Intelligent Transportation Systems Deployment in the United States

Lessons Learned and A Vision for A “Connected” Future

A Presentation for the World Bank

Robert L. Bertini, Ph.D., P.E.
Acting Director, ITS Joint Program Office &
Deputy Administrator, Research and Innovative Technology Administration
U.S. Department of Transportation

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Introduction and Outline

- Brief Summary of ITS Deployment in the U.S.
- Selected Lessons Learned with Potential for Future Deployments
- U.S. DOT's Vision for the Future
U.S. DOT is the Sum of its Modes—Including RITA

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DEPUTY SECRETARY

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Executive Secretariat
Board of Contract Appeals
Office of Civil Rights
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Office of Intelligence and Security
Office of the Chief Information Officer
Office of Public Affairs

General Counsel
Assistant Secretary for Transportation Policy
Assistant Secretary for Aviation and International Affairs
Assistant Secretary for Budget and Programs/Chief Financial Officer
Assistant Secretary for Governmental Affairs
Assistant Secretary for Administration
Office of Inspector General

FAA
Federal Aviation Administration

FHWA
Federal Highway Administration

FRA
Federal Railroad Administration

FTA
Federal Transit Administration

NHTSA
National Highway Traffic Safety Administration

SLSDC
St. Lawrence Seaway Development Corporation

MARAD
Maritime Administration

PHMSA
Pipeline and Hazardous Materials Safety Administration

FMCSA
Federal Motor Carrier Safety Administration

RITA
Research and Innovative Technology Administration

U.S. Department of Transportation
About RITA

- **RITA Mission**
  - Coordinate multimodal research and education programs
  - Advance deployment of cross-modal technologies
  - Comprehensive statistics research and analysis
  - Support transportation education and training

- Need to invest in robust, forward-thinking transportation research that reflects the reality on the ground and promotes collaboration with external stakeholders

- Committed to making policy and investment decisions based on sound science and rigorous analysis

- Secretary LaHood: solid transportation research would be a hallmark of this Administration’s DOT

- RITA established six years ago to bring together research across the operating administrations of DOT to achieve synergies—to make the whole of our research efforts greater than the sum of its parts

- RITA as catalyst for major steps forward in achieving national goals

- Research coordination as linchpin to progress: Safety Council and Distracted Driving Summits
ITS Joint Program Office

- More cross modal
- Now including rail and maritime
- Cars, trucks, buses, fleets, and vehicles of all kinds
- Commitment to dedicated short range communications
  - Safety
  - Mobility
  - Environment
- Increased outreach and involvement of stakeholders
- Broadening of participation of public and private sectors and universities
Snapshot: Evolution of U.S. ITS Program

- ITS Program in the U.S. was launched in 1991
- Three comprehensive transportation legislative acts have established and shaped the Program

<table>
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<th>Legislation</th>
<th>Time Frame</th>
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- In 1991 ISTEA established a federal program to:
  - Conduct research
  - Develop, and
  - Test
  Technologies that could be implemented to improve the efficiency, safety and performance of surface transportation with goals of saving lives and time, increasing accessibility and improving economic productivity.
Evolution of ITS Program in the U.S.

ISTEA (1991) directed three major efforts:

- Conduct basic research and development of promising technologies
- Conduct operational testing to determine what works and what doesn't – field testing in operational setting as bridge between research and deployment
- Support activities to provide technical assistance for early adoption of technologies to existing transportation facilities and vehicles
  - Provide common framework and facilitate integration of systems → National ITS Architecture
  - Development of critical ITS standards
- In parallel, development of intelligent vehicles and integrated intelligent infrastructure
Evolution of ITS Program in the US

- Early program evaluation results indicated that:
  - Many ITS technologies technically feasible
  - Technologies tested effective in addressing congestion
  - Safety and operational efficiency improved
  - Environmental impacts of growing demand reduced
  - Commercial vehicle operations experienced significant efficiency improvements
  - When integrated, technologies provided powerful platform for operating and managing transportation networks
  - Institutional and policy issues were far greater challenge than technology
- ITS community recognized that incorporating ITS into agency policies and procedures would require paradigm shifts → new ways of thinking about transportation required
- With TEA-21 (1998), Congress shifted focus from research & development to policy & institutional challenges to deployment
- Congressionally-directed projects provided expanded deployment opportunities through **ITS Deployment Program**
Evolution of ITS Program in the U.S.

- Program activities focused on:
  - Promoting processes for state and local transportation agencies to facilitate effective deployment of ITS technologies
  - Creating Model Deployment Initiatives to “showcase” synergistic & beneficial effects of integrated systems (vs. standalone)
  - Development of in-vehicle safety technologies
- With enactment of SAFETEA-LU (2005), Congress:
  - Funding for continued ITS research
  - Provided for continued “mainstreaming” ITS into transportation planning and deployment processes, but
  - Terminated appropriations for ITS Deployment Program
- Program currently pursuing major research activities to achieve:
  - To research and facilitate national, **multimodal surface transportation system** that features a connected transportation environment around **vehicles of all types**, the infrastructure, and portable devices to serve the public good by leveraging technology to maximize safety, mobility and environmental performance
  - The plan to achieve this vision was developed with full participation by all surface transportation modal administrations as well as with significant interaction with multimodal stakeholders
ITS Research = Multimodal and Connected

Drivers and Operators

Maritime

Vehicles and Fleets

Rail

Wireless Devices

Infrastructure
ITS Strategic Research Program Components

Applications
- Safety
  - V2V
  - V2I
  - Safety Pilot
- Mobility
  - Real Time Data Capture & Management
  - Dynamic Mobility Applications
- Environment
  - AERIS
  - Road Weather Applications

Technology
- Harmonization of International Standards & Architecture
- Human Factors
- Systems Engineering
- Certification
- Test Environments

Policy
- Deployment Scenarios
- Financing & Investment Models
- Operations & Governance
- Institutional Issues
Selected ITS Deployment Lessons Learned

- Evaluation long a hallmark of U.S. ITS program
- Lessons represent experiences of many ITS practitioners
- Valuable resource for leaders making informed decisions in future ITS deployment programs
- Our classification scheme:
  - Management and Operations
  - Policy and Planning
  - Design and Deployment
  - Leadership and Partnerships
  - Funding
  - Technical Integration
  - Procurement
  - Legal Issues
  - Human Resources
Management and Operations (M&O)

What Have We Learned About Operations?

- Operate Intelligent Transportation Systems as regional endeavors
- Operators understand the value of working together and implementing management and operations strategies on a regional basis
- Historically in the U.S. there has been a perception that management and operations are local issues – we are slowly changing this
- Operations focus on
  - Operational structure
  - Operational strategies
Management and Operations (M&O)

Key Operational Structure Lesson

- Managers must recognize the traveling public does not care about jurisdictional boundaries – only about moving safely and quickly
- ITS operators must coordinate across jurisdictions, share resources, develop procedures that do not threaten individual agency roles
- Successful technique: co-locating various agencies in Transportation Management Centers (TMCs)
  - Traffic operations
  - Transit staff
  - Public safety
  - Emergency response
  - Others as feasible
- Share facilities, data, equipment and funding
- Save money, enhance communication and collaboration
Operational Strategies

Key Lesson: Continually explore ways to improve effectiveness of operations when deploying ITS

- Once deployment is completed, plan for full-time technical support staff
- Managers must have “hands-on” experience with deployed technology—notable example: transit system administrator was critical of Automated Vehicle Location/Mobile Data Terminal effectiveness—until the software was installed on her computer—she then understood problems faced by dispatchers

Key Lesson: Continuously evaluate and upgrade maintenance programs

- Develop maintenance plan that addresses:
  - Maintenance requirements
  - Staffing and resource shortages
  - Training programs
  - Inventories of parts
  - Preventive maintenance procedures
- Careful preventive maintenance reduces demand for subsequent maintenance needs
Operational Strategies

Key Lesson: Managers must pay close attention to tools and models that can enhance operational strategies

Example: Traveler information websites are key tools; they must focus on usability based on customer input

- ITS Managers are frequently civil engineers
- Engineers and users have different perspectives
- Get website developers involved who will seek customer (traveling public) feedback
Management and Operations

Bottom Line: Successful ITS Projects are **not only** dependent on design and deployment

- Ongoing success depends on
  - Management
  - Maintenance
  - Operations
  - Feedback loop

- Proven strategies and solutions result in effective and efficient system performance
Policy and Planning

Goal: Incorporate ITS products and services in transportation planning processes – strive to “mainstream” ITS

Policy Lesson: Develop policies that ensure consistency and interoperability in deploying integrated systems:

- Develop and enforce statewide or regional ITS deployment policies and architectures
- Develop documentation to guide operations
  - Concept of Operations (what is system expected to accomplish)
  - Transportation Operations Center Operations Manual to guide engineers and operators
  - Policy document on fiber optic and wireless communications technologies to be used in ITS deployments
- Examples of issues that have surfaced requiring policy guidance:
  - Can one jurisdiction assume control of equipment located in an adjoining jurisdiction?
  - Can maintenance staff from one jurisdiction work on equipment in the neighboring jurisdiction?
  - Can jurisdictions use deployed systems for purposes other than those defined by partnerships?
Policy and Planning

Policy Questions
- Who is responsible for liability?
- Who is responsible for certain maintenance tasks?
- Who manages and coordinates funding?
- Who exercises control over specific deployed components?
- Are there partnerships with private sector participants?

Policy Lesson: Develop ITS data sharing policies
- What public data can be accessed by private partners?
- Can privately generated data be shared with public agencies?
- What are the fees and costs incurred by private sector for disseminating public data?
Planning

Some experience-based insights gained from planning complex projects:

- Think with regional perspective
- Plan for long-term operations and management
- Deal with intellectual property issues early
- Policies must be written—verbal guidance leads to trouble
- Designate and assign full-time project manager at key sites – key personnel turbulence will cause schedule slippage
- Aggressive schedules will not work
  - Develop realistic schedules
  - ITS projects require longer schedules—different knowledge, skills, abilities
- Software acquisition is challenging
- Many agencies involved
- Must test systems thoroughly before going operational
- Be flexible—be prepared to make changes
Planning

Key Lesson: Use available planning tools
- The National ITS Architecture
- ITS Deployment Analysis System (IDAS) software developed under Federal Highway Administration (FHWA) oversight, enables planners to estimate benefits and costs of ITS investments

Key Lesson: Deploying ITS in rural areas is more challenging than in metropolitan areas
- Longer distances between resources
- Susceptibility for vandalism
- *Traveler information reliability is critical*—must be highly reliable, timely and accurate to support safety

Insight: Trying to “mainstream” ITS in the planning process
Provide your ITS project input to the regional, long-range transportation programming process—the planners will not come looking for you—go to them!
Leadership and Partnerships

For Regional ITS Deployments – Multiple Agencies – Several Jurisdictions

Find a Champion

- Powerful and influential
- Can be – or can influence – decision makers
- Has respect of transportation community and political leadership
- Is effective at building coalitions

Champion Can

- Articulate region-level vision, goals and objectives
- Get support from decision-makers at all levels
- Advocate effective public education
- Raise funding
- Insist on rigorous performance measures for all participants
Design and Deployment

Experienced-based Lessons

- Adopt flexible, systems engineering-based project management techniques
  - Conduct In-Process Reviews (IPRs) more frequently than you do in a standard project
- Teleconferences are good – people appreciate being informed
- Project manager must be readily accessible
- Roles and Responsibilities must be clear and understood
- Design and tailor the system technology to meet the needs of the users and customers
- Emphasize * interoperability* in cross-regional deployment projects
Design and Deployment

- Be prepared for organizational Interference
- Prime Example: CIOs think ITS is IT and will want to take charge of projects – not true!

### Table

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<th>ITS</th>
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<td>Intelligent transportation systems (ITS) and technologies are the application of integrated information and communications technologies to infrastructure and vehicles in order to improve safety and better manage travel and travel choices</td>
<td>Information technology (IT) is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware</td>
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Example problems:

- IT software acquisition rules hinder ITS deployment
  - Low bid contracts
  - Statewide list of approved equipment
  - IT office approval of equipment purchases
- IT staffs do not recognize importance of legacy systems, low-tech options and purchasing over leasing
- Interdependence between security software and the DOT network e.g., hackers can use TMC software to do malicious damage on DMS etc
Conversely, security requirements established by IT policies can be overly restrictive for ITS software

For example: Precluding remote access – when remote access is critical for restarting ITS devices (DMS) in emergencies

Telecommunications conflicts – DOT wants to use statewide communications network for ITS (traffic signal coordination, actuation of DMS, etc). IT and DOT have vastly different performance and security standards

A story from California: At one point (late 1990s) the California IT leadership wanted to control the entire Caltrans operational systems down to the level of embedded code in traffic signal controllers
ITS Managers find leasing communications systems to be:
- Expensive
- Unsatisfactory
- Unreliable

If you can (Have $ + Right of Way, etc)
- Lay as much fiber optic cable as possible
- If you don’t use it all in the near-term, you will in the long-term
- If you don’t use it all in the long-term, lease it; your agency will benefit
Funding

Experience in the U.S. – may be applicable in other nations:

If you receive funding from your federal government, obtain immediate clarification on regulations for projects that do not deliver **tangible products**

- Funding regulations cover products like asphalt, concrete, highway lanes, reconstructed bridges
  - ITS projects usually deliver a **service**
  - Someone (champion, powerful, important) must go to the high-level contracting managers – and get clarification and approval early
  - If you leave it to your project managers, your project schedule **will be delayed**

- Consider Public-Private Partnerships and Innovative Financing to fund ITS Projects

- Explore private sector partners who will:
  - Invest
  - Actively participate in project development, and
  - Operation

- Be prepared for private sector partners who may want to expand into other (non-transportation-related) areas

- Explore development impact fees, special assessments and other innovative techniques to support ITS project development, operation and maintenance
Technical Integration

To put all the pieces of an ITS project puzzle into one working whole, ITS managers must integrate three areas:

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<th>Functional Integration</th>
<th>Jurisdictional Coordination</th>
<th>Legacy Systems</th>
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<td>- Develop requirements based on user needs</td>
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<td>- Conduct surveys</td>
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<td>- Perform usability testing</td>
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<td>- Seek user feedback</td>
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<td>- Use ITS standards and protocols</td>
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<td>- Develop systems and planning that ensures information sharing and coordination among regional agencies and states</td>
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<td>- During September 11, 2001 attack on the Pentagon, traffic management agencies in DC, Virginia and Maryland could not communicate and did not coordinate evacuation</td>
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<td>- Each jurisdiction set plans in motion that conflicted with, or did not support procedures in adjoining regions</td>
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<td>- Must be folded into the regional project</td>
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<td>- Project schedule must allow adequate time to identify/resolve issues with existing legacy equipment</td>
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Procurement

Method of Award

- Procurement rules for transportation construction projects require that price is the selection criterion.
- Price alone is not adequate for technically complex ITS Projects.
- Consider qualifications, experience, key personnel (especially project managers), depth of expertise … and price.

Contract Form

- Consider the advantages of dividing a large ITS project into multiple, manageable task orders.
  - The traditional large cost-plus-fixed fee contract reduces flexibility.
- Several manageable task orders can:
  - Facilitate development of scopes of work, estimates, and schedules for each task order.
  - Improve management of cost, schedule and performance.
  - Highlight the dependencies in the overall project so the PM can better assess progress.
Procurement

Contract Types
ITS Projects managed with performance-based contracts – including incentives and penalties – have proven successful in adhering to schedule and performance

Terms and Conditions
- Develop policies that address software and technologies (including intellectual property rights) that are introduced into the project
- Do this early
Legal Issues

Develop policies early to clarify the handling of:

- **Intellectual Property Rights**
  - Project cannot deploy until issues are resolved
  - Develop licensing agreements
  - Use available resources – *Intellectual Property Manual*

- **Liability**
  - Develop written policies early
    - Is each partner responsible for actions of its employees?
    - Are there indemnification clauses and limitations on liability?
    - Will the project establish thresholds guiding the alteration of signal timing plans?

- **Privacy**
  - What are the data sharing rules?
    - “Big Brother” concerns
    - Who can access data?
    - How does law enforcement fit in the policy?
  - Is there a provision for anonymous use of transponders for probes?
Human Resources

- **Statement of the Obvious**
  - Human resource needs for ITS projects vary greatly from those of traditional transportation engineering projects

- **Recurring Observation**
  - In assessing the causes of schedule slippage in US ITS deployment projects, project manager turbulence was a major contributing factor
  - ITS Projects are complex in a variety of ways. When obstacles are encountered, strong, effective leadership must act immediately

- **What have we learned?**
  - Create meaningful career paths to:
    - Facilitate recruiting and retention
    - Guard against excessive workloads
    - Avoid vacancies – hire staff as soon as a future vacancy is identified – TMCs cannot afford unfilled positions
Human Resources

- **Training is critical**
  - Train staff throughout the life cycle of a project-deployment, when systems become operational, as project responsibilities and capabilities expand (they always do)
  - Train the trainer – leverage investments in formal training by developing your in-house trainers

- **Cross-training is the best form of crisis insurance**
  - Cross-train staff to handle peak workload/emergency or special situations
  - Cross-train promising employees for rapid promotion when need arises
Conclusion

- This has been a quick trip through some of the ITS deployment experiences in the U.S.

- Forms of government in nations deploying or planning to deploy ITS are different, but some relationships (federal-to-state; state-to-local jurisdiction) will create the same challenges we in the US encountered.

- We have documented our experiences, if you need help, we can provide assistance.

- Project managers approaching ITS projects as they would manage traditional transportation engineering projects will be in trouble.

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