system

Dong Won Kim is a Doctor of Philosophy from Virginia Polytechnic Institute, June 2001, “Intelligent Transportation Systems: A Multilevel Policy Network”, Proquest, JJ

The European structure is even more fragmented than is the Japanese one. As shown in Figure IV-8, European countries also have no public agency in charge of a panEuropean ITS architecture and intermodal coordination (Shibata and French, 1997: 162). The European Community includes three R&D-specialized agencies, the Directorate General VII (DGVII), the Directorate General III (DGIII), and the Directorate General (DG), each of which covers different R&D areas and supports various organizations in Europe. The European Road Transport Telematics Implementation Coordination Organization (ERTICO) is the European counterpart of ITS America in the U.S. and VERTIS in Japan, and it is a transnational public/private partnership that develops overall ITS implementation strategies for European countries. Actual implementation is proceeded by actor interaction at national or local levels, but national sovereignty issues still hamper the deployment of widespread interoperable European ITS (Shibata and French, 1997: 96). Each of the most European countries has its own national programs 52 and public/private partnership forum such as ITS Focus of UK, ITS Germany, ITS France, and ITS Netherlands. A cross-national comparison of ITS organizational structures shows that three ITS leaders including the U.S., Japan, and Europe all use public/private collaboration to promote ITS. 17However, **the U.S. system is most helpful for coordination and cooperation because it does not face problems of dispersed authority** as in Japan and separate national sovereignties as in Europe. This organizational strength would seem to be a great advantage for the U.S. ITS community, although I have not actually compared coordination levels across the countries.

2AC Obama Good Elections DA

Romney will win – more money, better strategy and timing

Racinski 7/19

Robert Tracinski writes daily commentary at TIADaily.com. He is the editor of The Intellectual Activist and a contributor to RealClearMarkets, 7/19/12, “How the Election Will Play Out (and Why Romney Will Win)”, <http://www.realclearpolitics.com/articles/2012/07/19/how_the_election_will_play_out_and_why_romney_will_win_114848.htm>

The question in November is how many voters will accept Obama's warped message of resignation and resentment—how many will be like Ron Brownstein's swing voters—and how many will be repulsed by it. That, in turn, will depend on what Mitt Romney does to fight back, not just against the details of the negative attacks on him, but against the world view behind them. When it comes to his record and his biography, I suspect that Mitt Romney has not yet begun to fight, and that is the other big development I'm predicting for the final months of the general election. I have been speculating for some time—and others have begun to say the same thing—that Romney's election strategy can be described as "rope-a-dope." This was a sports reporter's coinage for Muhammad Ali's strategy in the famous 1974 "Rumble in the Jungle" against George Foreman. Foreman was a large man known as a hard hitter, so Ali's strategy was to goad Foreman into throwing a frenzy of punches while Ali adopted a protective position and leaned against the ropes so they would help absorb the energy of the blows. Foreman fell for it and punched away in a fury, tiring himself out in the early rounds only to find himself fatigued while Ali was still fresh. Ali dominated the later rounds and knocked Foreman down long enough for the referee to call him out. The analogy here is that Romney is letting the Obama campaign punch itself out, spending like crazy on a blitz of negative advertising early on, before swing voters have made up their minds or even paid much attention to the race. Meanwhile, Romney has been holding his fire and money, saving it for when it will really count. Why is the Obama campaign falling for this? Because they have no other option. Here we have to refer back to the established rules of the horse-race analysis. When a president is running for re-election, it is inherently a referendum on the incumbent, so if his approval ratings are below 50%, he's in trouble. If a majority disapproves of his performance, that means they are going to be likely to cast their votes for the challenger. Obama is below 50% now. He's been around 47% in the RealClearPolitics average for a long time now, and since some of the polls tend to overestimate support for Democrats, the real number is probably a few points lower. But this just means that voters are willing to consider the challenger, and you can still convince them to stop considering him. Which means that an embattled incumbent has only one way to win: convince voters that the challenger is not an acceptable alternative. Hence the negative campaign against Romney. He needs to be made out as a corporate Snidely Whiplash who lays off workers, outsources their jobs to China, hides his profits in Swiss bank accounts, and lies about it to cover it all up. So that is exactly the story Obama's negative ads have been trying to tell. The attack ad in which Romney ties the girl to the railroad tracks is coming next. There is no evidence that these negative ads have worked so far—the variation in the candidates' RCP poll averages has been within the range of static for at least a month—so the Obama campaign is turning the volume up to eleven. They have poured $100 million into advertising in swing states over the past month, three-quarters of which has gone into negative ads. And they have increased the seriousness of the accusations, to the point of hinting that Romney might be a felon. But there is a big problem with dumping all these negative ads so early. If you bring up a charge in May or June, the Romney campaign and dozens of commentators and bloggers will have time to refute the attacks, or at least come up with convincing attempts to explain them away. You also run the risk of over-reaching—as in the Romney felony charge—and creating a story, not about Romney's wrongdoing, but about your campaign's unfair attacks. But most of all, these charges become "old news," so when the Obama campaign tries to bring them up again in October, once everyone is finally paying attention, the charges lose their impact because the press and the pundits have already heard it before. This business is called "news" for a reason, because it moves forward on things that are new. So why has the Obama campaign launched their attack on Romney so early and allowed it to become so vicious? I think they realize that they are running out of time. If they don't "define" Romney in hopelessly negative terms now—and by "now," I mean now—the game is over. While I've been using the rope-a-dope analogy, Washington Post blogger Jennifer Rubin has come up with a somewhat grander analogy. Here is her description of Obama's strategy. "Extend the Republican primary by running ads hitting Romney and encouraging Democrats to vote against Romney in Michigan and elsewhere. Then, before Romney could fully get his bearings, unload a barrage of negative attacks, scare-mongering, and thinly disguised oppo attacks through the mainstream media, taking advantage of many political reporters’ relative ignorance about the private equity field and their inclination to accept whole-hog President Obama’s version of 'facts.' "The extent of that effort is only now becoming clear. The Associated Press reports: 'President Barack Obama’s campaign has spent nearly $100 million on television commercials in selected battleground states so far, unleashing a sustained early barrage designed to create lasting, negative impressions of Republican Mitt Romney before he and his allies ramp up for the fall.' Think of it like the Confederacy’s artillery barrage on the third day of Gettysburg before Pickett’s Charge—you have to in essence disable the other side before the charge begins, or it's curtains." **For those not versed in Civil War history, Pickett's Charge ends badly**. I'll refer you to this scene from the magisterial 1993 film Gettysburg, which captures the point at which General Lee realizes the full scope of the debacle. It's worth looking at why specifically the Obama campaign is running out of time. It has to do with money and with the calendar. Obama started out with a distinct money advantage, since he could start raising money for the general election while Romney was still spending money on the primaries. But he is rapidly blowing his money advantage. In recent months, he has raised less than Romney and spent a lot more, particularly on his huge spree of negative ads. Jack Wakeland first pointed this pattern out to me and speculated that Obama is running his campaign finances about as well as he has been running the nation's finances. The result is that it now looks as if Romney and his supporters will be able to outspend Obama by a significant margin in the final months of the race. And if there's one thing we learned from the primaries, it is that Romney can win when he's able to outspend his rivals. Then there is the calendar. Outside of Washington and the media, most voters are not paying much attention to the race yet. And in exactly eight days, the Olympics begin. The Olympics are the crucial dividing point, because they will dominate the airwaves and the news, sucking away whatever attention anyone is now paying to the election. So Obama's negative campaign blitz has to have whatever effect it's going to have in those eight days. But what happens when the Olympics start? To begin with, the Olympics provide an opportunity for Mitt Romney to highlight the best part of his record, his successful turnaround of the 2002 Winter Olympics. And he can do so without having to do very much or spend much money. It will be natural, after all, for the sports reporters covering the Olympics to mention Romney's history with the movement. Obama can still be in the news during the Olympics just by showing up in London or doing something to root on the U.S. teams, but that's just a marginal bit of extra public exposure, not a message about his leadership. For Romney, by contrast, the Olympics are a leadership message. He can claim that his competence helped save a beloved institution whose appeal cuts across partisan lines. Remember that it was not his business success that launched Romney's political career. It was the Olympics: he ran for governor of Massachusetts in the afterglow of the 2002 games. Yet Romney's history with the Olympics has barely been mentioned yet, precisely because the Obama campaign can't find anything negative to say about it. Well, now it's going to be mentioned. And what happens after the Olympics? There are only two weeks between the end of the Olympics and the beginning of the Republican National Convention. It is logical that Romney would use those two weeks to announce his vice-presidential running mate. There is some speculation that he would do so earlier, but with so few days left to the Olympics, I'm not sure he would risk having the announcement be overshadowed. So it's slightly more likely he will make the announcement a few days after the Olympics, which will have the effect of dominating the news for the period between the games and the convention. Then the Republicans get to go first with their convention, giving them a chance to present all of the positive aspects of Romney's personal life and his professional achievements, just as most voters are beginning to tune in to the election. Which means that they have the opportunity to wipe out more than $100 million in Obama's negative advertising. So what this means is that the Obama campaign has only eight days left to have it all their way. After that they will be upstaged for more than a month, and probably outspent for the rest of the campaign. If they want to make Romney seem unacceptable to swing voters, the next eight days are the whole game. The big picture is that the Obama campaign is reaching its full tide. This is its moment of maximum impact, and everything after this is a pushback from the Romney campaign. So the fact that Obama is still just even in the polls, at the full extent of his effort, means that we can expect that everything from here on out will be a loss. From now on, the campaign will be about Romney making his own positive case, building back his image, setting his own message, firing back in the debates, and sending it all of home with giant advertising buys that Obama won't be able to match. Jennifer Rubin's reference to Pickett's Charge reminded me of another scene from Gettysburg. An actor who has been serving as a spy for the Confederacy asks General Longstreet for a musket so that he can, for once, fight honorably as a regular soldier. Longstreet then explains to him why he thinks Pickett's Charge—which he hasn't been able to talk Lee out of—will fail. It is, he explains, like a mathematical equation, as he ticks off the casualties Pickett's division will take at each stage of the assault. He briefly entertains hope that the artillery barrage will cause the Yankees to panic and break, then he concludes that they won't, so "it's mathematical after all." In much the same way, the numbers are against Obama. In political science, unemployment above 8%, economic growth below 2%, and approval ratings below 50%—all of it adds up to defeat. But the Obama campaign will entertain the hope that maybe, just maybe, they can vilify their opponent and create a negative impression of him in the minds of voters, or dredge up some scandal that knocks him out of the race before we even get to the conventions. They can hold on to that hope. And they're right: maybe it will happen. This has been a very unpredictable election from the beginning. But if something doesn't happen, and happen soon, the numbers kick in, and it's mathematical after all. So far, the polls show that the negative ads haven't broken Romney's campaign. But there is a deeper ideological reason why this campaign is not likely to succeed. Remember that this is not just a negative campaign against Romney. It is a negative campaign against capitalism and against success. And it's not just that the Obama campaign overreaching with their negative attacks on Romney. They are also overreaching with their negative attacks on success.

ITS is a win for Obama

Gerard Baliles is the Director and CEO and the Miller Center, April 2012, “Are We There Yet?”, <http://www.infrastructureusa.org/wp-content/uploads/2012/04/conf_2011_transportation-Miller-Center.pdf>

Transportation keeps the American economy humming. For future prosperity, transportation policymakers must make strategic investments in smart projects with defined outcomes. There must be adequate funding, both for the maintenance of existing systems and for the further expansion and interconnection of new systems. Transportation experts, stakeholders, and users agree that change is needed. To set change in motion, however, there must first be public pressure for transportation investment and reform. Despite broad support in principle, however, active public engagement on these issues has been elusive. While many Americans experience the inefficiencies of our current transport systems on a daily basis, other impacts—such as the impact of lost productivity on the broader economy or the impact of high transportation costs on the price of goods—are less immediately obvious. Faced with other urgent concerns and economic challenges, many Americans believe we simply can’t afford to invest in transportation repairs and upgrades given our country’s current budget situation. Many also do not have faith that money allocated to transportation projects will be used in the most efficient and effective ways possible. Simply put, there is a lack of confidence and trust in the ability of policymakers to make good decisions in transportation policy and planning. And without a mandate from the broader public, most policymakers don’t want to risk reforming the current system in a political landscape fraught with many other challenges and competing demands. The Miller Center convened its second biennial David R. Goode National Transportation Policy Conference in Washington, D.C. to pose the question: How do we craft a compelling message that captures the attention of the public so that Americans become engaged in the issue of transportation reform? The timing for a broad-based campaign focused on the need for smart transportation investments and related policy reforms is propitious. The next presidential election is only months away. Congressional reauthorization of existing transportation programs is long overdue, even as congressional interest in ways to accelerate the economic recovery and jump-start job growth remains high. The recommendations in this report grow directly from the conversations that took place at our November conference. We believe they provide a solid foundation for rallying all Americans around a transportation agenda that is equal to the challenges of a new century.

And, We have the biggest internal link to the economy – ITS is the fastest growing industry

Leslie Guevarra is an editor at GreenBiz.com, 8/10/11, “Smart Transportation Industry to Grow to $67B by 2015”, http://www.greenbiz.com/blog/2011/08/10/smart-transportation-industry-grow-67b-2015

The business of intelligent transportation -- everything from traffic and transit controls to sophisticated telematic systems for connecting EVs to the smart grid -- is a quiet but growing industry poised for a boom. That's my takeaway from a new report that predicts the intelligent transport industry will grow from $48 billion in revenue in 2009 to $67 billion by 2015 in the U.S. "Intelligent transportation is the largest industry you've never heard of," said Scott Belcher, president of the Intelligent Transportation Society of America, during an online media briefing today. Smart transportation -- cars, public transit, commercial trucking, traffic and the systems that help power and manage them -- is central to a concept GreenBiz Group calls VERGE. That's the intersection of vehicles, energy, buildings and information technology and its effect on the evolution of business. In researching the report, ITSA and IHS Global Insight found that revenue for intelligent transportation outstripped that for computers and motion picture video production during the recession. The factor is a key reason why continued growth is projected for industry. As companies and cities remain pressed by the tough economy and its faltering recovery, "we're a way to squeeze much more out of existing systems," Belcher said. "More creative leaders, in tough financial times, look to technology as their solutions base," he said. "We're bullish on the intelligent transportation systems industry and do expect it to grow even despite the economic slowdown." Belcher offered more reasons for the positive forecast when I asked about barriers for companies participating in the industry: Size doesn't matter. Most of the 3,000 companies in the industry, which employs about 183,000 in the U.S., are small to medium-sized with 500 employees or fewer. There's money for the taking. "There is a lot of money out there right now for companies out there trying to get into this space," Belcher said, pointing to the $37-million infusion that traffic tech firm INRIX received last month in Series D funding led by Kleiner Perkins and August Capital. Up to 10 firms will have a chance to pitch to Kleiner Perkins and Fontinalis Partners in an investment match-up event at ITSA's annual conference later this year. The concept isn't difficult to wrap your head around. Two years ago, Massachusetts' Department of Technology opened the books on its transit data and invited software developers to create apps that make it easier for people to use public transit. Developers flooded the department with hundreds of apps, Belcher noted. "This is an area where I don't think there are really huge barriers to entry," he said. Here are the some of the report's major findings: Market Growth: Industry revenue is expected to jump 40 percent to $73 billion in North America over the next four years, with the lion's share in the U.S. Job Growth: About 203,000 people work in the industry in North America. The figure is expected to grow more than 10 percent with 208,000 in the U.S. and 26,000 in Canada and Mexico by 2015. Jobs Pay Well: The average salary in the industry was about $75,000 a year in 2009, roughly 75 percent more than the average salary. Best States for Jobs: California, Texas, Virginia, Florida, New York, New Jersey, Maryland, Massachusetts, Pennsylvania and Illinois are the 10 states with the most people working in the industry. The first three states also lead projections for 2015; the other seven are in the mix in different order. States with Best Revenue: California, Texas, Virginia top the lists for recent and projected revenue. The others in varying order for present and future revenue are Michigan, Florida, New York, Illinois, Ohio, Pennsylvania and New Jersey.

Random Neg Cards

Stephen Ezell is a Senior Analyst with the Information Technology and Innovation Foundation (ITIF), with a focus on innovation policy, science and technology policy, international competitiveness, and trade, manufacturing, and services issues, January 2010, “Executive Summary: Intelligent Transportation Systems”, http://www.itif.org/files/2010-1-27-ITS\_Leadership.pdf; AB

Challenges In ImplemenTIng ITs Given the technical feasibility and significant benefitcost ratios, why have ITS systems not been deployed more broadly, especially in lagging nations? One reason is that there are a number of challenges involved in developing and deploying intelligent transportation systems. ITS face a range of challenges, including system interdependency, network effect, scale, funding, political, institutional and other challenges. Some challenges are inherent to intelligent transportation systems across all countries; others are specific challenges faced with regard to deploying intelligent transportation systems in the United States. At the outset, this report provided a taxonomy classifying ITS applications into five categories. But another lens to categorize ITS applications, one more relevant to understanding ITS challenges, is to distinguish between two classes of ITS applications: 1) Those that can be deployed locally on an independent basis and deliver value, and 2) Those that must be deployed as part of a scalable interrelated system to deliver meaningful value. The distinction is useful because many ITS applications are subject to system interdependency challenges, require system coordination to deploy, and must operate at scale to be effective. In this dichotomy, the first class includes ITS applications such as ramp meters, computerized smart signals, roadside cameras, and even local traffic operations centers. Communities or regions can make independent decisions about whether to fund and deploy ramp meters or adaptive traffic signal lights, and these applications will deliver local benefits to motorists without having to be connected to a scaled system or without travelers having to adopt these technologies at the same time. 75 (That is, traffic will flow more smoothly if a city or region optimizes its traffic lights or implements ramp metering, as the Minneapolis region experienced.) But the vast majority of ITS applications—and certainly the ones primed to deliver the most extensive benefits to the transportation network—must operate at scale, often must operate at a national level, and mustinvolve adoption by the overall system and by individual users at the same time to be effective, raising a set of system interdependency, network effect, and system coordination challenges. ITS applications that must operate at scale include VII and V2V systems, real-time traffic information systems, electronic toll collection systems, and vehicle miles traveled systems.For example, real-time traffic information systems are system interdependent. If a region or state makes all its roadways intelligent with real-time traffic data, such efforts do little good if motorists do not have telematics displays in their vehicles (or on mobile phones) to receive and act on that information. Likewise, consumers are unlikely to demand such devices for their vehicles if a large share of communities does not make that real-time traffic information available. VII and V2V systems such as the United States’ IntelliDrive initiative also experience network effects. Each additional IntelliDrive-equipped vehicle on the roadway adds value to the network (and over time, each addition to that network has a positive, downward effect on individual systems’ marginal costs). 76 Moreover, VII systems like IntelliDrive must work on a national basis to be truly effective: it does a driver little good to purchase an IntelliDrive-equipped vehicle in Michigan if the system doesn’t operate when he or she is driving in Indiana. Likewise, electronic toll collection systems present a far better driver experience when motorists can traverse a country with a single fare payment system, instead of having to acquire multiple passes to pay tolls in differing jurisdictions. The same holds true for vehicle miles traveled systems: it makes little sense for states to independently develop a VMT system because, in addition to requiring a device in the vehicle (ideally as part of the original factory-installed equipment), VMT requires a satellite system and a back-end payment system, and it makes little sense for each state independently to replicate investments in the infrastructure. Thus, many intelligent transportation systems are subject to network effect and scale challenges, thus requiring extensive system coordination—often needed at the national level—to deploy and integrate ITS systems. Uncertain marketplaces for intelligent transportation systems may also inhibit their development. In many industries, companies are more than willing to selffund research and development investments for new products and services, such as new desktop operating systems, software programs, even entirely new jetliners, for which there is a clear customer. But in the case of intelligent transportation systems, companies participating in the industry in some countries may have no clear sense if the customers (principally national, state, or regional transportation agencies) have any money—or appetite—to purchase such systems. ITS development thus entails much higher risk than does development of many other products and services, in part because governments are key buyers, and in some countries, such as the United States, they have shown at best mixed signals as reliable purchasers. Moreover, many government transportation departments barely have enough money to engage in needed maintenance, much less invest in new technologies. At the same time, many are more comfortable investing in concrete than in (silicon) chips. Given that customer interest in ITS may be unclear or uncertain, companies may be understandably reticent to invest in highly risky research and product development of ITS systems. As discussed subsequently, the United States’ federated governance structure for surface transportation creates an inherent challenge to building ITS systems to scale and approaching the transportation system as a nationally integrated network. But travelers don’t just drive within state lines; they want to travel across state lines, and they want their ITS applications—whether traffic information systems, toll payment systems, or IntelliDrive systems—to travel with them. But even with regard to ITS applications that leverage long-established technologies and don’t face systemic barriers—such as ramp meters, computerized smart signals, or traffic cameras—many nations, including the United States, under-invest in and insufficiently deploy ITS solutions. This happens, in part, because transpor-tation funding is often allocated without consideration of performance, giving local and state transportation planners little incentive to give preference to investments that can have maximum impact on optimizing system performance. Part of this is legacy; state and local transportation agencies were created to build and maintain infrastructure, not to manage a transportation network. 77 Yet combined with bureaucratic inertia and a lack of vision, some government transportation agencies see themselves as “builders of pieces” and not “managers of a system” and place more emphasis on building roads than on ensuring the system functions optimally. Lastly, ITS face a range of thorny institutional barriers, including jurisdictional challenges, such as which level of government—federal, state, county, city, public authority, or interstate compact—has responsibility for or jurisdiction over ITS deployments. 78 Organizational challenges include how performing organizations, often across jurisdictions, establish and maintain common plans and schedules; how they allocate funding priorities; and how information is shared. 79 Other ITS challenges include a lack of expertise within local and regional transportation agencies with regard to the technologies underlying intelligent transportation systems and their implementation. Also, a lack of technical standards for ITS technologies makes it difficult to ensure that systems purchased by different localities can be integrated. 80 While intelligent transportation systems face a number of challenges, none of them are insurmountable, and indeed many nations have overcome them. Which countries have done so the best, and how, are the subjects to which this report now turns. meThodology Intelligent transportation systems represent such a critical emerging set of IT applications that it is important to identify which countries lead in their development and deployment and to understand why these countries are ahead and why others are lagging. This report seeks to ascertain what the leading countries are doing differently than the lagging countries and to offer recommendations for countries that seek to be leaders in intelligent transportation systems. Because ITS represent such a broad category of technology and applications, with a number of different countries leading in the deployment or technological development of specific applications, identifying the world’s leaders in ITS requires a holistic assessment that evaluates the evidence and asks, “Which countries’ citizens are benefitting the most from a range of operationally deployed intelligent transportation solutions?” The operationally deployed criterion is crucial because many countries are in the process of field testing or initially deploying intelligent transportation systems, but in many cases these have not yet reached widespread implementation.