

Grand Challenges in Transportation: The Role of Geographic Information Systems and Science

William (Billy) Bachman
Geostats

wbachman@geostats.com

2007 Geographic Information Systems for Transportation annual symposium

Nashville, TN, 26-28 March

Context

- **Transportation Research Board (TRB)**
 - Division of the National Research Council
 - Promote innovation and progress in transportation through research
- **Spatial Data and Information Sciences committee (ABJ60)**
 - Advance GIS science, technology and applications in the field of transportation
 - Research and Education Subcommittees

Spatial Data and Information Sciences committee (ABJ60) activities

- **Stimulate research** by developing and publishing research problem statements, issuing calls for papers, submitting research problem statements to the NCHRP and TCRP, and defining and publishing critical issues and research needs.
- **Keep the transportation community apprised** of recent and ongoing research through sessions at TRB Annual Meetings, specialty conferences and workshops, committee meetings, informal networking, responses to requests for information, and referrals to other experts.
- **Synthesize and disseminate research results** through sponsorship of workshops and conferences, compilation of bibliographies, and publication of compendiums of research papers and state-of-the-art and state-of-the-practice reports.
- **Review and recommend research papers** for publication by TRB and for TRB-sponsored awards.
- **Cosponsor special activities** and providing liaison with other transportation-oriented agencies in the United States and in other countries.
- **Encourage participation** in TRB by students and professionals entering the transportation field.

Grand Challenges in Transportation

- Why?
 - Global transportation demands
 - E-commerce and interdependency
 - Doubling of freight
 - Better understand needs
 - Better Management
- Major problems with decadal time frames
- Spatial problems ... spatial solutions

TRB's Grand Challenges for Transportation

- *Congestion*
- *Emergencies*
- *Energy and the environment*
- *Equity*
- *Finance*
- *Human and intellectual capital*
- *Infrastructure*
- *Institutions*
- *Safety*

Traditional design, planning and investment methods are unable to meet these challenges.

Grand Challenges in GIScience and Applications for Transportation

- How can GIS-T help meet these challenges?
 - Fundamental science required to meet challenges
- GISystems and science have matured
 - But, there are still fundamental issues to be resolved
 - However, GIS-T is mature enough to shift focus to substantive problems/applications
- How?
 - Bottom-up process
 - Venues and workshops
 - 2006: DC - Feds (August)
 - 2005-present TRB meeting (January), GIS-T symposium (March)
- What?
 - "Next generation" GIS-T activities
 - Outreach to others in transportation communities

GIS-T Grand Challenges

- Infrastructure renewal and asset management
- Operations and congestion
- Environment
- Safety
- Security
- Planning and programming
- Science

White paper

- Harvey Miller, co-chair and author/editor
- Posted at SDIS webpage for review
- www.ncgia.ucsb.edu/ABJ60/

Cross-cutting developments in GIS

- High resolution environmental monitoring
- Location-aware technologies*
- Spatio-temporal and moving objects databases*
- Tools for exploring spatio-temporal data
- Improving science and tools for simulating transportation and other human systems
- Data standards and infrastructures for integrating and interoperating data*

*topics of 2007 TRB workshops/sessions

Infrastructure Renewal and Asset Management

- Higher demands are being placed on transportation systems at the same time that transportation infrastructure is maturing and public investment is declining.
- How do we preserve and renovate saturated transportation systems without increasing the investment of resources?

Infrastructure Renewal and Asset Management

- Comprehensive system performance and risk assessment
- Integration of infrastructure data with ops/safety/security
- Let space and time be the linkage across elements

Operations and Congestion

- The increasing need for **efficient and responsive transportation** to support the global economy and mobile lifestyles is occurring in an era when the ability to **expand networks is increasingly limited**.
- Can we maintain **current or achieve improved levels of performance** without substantial physical expansion?

Operations and Congestion

- What do we do with all of the operational data created by ITS and in-vehicle systems?
- Great value in optimization of systems
- Need management, reduction, and analysis methods and guidance

Environment

- Transportation systems have a **direct and large environmental footprint**, as well as an indirect footprint through inducing other systems such as cities to manifest in environmentally unsustainable forms.
- **Can we reduce the direct and indirect environmental footprints and achieve a sustainable transportation system despite increasing population and travel demands?**

Environment

- Coordination of applications throughout the planning process
- Understanding of environmental factors in early stages of project development
- Improved methods
- Enterprise GIS ...

Safety

- More people and objects within a transportation system with minimal physical expansion implies higher incidence of accidents, injury and loss of life.
- Can we reduce or even eliminate the number of transportation accidents without harming the efficiency and responsiveness of transportation systems?

Safety

- Anything to reduce the 40,000 annual deaths ...
- High accident locations, crash investigations
- Potential analysis and management of "black box" and in-vehicle system data
- Performance based insurance rates

Security

- Recent events vividly illustrate our **vulnerability of transportation**, both due to the direct harm as well as the strangling of economies and lifestyles due to disrupted transportation systems.
- Can we make our systems **more resilient**, prevent the **improper and unauthorized use of transportation systems**, and reduce our **vulnerability** to their disruption, without restricting mobility or violating individual rights?

Security

- **Coordination and jurisdictional issues**
- **Design for resiliency**
- **Better evacuation and emergency planning -**

Planning and Programming

- Develop tools and methods that can help to **effectively prioritize** future transportation investments
 - weighing **future** safety, environmental integrity, aging infrastructure investments, and equity considerations
- Enhance **financial planning** through demand-based revenue forecasting
- Improve congestion management through better understanding of the **relationships** between land use, transportation infrastructure, and traffic operations
- Improve **public involvement** and equity considerations through interactive visualization tools
- Improve emergency response through **evacuation planning**

Planning and Programming

A challenge is to enable planners to effectively **utilize the rapidly growing body of geo-spatial data and information technologies** in order to **better address critical transportation issues**.

- **Quality data and analysis will allow planning and programming to rely more on data and less on political motives**

GIScience

Identify the underlying scientific frontiers

Relate to other GIScience research challenges

- Cognition of geographic information
- Spatial data acquisition and integration
- Spatial analysis in a GIS environment
- Interoperability of geographic information
- Distributed computing
- Future of the spatial information infrastructure
- GIS and society
- Uncertainty of geographic data and GIS-based activities
- Extensions of geographic representations
- Scale

Your role in this process!

- Where would you like to be?
 - You tell us - what do you wish you could do?
 - We* figure out - how can GIS and spatial data support this?
 - Think **big!**

*join ABJ60 as a friend at our web site



ABJ60

Committee on
Spatial Data and
Information Science

[Home](#)

[Roster](#)

Subcommittees

[Education](#)
[Data Integration](#)
[Research](#)

Research Focus

Groups
[Safety](#)
[Operations](#)
[Environment](#)
[Planning](#)
[Infrastructure](#)
[Security](#)
[Science](#)

[Meetings](#)

[TRB Staff Page](#)

[Documents](#)

[Resources](#)

[Contact Us](#)

[Join Us](#)

Transportation Research Board

Committee on Spatial Data and Information Science, ABJ60

Co-chairs: Harvey Miller, Reg Souleyrette. Secretary: Cesar Quiroga. TRB Contact: Tom Palmerlee

AM 2006

Call for problem statement

us group vision statements

Mission

The Committee on Spatial Data and Information Science was created to advance GIS science, technology and applications in the field of transportation through research in communications and visualization, spatial data, systems integration, organization, and spatial analysis and modeling. The Committee is also to conduct outreach through TRB and to communicate the effective use of GIS to the transportation community.

Scope

The scope of this Committee includes all aspects of the spatial, locational and temporal data used in transportation. The Committee is interested in both research into and applications of this information and its associated information systems, commonly referred to as Geographic Information Systems in Transportation (GIS-T). The committee will provide a focal point for and promote coordination of GIS-T activities within the TRB committee structure. Relevant activities include the application of spatial data and spatial sciences across the entire domain of transportation information systems.

Links

[Transportation Research Board](#)

[National Academy of Sciences](#)

Hosted by the [National Consortium on Remote Sensing in Transportation—Infrastructure](#) (NCRST) at the [National Center for Geographic Information and Analysis](#) (NCGIA), University of California, Santa Barbara. We are interested in [your comments](#) on this web site.

Disclaimer: The information at this site is maintained by members of the Committee on Spatial Data and Information Science, ABJ60, and does not imply endorsement by the Transportation Research Board, the National Academy of Sciences, or the National Research Council.

www.ncgia.ucsb.edu/ABJ60/