

Geospatial Information  
Infrastructure for  
Transportation Organizations  
*Toward a Foundation for  
Improved Decision Making*

Committee on Multimodal Transportation Requirements  
for Spatial Information Infrastructure

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This report has been reviewed by a group other than the authors according to the procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Cover image: Orthophotograph of Chicago, Illinois, Loop with overlays of several Chicago Transit Authority bus and rail routes. (Courtesy of Chicago Transit Authority.)

# Executive Summary

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Making well-informed, responsible decisions is critical to shaping the nation's transportation infrastructure. Geospatial data are a foundation for relevant and critical information for planning, engineering, asset management, and operations associated with every transportation mode at all levels of government and administration. One definition of geospatial data is found in the executive order on coordinating geographic information and access: "Geospatial data' means information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth. This information may be derived from, among other things, remote sensing, mapping, and surveying technologies. Statistical data may be included in this definition at the discretion of the collecting agency."<sup>1</sup> Extracting these data, transforming them, and making them available to decision makers has dramatically increased in importance as all modes and levels of government face increasing responsibility for improving efficiency while maintaining mobility, improving safety, and anticipating and addressing security threats.

The supporting information used in this project was primarily obtained from three workshops held in three cities during 2002. The first workshop, held in Chicago

in May 2002, examined the role of geospatial data in the project delivery process. The second workshop, held in Seattle in June 2002, focused on safety, security, and mobility. The third workshop, held in Washington, D.C., in October 2002, reviewed current activities of the modal administrations within the U.S. Department of Transportation (USDOT) in using geographic information systems (GIS), the Global Positioning System, and remote sensing to make decisions. Representatives of each modal administration were invited to present their perspectives. All three workshops included ample time for discussion of the issues through breakout sessions designed to provide feedback to the committee.

The committee offers a series of findings that have been divided into three areas:

- Institutional roles and responsibilities,
- Capacity and commitment building, and
- Geospatial information.

Recommendations based on these findings address strategies to enhance the interoperability of geospatial information among and across modal and multimodal transportation organizations and are addressed to USDOT. While all transportation organizations need to embrace geospatial technologies to improve decision making, the committee believes that USDOT needs to take a leadership role for the transportation system as a whole. Likewise, each modal administration should develop capabilities to use these technologies and provide leadership within its mode. Because the committee believes that many of the greatest payoffs can come

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<sup>1</sup> Executive Order 12906, published in the April 13, 1994, edition of the *Federal Register*, Vol. 59, No. 71, pp. 17671–17674. Amended by Executive Order 13286, published in the March 5, 2003, edition of the *Federal Register*, Vol. 68, No. 43, pp. 10619–10633. See also [www.fgdc.gov/publications/documents/geninfo/execord.html](http://www.fgdc.gov/publications/documents/geninfo/execord.html), Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure.

from improving the efficiency of the multimodal transportation system as a whole, coordination of geospatial technology initiatives within USDOT is essential. That is a role that the Bureau of Transportation Statistics has begun to play. The committee believes that this leadership role within the department and within the transportation community needs to be strengthened with adequate resources, formal departmental recognition, and management support.

Although the recommendations resulting from this project are specifically addressed to USDOT, they can apply to all levels of decision making and should be considered by every agency and decision maker as they relate specifically to each environment. The findings are summarized below; the recommendations are discussed in detail in Chapter 4.

### INSTITUTIONAL ROLES AND RESPONSIBILITIES

The roles and responsibilities of decision makers must evolve if we are to leverage geospatial information and tools to best advantage. This entails building and maintaining different relationships and enabling new and creative ways to do business. To accomplish this,

- The role of government should shift from implementer to facilitator/enabler and role model, allowing agencies to become more flexible and responsive;
- Different relationships should be established, both horizontally across functions and vertically across levels of government and the private sector, to ensure that resources are used most effectively;
- The transportation sector should play an active role in national and international activities associated with the establishment of standards and other data exchange and outreach initiatives; and
- Current project-based data acquisition should be transformed into a systematic activity for building and sustaining a geospatial information infrastructure.

### CAPACITY AND COMMITMENT BUILDING

The ability of organizations to apply geospatial information technologies to improve transportation is dependent on the awareness and appreciation of an organization's leaders, the level of knowledge of staff, the development of human capital, and the advancement of the geospatial infrastructure for use by an organization. To ensure that these abilities are leveraged,

- Assistance should be provided to agencies to incorporate technologies into their day-to-day operations and, as necessary, expand and modify their business processes to capitalize on these technologies;
- Current and future transportation professionals at all levels should be well grounded in geospatial information concepts and should continually update their knowledge and skills in geospatial information technology;
- Techniques, tools, and innovative approaches for using geospatial information and technologies should be disseminated to transportation professionals quickly and effectively; and
- The state of the art of geospatial information technology should be advanced by developing fundamental knowledge that influences long-term technological innovations in the use of geospatial information for transportation.

### GEOSPATIAL INFORMATION

Geospatial information and technology are a critical part of the transportation infrastructure. With the emergence of GIS from static map production to near-real-time decision support, the availability and accessibility of hardware and software tools that manage voluminous databases, and the availability of more and more data, increased interoperability and the necessary infrastructure to support that interoperability are critical to positioning agencies to take advantage of these capabilities. To advance the use of these tools,

- Different levels and types of transportation organizations need to combine geospatial information to improve decision making and resource allocation; and
- A mechanism needs to be provided for transportation stakeholders to access information and policies for all levels, modes, and application areas of transportation.

Information, and the data and technologies that support and generate it, is not without cost. However, it should be viewed as infrastructure that is just as necessary as bridges, ports, runways, rails, and roads. Its cost is minimal compared with the potential for what one speaker described as "billion-dollar bonehead decisions" that could occur without adequate information. To ensure that we make the best decisions possible, we need to support the information infrastructure, or we will find ourselves without the means to make the necessary decisions.

## CHAPTER 5

# Call to Action

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The potential for having comprehensive, timely, and usable geospatial information necessary to support informed decision making in transportation is good. However, that potential has been realized only in a limited number of cases and not on a broad, systemwide scale. This report represents a call to action to transportation agencies, primarily at the federal level, to make this happen.

### PAST AND CURRENT REPORTS

The call for enhanced geospatial information is not new. During the last decade, nearly one document each year has recognized or evaluated the need for geospatial data as part of a comprehensive information decision-support environment (see Box 5-1). Findings from these reports consistently maintain the theme that the comprehensive data necessary for effective decisions at a national level or to be provided to state or local decision makers do not exist, except for very specific applications, and that integration across data sets has not been practical. Recommendations routinely support the enhancement of the quality, interoperability, and dissemination of these data through coordinated activities at the national level and through partnerships with stakeholders. But because these reports have spanned the last decade and the findings and recommendations represent variations on the same theme, it appears that proponents have both underestimated the complexity of the task and failed to effectively communicate the fundamental need to the appropriate

decision makers to make geospatial information not only a priority but a necessity. Partnerships exist to provide benefits for one or more parties. Identifying what benefits are for whom as well as what responsibilities are required of which stakeholders is an essential foundation for any data-sharing arrangement. Both the benefits and the responsibilities must be balanced in an equitable manner.

The work performed for this project and reports from previous studies indicate that the keys to successfully accomplishing the goal of an effective geospatial information infrastructure are to redefine and enable the roles of the stakeholders as partners; educate and demonstrate to decision makers the benefits of a comprehensive information infrastructure; and ensure that the technology, procedures, and best practices are made available to stakeholders to put the infrastructure in place.

The recommendations from this effort are divided into three categories:

- Institutional roles and responsibilities,
- Capacity and commitment building, and
- Geospatial information.

Each category is further divided into specific areas. Each area includes one or more recommendations for consideration by all levels and areas of transportation organizations, but in particular for the federal government and more specifically the U.S. Department of Transportation and its Bureau of Transportation Statistics.

## Box 5-1

**Previous Calls for Improved Geospatial Information**

1991—*A National Geographic Information Resource: The Spatial Foundation of the Information Based Society*. Federal Geographic Data Committee.

1992—*Special Report 234: Data for Decisions: Requirements for National Transportation Policy Making*. Transportation Research Board, National Research Council, Washington, D.C.

1993—*NCHRP Research Results Digest 191: Management Guide for Implementation of Geographic Information Systems (GIS) in State DOTs*. Transportation Research Board, National Research Council, Washington, D.C.

1993—*Toward a Coordinated Spatial Data Infrastructure for the Nation*. National Research Council, Washington, D.C.

1995—*Promoting the National Spatial Data Infrastructure Through Partnerships*. National Research Council, Washington, D.C.

1995—*A Data Foundation for the National Spatial Data Infrastructure*. National Research Council, Washington, D.C.

1997—*Bureau of Transportation Statistics: Priorities for the Future*. C. F. Citro and J. L. Norwood (eds.), National Research Council, Washington, D.C.

2001—*National Spatial Data Infrastructure Partnership Programs: Rethinking the Focus*. National Research Council, Washington, D.C.

2003—*IT Roadmap to a Geospatial Future*. National Research Council, Washington, D.C.

2003—*Weaving a National Map: Review of the U.S. Geological Survey Concept of the National Map*. National Research Council, Washington, D.C.

Brief discussions of these reports are provided in Appendix C.

The recommendations are broad and will require leadership from the federal level to have a chance of meeting the goals set forth in this report.

**CONCLUSION**

Information, and the data and technologies that support and generate it, is not without cost. However, it should

be viewed as infrastructure that is just as important and necessary as bridges, ports, runways, rails, and roads. Its cost is minimal compared with the potential for “billion-dollar bonehead decisions” that could occur without adequate information. To ensure the best decisions possible, the information infrastructure must be supported, or the means to make the necessary decisions will be unavailable.