EXECUTIVE SCAN TOUR REPORT

Geospatial Technology for Improved Decision Making in Transportation

Observations and Moving Forward

Prepared for the Office of Interstate and Border Planning
Federal Highway Administration
U.S. Department of Transportation

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Executive Summary

Geospatial technologies are emerging as robust tools to help improve transportation decision-making. These tools, which are becoming increasingly user-friendly, accessible, and cost-effective, are transforming the ways transportation agencies can store, manipulate, analyze, and present data relevant to transportation needs. With the development of innovations in geospatial technologies likely to continue, it is important for transportation agencies to consider the present state of the art, as well as what might be available and possible within the near future.

In 2004, the Transportation Research Board published "Geospatial Information Infrastructure for Transportation Organizations: Toward a Foundation for Improved Decision Making.[1]" The report provides recommendations for improving geospatial information infrastructure among and across all modes of transportation. The findings of the report, which drew on information presented at three workshops during 2002, focused on institutional roles and responsibilities; capacity and commitment building; and geospatial information. The recommendations made were based on these findings and were addressed to the U.S. Department of Transportation (U.S. DOT) – an agency the report authors viewed should take a leadership role in coordination of geospatial technology initiatives for multimodal transportation.

In response to the report's recommendations, as well as to a growing need and capacity at transportation agencies to successfully implement geospatial technologies, the Federal Highway Administration (FHWA) sponsored the *Executive Scan Tour on Geospatial Technology for Improved Decision Making in Transportation* (Executive Scan) in the fall of 2005. The focus of the Executive Scan Tour was on noteworthy practices that are leading to the advancement of cutting edge geospatial applications. By highlighting the success stories, methodologies, and lessons learned of several public and private organizations, the Executive Scan Tour aimed to identify the critical information needed by transportation executives to enhance decision-making through breakthroughs in the implementation of geospatial technology and expertise.

The Executive Scan Tour team was comprised of transportation leaders from State Departments of Transportation (State DOT)[2]. In requesting their involvement in the tour, it was anticipated that these executives could successfully influence the use of current and future geospatial technologies at their agencies and identify the business strategies conducive to widespread, successful implementation at State DOTs nationwide. Other scan team members included representatives from FHWA's Office of Interstate and Border Planning, the FHWA Resource Center, the Transportation Research Board (TRB), the U.S.DOT Bureau of Transportation Statistics (BTS), the U.S. DOT Volpe National Transportation Systems Center, and Virginia Tech University.

During trips to two States (San Diego, CA – October 2005 and Harrisburg, PA – November 2005), the scan team visited a combination of State DOTs, Metropolitan Planning Organizations (MPOs), local associations of governments, and commercial vendors to learn about the history of current, transportation-related geospatial applications and the challenges faced during implementation; business models and practices that support investment in these applications; as well as, trends and promising applications potentially implemented within the next five years.

The prevailing lessons learned included:

- The value of geospatial technologies should be clearly articulated to executive decisionmakers and linked to their performance plans, goals, and objectives.

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[1] Committee on Multimodal Transportation Requirements for Spatial Information Infrastructure. Geospatial Information Infrastructure for Transportation Organizations: Toward a Foundation for Improved Decision Making. Transportation Research Board of the National Academies. Washington, D.C. 2004.
[2] See Appendix A for full list of Executive Scan Tour Team members.

- Transportation agencies should be organized and business processes developed that support geospatial technologies and a favorable working environment.

- An appropriate array of skills should be hired.

- Provide real-time information to help customers make more informed decisions.

The Executive Scan Tour Report is intended to summarize lessons learned and other observations made over the two trips of the Executive Scan Tour. The report sets the context for a one-day workshop in which the scan team will reconvene and meet with transportation executive invitees from across the country. Together, workshop participants expect to formulate an action plan for facilitating the implementation of geospatial technologies at transportation agencies. The workshop is planned for February 2006.

I. INTRODUCTION

Context and Objectives

Geospatial technology refers to the tools and science used to gather, store, analyze, and present data that are referenced to the earth by some type of real-world coordinate system (e.g., a map projection). These tools generally include geographic information systems (GIS), remote sensing, thematic mapping, image processing, Global Positioning Systems (GPS). Because of their ability to convey more information than is sometimes visible, emerging geospatial technologies have great potential to improve decision-making at State Departments of Transportation (State DOTs).

In its 2004 report "*Geospatial Information Infrastructure for Transportation Organizations: Toward a Foundation for Improved Decision Making*," the Transportation Research Board (TRB) describes challenges limiting successful implementation of a comprehensive geospatial information infrastructure. Two of these challenges were:

- "the lack of or limited awareness on the part of decision makers, particularly at the level of resource allocation, about the availability and use of the geospatial information infrastructure and potential cost of making decisions without geospatial information," and

- "the inability of organizations (a) to keep pace with the rapid expansion of this technology, (b) to ensure that staff receive the necessary training to effectively use the technology, and (c) to expand their business processes to fully enable the technology."

The report also offered recommendations to the United States Department of Transportation (U.S. DOT) for developing new and strengthening existing approaches for addressing these and other challenges[3]. The recommendations focused on institutional roles and responsibilities; capacity and commitment building; and geospatial information.

In response to the report's recommendations, as well as in general support of the development and adoption of geospatial technologies at State DOT's, the Federal Highway Administration (FHWA) sponsored an *Executive Scan Tour on Geospatial Technology for Improved Decision Making in Transportation* (Executive Scan). The purpose of the Executive Scan, which included site visits in San Diego, California (Oct. 2005) and Harrisburg, Pennsylvania (Nov./Dec. 2005), was to identify and understand the critical information needed by transportation executives to improve decision-making through use of geospatial technology. By listening to the experiences that State DOTs, MPOs, and commercial vendors have had in implementing geospatial technologies for transportation decision-making, Executive Scan team members hoped to learn about practices that can prove successful in fully realizing the growing possibilities geospatial technologies offer.

Other goals of the scan were to:

- Develop an understanding of the factors leading to the implementation of specific geospatial applications at presenters' organizations;
- Identify business practices and models used to support the advancement of geospatial technologies;
- Study the institutional arrangements that foster successful partnerships;

[3] TRB's *Geospatial Information Infrastructure for Transportation Organizations: Toward a Foundation for Improved Decision Making* is one of several previous calls for improved geospatial information. Page 30, as well as Appendix C of the TRB report cites and annotates reports recognizing or evaluating the need for geospatial data as part of a comprehensive information decision-support environment.

- Promote GIS champions within State DOTs and determine creative ways to make a business case for investment in geospatial technologies; and,
- Expose members of the transportation community to future geospatial applications.

The scan team that worked towards achieving these goals consisted of leaders from California Department of Transportation (Caltrans), Florida Department of Transportation (FDOT), Idaho Department of Transportation (IDOT), New York State Department of Transportation (NYSDOT), Ohio Department of Transportation (ODOT), and Virginia Department of Transportation (VDOT), as well as staff from FHWA's Office of Interstate and Border Planning, the FHWA Resource Center, the Transportation Research Board (TRB), the U.S.DOT Bureau of Transportation Statistics (BTS), the U.S. DOT Volpe National Transportation Systems Center, and Virginia Tech University. See Appendix A for a full list of scan team members.

Presenters

This section briefly describes the organizations that were invited to present during the two scan visits. These organizations were asked to speak to the group because they had been identified as being leaders in geospatial technology development and/or implementation, or were believed to be able to offer valuable insight into the challenges faced when implementing such technologies.

San Diego, California – October 24-26, 2005

San Diego Association of Governments (SANDAG)

In San Diego, the Scan Team met with the San Diego Association of Governments (SANDAG). SANDAG is the regional planning agency for San Diego County and is comprised of the region's 19 local governments. SANDAG's main program areas are land use and regional growth, transportation, housing, economics and finance, environment, borders, and public safety.

Having used geospatial technologies since early in the 1970s, SANDAG has developed an extensive GIS and continues to pioneer innovative approaches to geospatial database development, maintenance, analysis and display. In order to continually improve and develop more uses for its geospatial technologies, SANDAG has formed partnerships and data sharing agreements with several agencies, including SANGIS, San Diego State University (SDSU) Department of Geography, Environmental Systems Research Institute (ERSI), and Earth Resources Data Analysis System (ERDAS), among others.

Southern California Association of Governments (SCAG)

As the largest council of governments in the United States, Southern California Association of Governments functions as the MPO for six Southern California counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. This region of over 38,000 square miles supports a population over 15 million. In San Diego, SCAG representatives described how the MPO has successfully used geospatial applications as decision-support tools. A demonstration of how SCAG has partnered with Google Earth was also given.

Caltrans, District 11

District 11 of the California Department of Transportation (CALTRANS) is located in the southernmost part of California, and includes San Diego County and Imperial County. District 11 oversees approximately 1,000 miles of freeways and highways, both urban and rural. The district is also involved with local agencies to develop a diverse multimodal transportation system that includes light rail, transit, as well as commuter rail and high-occupancy vehicle programs and facilities.

ESRI

Founded in 1969, Environmental Systems Research Institute (ESRI), in Redlands, California, was founded as a private consulting firm specializing in land use analysis projects. In 1982, ESRI

released its first software application, called *ArcGIS*. Over the past 20 years, this software application has evolved into an integrated collection of GIS software that can be used on desktops, servers, and mobile devises. ESRI professional services also provide GIS consultation to businesses interested in implementing GIS technologies.

In San Diego, ESRI discussed with the scan team how innovations in computer technology and software have fueled the rapid growth of sophisticated geospatial operations and applications within State DOTs. Challenges that commercial vendors face when working with State DOTs were also described.

SANGIS
The mission of SanGIS, which was established in 1984, is "to maintain and promote the use of a regional geographic data warehouse for the San Diego area and to assist in the development of shared geographic data and automated systems which use that data." SanGIS was established in 1984, when the City and County of San Diego jointly initiated the Regional Urban Information System (RUIS) in an attempt to deliver municipal services in an increasingly complex and growing region. The primary goal of the RUIS was to develop an integrated GIS system designed to meet the needs of the San Diego area. Today, SanGIS is the central clearinghouse with over 400 layers of geographic data.

Google Enterprise Solutions, Inc.
Google Earth is an interactive, satellite-image software offered by Google. Google Earth is the newest generation of Keyhole Software and combines advanced 3-dimensional graphics and network streaming innovations to produce a high performance system that operates on personal computers. It also has the ability to integrate GIS data produced with other software vendors, such as ESRI's ArcGIS. Their presentation highlighted uses of Google Earth for emergency response and potential uses for governmental agencies.

Harrisburg, Pennsylvania - November 30 – December 1, 2005

Pennsylvania Department of Transportation (PennDOT)
In Harrisburg, Pennsylvania, the Pennsylvania Department of Transportation (PennDOT), hosted the scan team. PennDOT has an extensive collection of geospatial technologies, which it started accumulating in the late 1980s while attempting to digitize maps for the state. In 1990, a GIS working group was established to create a more focused effort on developing GIS in PennDOT. One of the longest ongoing projects has been the development and maintenance of the State's base maps. The Department also uses GIS in the development of safety applications, interactive mapping and traffic monitoring systems.

GeoDecisions
In 1986, Pennsylvania State University faculty members founded GeoDecisions, a GIS mapping company in Camp Hill, Pennsylvania. To support geospatial technologies, GeoDecisions provides many services, hardware and software applications, and client training. Its customers include commercial, environmental, government, homeland security, law enforcement, military, transportation, and utilities industries. Together with PennDOT, GeoDecisions has developed a new version of VideoLog, which allows users to virtually "drive" on roads while on their computer.

Intergraph SG&I
Intergraph Security, Government & Infrastructure (SG&I), located in Huntsville, Alabama, serves clients worldwide in both the private and public sector. The Geospatial Production Services of Intergraph SG&I includes many GIS and mapping services, as well as technical support. GeoMedia, Intergraph's suite of GIS and mapping applications, is one of Intergraph's primary GIS applications. Intergraph SG&I paired with PennDOT to develop a web-base for all of their GIS applications. In Harrisburg, Intergraph gave the scan team an overview of technology initiatives at the firm and descriptions of common challenges State DOTs face. The presenters also led a discussion focusing on the private-side perspective of working with DOTs.

New York State Department of Transportation (NYSDOT)
Many decisions and a lot of work at NYSDOT are done with a backdrop of geospatial information and the use of geospatial technologies. In NYSDOT's Central Office, the GIS section is in the Information Technology (IT) division. In the regional offices, GIS work is done in planning divisions. An executive management team makes NYSDOT's corporate GIS decisions. In Harrisburg, NYSDOT suggested ways to measure the effectiveness of geospatial technologies and to justify the budget for their implementation.

Virginia Department of Transportation (VDOT)
VDOT, an agency expecting to shift to a customer-oriented, operations culture over the near future, has developed an enterprise GIS system. The system, which is publicly available on-line, uses a map-based graphical interface linked to various types of transportation data. VDOT also anticipates being able to provide geospatial information about its transportation networks around the clock, supporting the public's mobility and providing for facilitated performance measurement.

Ohio Department of Transportation (ODOT)
ODOT's GIS is organizationally located in the Planning Division. In the early days, this GIS was used predominately to show crash-related data. Over time, ODOT began digitizing and analyzing other data sets. Now, ODOT has decentralized its GIS budgets and instituted an Organization Performance Index (OPI), which helps the Department measure system performance and provides GIS staff a setting for justifying investment in geospatial technologies.

II. OBSERVATIONS

Common Challenges

During the two scan visits, presenters described some of the challenges public, private, and non-profit organizations face when implementing geospatial technologies for transportation decision-making. A majority of the challenges identified had overlapping themes despite being conveyed by different presenters. Below, these challenges are synthesized into five overarching obstacles many State DOTs are attempting to overcome. A full list of the challenges identified in San Diego and Harrisburg can be found in Appendix C.

Difficulty articulating value of geospatial technologies – Executives and decision-makers do not always understand the promise of geospatial technologies. It is sometimes difficult to make them aware that their decisions are based on results of geospatial analysis. GIS staffs often intuitively know that geospatial technologies are useful, but a clear case for further investment in them is not always made or documented. Sometimes the payoffs of using these technologies are not immediately apparent, as it is difficult to quantify the value of being able to do analyses not previously possible. However, without an unambiguous business rationale, convincing decisionmakers to dedicate funds to the development, operation, and/or maintenance of geospatial technologies can be challenging.

Lack of data standards – Without policies regarding data standards, State DOTs are often confronted with overcoming inconsistent basemaps and/or spending large amounts of time updating data. Additionally, vendor-supplied data is often licensed and cannot be shared. Because of issues related to homeland security and emergency response/recovery, State DOTs may be required to play a larger role in providing data normally acquired from the locals. Under these types of scenarios, State DOTs would likely need the ability and authority to share and distribute reliable, high-quality external datasets.

Unrealistic expectations – Technology changes expectations. Often expecting "a world of everything," end users' imaginations can be a step ahead of what is currently possible. This can create in GIS staff a sentiment of "chasing the technology," causing them to feel pressure to deliver more and more each additional project.

Decision-makers also sometimes lack the understanding that significant time investments are required to develop geospatial applications. They may not recognize that new applications do not always work flawlessly during initial implementation. Without this insight, unfeasible demands might be made of staff.

Matching correct skill sets – In the past, geographers were primarily responsible for developing and operating geospatial technologies. Although geography skills remain necessary, geospatial technologies are requiring an increasingly IT-savvy user. Currently, many State DOTs lack a process, or necessary job descriptions, to hire geospatial staff with the appropriate level of IT skills. In addition, some State DOTs have organizationally separated GIS and IT divisions. For this reason, many GIS divisions are faced with determining how to most effectively partner and team build with their IT counterparts, instead of having the two skill sets integrated.

Timing system and software upgrades – Sometimes system and software upgrades between and within organizations are not temporally aligned. When this incompatibility occurs, one organization can be confronted with having to decide whether to move forward only to have to wait for its partners to catch up, or to postpone the planned upgrade(s). With end users asking that information be delivered more and more rapidly, such delays can be detrimental to a transportation project.

Similarly, some vendors are often tasked with developing complex "one-off," stand-alone applications. Since these applications are often developed at different times and with different requirements, it can be difficult to integrate the applications together and into the diverse business system.

Business Models and Practices

Several effective business practices were described during the scan tour. These ranged from innovative public-private partnerships and unique pricing schemes to top-down priority setting for geospatial technologies. In each case, staff had worked to garner the champion support of executive decision-makers within their respective agencies. Three business models/practices are summarized here:

San Diego Association of Governments (SANDAG) Partnership – Understanding that public service agencies are not always effective in collecting revenue from GIS products, SANDAG worked to develop a private, non-profit to serve this role. Since 1982, SANDAG has managed SourcePoint, a non-profit that does transportation analyses, growth projections, and other planning studies for private business and public agencies. Revenue that SourcePoint generates feeds SANDAG and SourcePoint programs.

In addition to this partnership, SANDAG has implemented a unified pricing structure. This fee structure, in which there is a 17% mark-up (a regional information system maintenance fee), is based on competitive market rates. Customers have been accepting of the mark-up, understanding that there is a need to maintain the system.

Virginia DOT Priority Setting – At VDOT, IT managers typically try to meet to determine geospatial application priorities. This usually involves a discussion of how to shift resources to meet customer needs. Monthly status reports are sent to the chiefs to inform them of project progress. With this information in hand, IT managers then meet annually with VDOT chiefs to further talk about priorities and how they can be best implemented.

Ohio DOT Roadway Deficiency Identification – ODOT's Director is interested in learning where road network deficiencies are. In response, GIS staff has driven every mile of the state road network and GPS marked each incidence of litter, potholes, vandalized road signs, ditch obstructions, missing pavement markings, vegetation obstructions, etc. These data – or "deficiencies" – have been entered into the Department's GIS so that the flaws can be tracked

over time. ODOT can now determine whether the number of deficiencies is being improved and if not, then they can determine why not.

Implementation

During the two scan visits, several effective practices for achieving successful implementation of geospatial technologies were identified. Summarized below, these practices can help State DOTs to overcome some of the challenges they commonly face.

Articulate value – In order to put geospatial technologies on the radar of executive decisions, it is necessary to be able to articulate the value of investments in them. Top-level executives often make decisions based on improving the conditions of assets, and thus the benefits and costs of developing geospatial applications is critical information for making these decisions and showing that results have indeed improved.

One effective way to do this is to keep geospatial applications small and affordable, while showing application developers how different aspects of the data feed the ultimate goal. By doing so, it can be easier to show decision-makers that meaningful accomplishments have been made along the way.

Organize agency divisions and hire appropriate skills - Focus on the business factors that lead to success and what accomplishments are desired. Often these factors do not involve the latest technology, but successful implementation of existing technologies. While technology development is not usually a limiting factor, getting an agency organized to be able to efficiently address issues with geospatial technologies is.

As an alternative to or in conjunction with reorganization, it is important to bring the appropriate skills into a geospatial application project from the project's outset. When approaching major geospatial technology tasks, the skills needed on the project team include, but are not limited to: 1) "business people" who can verbalize application requirements and who can remain involved throughout the project's life-cycle, and 2) IT people who think on the business-side. State DOTs can consider creating job descriptions that allow for the hiring of a staff with the appropriate balance of geography, IT, and business skills.

Manage expectations – "Faster and better" cannot always be delivered in respect to geospatial technologies' outputs. It is important that the institutional knowledge developed around geospatial applications take this into account.

The development of "rogue" applications, or applications developed for one particular issue, sometimes do provide faster solutions. However, they are often developed without much regard to previously developed applications. Although they are sometimes the most creative applications, rogue applications must fit into and align with the bigger picture at State DOTs. Continued DOT support of the more traditional uses of geospatial technologies can help to manage any unrealistic expectations that rogue technologies may help perpetuate.

Other effective practices – Other practices that can be useful in the successful implementation of geospatial technologies for transportation include:

- Plan work so asset management plans are linked to a corridor, e.g. an intercity corridor, a community corridor, a tourism corridor, a general use corridor, and/or a trade corridor. One place where a State DOT has tried to do this is in New York. NYSDOT has worked to link the performance of geospatial applications to decisions made along various regional corridors. Since the way that a transportation system serves a community is often a localized issue, using a "Corridor Approach" to geospatial technology implementation can help decision-makers develop context sensitive decisions.

- Use State Planning and Research (SPR) funding. The planning portion of SPR funding has been a valuable funding source for developing geospatial applications and positions. State DOTs should look into how SPR's research portion could be leveraged to develop applications.

- Develop a plan for how to use information once a geospatial application or website is up and running. Understand how users will apply the information so that a business case can be made for continued investment to support operation and maintenance of the application or website.

- Build partnerships within and between agencies. Determine a common interest around which partnerships can be developed. When built around a common interest, partners can specialize to most efficiently utilize resources.

III. Moving Forward

The Next Five Years

The importance of geospatial technologies is likely to continue to grow within State DOTs. With the persistent lowering of hardware and storage costs, geospatial applications will likely provide a backdrop for most State DOT decisions. It is anticipated that not only will users be able to integrate geospatial applications more easily, but they will also have immediate access to real-time information flows. This will allow decision-makers to have continuous information about the conditions of their transportation systems.

These developments, which are expected to occur over the short-term, are briefly discussed below.

Continued development of web services and interoperability – There is a need to provide GIS data and tools to people without GIS expertise. This is a trend that is likely to continue. For this reason, the evolution of web services, or Internet-based applications that interact with other web applications for the purpose of exchanging data, is expected to continue over the next five years. The use of portals allowing for the sharing of specific application components of applications is also expected to surface.

This emergence likely means increased, seamless integration with other systems. State DOTs and GIS vendors alike expect the interoperability of geospatial technologies to improve. With the ability to gather information from a range of systems originally developed for different activities and analyses, decisions can be based on an understanding of conditions and issues perhaps more comprehensive than ever before. Similarly, users should be able to more easily import data from previously incompatible softwares. This will help further expand the utility of an agency's geospatial infrastructure.

It is also foreseen that geospatial technologies will expand to systems not normally tied to geography, such as financial systems. All of the electronic systems will likely be able to communicate with each other, helping to ensure that decisions are as efficient and effective as possible.

Implementation of geospatial technologies at an enterprise level – Executive Scan Tour presenters anticipate that over the next five years, State DOTs will begin incorporating geospatial technologies into their existing business processes, giving everyone across a State DOT better access to information. Having then developed experience at measuring the performance of modern geospatial technologies, GIS managers will likely be equipped with enhanced data regarding the returns on investment in geospatial technologies. This should allow them to make a better business case to upper level management for enterprise level implementation. Because

IT directors sometimes have less access to lead decision-makers, it is expected that planning directors at State DOTs will primarily be the ones conveying this message up the organizational ladder.

New Types of Partnerships – With roles concerning data and software development and maintenance shifting, it is expected that State DOTs will continue exploring new types of partnerships. In particular, public-private partnerships where State DOTs look towards private organizations to supply data are increasingly plausible. Although, this type of partnership can lead to data governance challenges, the opportunities they allow for in resource – both staff and funding – savings are potentially great.

A First Step – One-day Workshop

FHWA's Office of Interstate and Border Planning is taking a first step towards seeing that some of the effective practices and success stories presented and assembled on the Executive Scan Tour carry over to other State DOTs and transportation agencies. On February 28, 2006, the Office is hosting a one-day workshop of transportation executives from across the country. These executives, as well as other invitees, will meet with the scan team to discuss the learning accomplished on the scan visits, as well as to draft an action plan that will help guide FHWA's State DOT's, and other transportation partners' involvement and responsibilities in most effectively using geospatial information and technologies in current and future transportation activities.

Appendix A. Scan Team Members, Hosts, and Site Presenters

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Appendix B. Executive Scan Questionnaire

In advance of their travel, the Scan Team provided the participating host sites with a questionnaire. The questions it included were intended to allow the hosts to prepare and plan for the scan team's visit and to understand the types of information that were sought during the visit. The questionnaire was not intended to be formally answered, but instead, serve as a starting point for discussion during the site visits.

CURRENT USE OF GEOSPATIAL TECHNOLOGY

1. How is geospatial information currently being used?
2. What are some of your notable geospatial applications?
3. Why was this use/application(s) created? In response to specific issues or needs?
4. Who administers and/or manages application and/or data? Why?
5. How is the application funded?
6. What is the current status of the project/application?
7. Who is involved in the project/application and why/how did they become involved?

EXPERIENCE

8. What have been the biggest obstacles to and successes of using geospatial information?
9. Has using this application saved money/staff time? How much (estimate)?
10. Did you outsource the work in developing the application or was it done mostly in-house?
11. What unexpected issues, events and/or results have come out of using geospatial information?
12. Has feedback from public/partnering agencies or anyone else involved in using the application been received? What was the nature of the feedback?
13. What has been learned from this application/project? Do you have advice for others undertaking a project/application of this nature?

FUTURE USE OF GEO-SPATIAL TECHNOLOGY

14. What new projects/activities are planned? As a result of the new technology, are there issues that will be able to be addressed that were not being addressed before? What issues will not be addressed?
15. Are there ways that the application is helping to make better transportation decisions?
16. Do you expect to do more outsourcing of GIS services in the future or more in-house GIS work? Why?

TECHNICAL ASSISTANCE/ POLICY GUIDANCE

17. Can the Scan Team provide any technical or policy guidance to you or your community during the visit? If so, please describe the assistance requested.
18. What topics do you recommend be covered at a workshop to develop an action plan for geospatial technology?

Appendix C. Site Visit Notes

SAN DIEGO VISIT NOTES

LOCATION: SAN DIEGO ASSOCIATION OF GOVERNMENTS (SANDAG)
DATES: OCTOBER 23 – 26, 2005

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Andrea McCool

SANDAG
Jeff Tayman

SANGIS
Lisa Stapleton

Southern California Association of Governments (SCAG)
Richard Maden and Ping Wang

San Diego, California AGENDA Days 1-2

Sunday, October 23, 2005 — Travel Day
Meet for dinner in hotel lobby — 5:30 pm

Monday, October 24, 2005
Meet in hotel lobby — 8:00 am

Travel to SANDAG Boardroom – 7th Floor — 8:15 am
401 B Street, Suite 800
San Diego, CA 92101

SANDAG — 8:30 am – 12:00 pm
- ♦ Tour of Facilities
- ♦ Programs and Activities
- ♦ Management Challenges
- ♦ Future Vision

Lunch — 12:00 pm– 1:30 pm

SCAG — 1:30 pm – 5:00 pm
- ♦ Programs and Activities
- ♦ Management Challenges
- ♦ Future Vision

Tuesday, October 25, 2005
Meet in hotel lobby — 8:00 am

Travel to SANDAG Boardroom – 7th Floor — 8:15 am
401 B Street, Suite 800
San Diego, CA 92101

CalTrans, District 11 — 8:30 am – 10:00 am
- ♦ Programs and Activities
- ♦ Management Challenges
- ♦ Future Vision

ESRI — 10:15 am – 12:00 pm
- ♦ New products/services
- ♦ Private-side perspective working with DOTs
- ♦ What should state DOTs look for (technology trends, etc.)

Lunch — 12:00 pm – 1:30 pm

SANGIS — 1:30 pm – 3:30 pm

Google Enterprise Solutions, Inc. — 3:30 pm – 4:30 pm

Summary Discussion of the Visit — 4:00 pm – 6:00 pm

Wednesday, October 26, 2005
Travel Day

SAN DIEGO ASSOCIATION OF GOVERNMENTS

JEFF TAYMAN, DIRECTOR OF TECHNICAL SERVICES

Day 1 – Monday, October 24, 8:30 am – 12:00 pm

Mr. Tayman gave a PowerPoint presentation focusing on SANDAG's experience in using geospatial technology at the Metropolitan Planning Organization (MPO) level. After the presentation, Mr. Tayman led a discussion of where and how SANDAG is using geospatial technology, as well as how SANDAG funds these activities.

Articulating Benefits
SANDAG's first GIS client was the Polygon Information Overlay System (PIOS). Since this initial implementation of geospatial technology at the MPO, SANDAG has develop a program that uses geospatial technologies for:

- Statistical analyses;
- Demand forecasting;
- Transportation modeling support;
- Socio-economic modeling support;
- Computerized crime fighting (tactical and investigative) support;
- Visualization;
- Relational database management; and
- Scenario analysis, among others.

The use of geospatial technologies can permeate all sections of a transportation agency. Currently, SANDAG is effectively using the tools in places where day-to-day business relies on it. However, higher up in the organization, geospatial technology plays less and less of a role in daily job activities. Decision-makers are accustomed to seeing maps, but are perhaps not aware of geospatial technologies analytical power.

SANDAG is working to try and make those in elevated positions within the organization more aware of how their decisions are founded on the information and analysis made possible by geospatial technology implementation. Despite an intuitive understanding of the value of geospatial technology use, articulating this value has been a challenge. It has often been difficult to make a clear case for investing more in the new technologies/business model; a question that has arisen is: how can one quantify the benefits of being able to do analyses now that were not possible before the technologies emergence?

Similar challenges mentioned during the SANDAG presentation include:

- USDOT – not currently in a position to provide geospatial leadership because there must be intellectual confidence before implementing a plan. This confidence has not always been demonstrated clearly;
- Idaho DOT – struggling with how to best use geospatial technologies;
- TRB – struggling with how to bring all of the disciplines within the environmental field together most effectively.

The SANDAG Business Model
The use of geospatial technology at SANDAG was originally funded from transportation funds. SANDAG, which has built in flexibility in accepting grants and contracts, has now implemented a unified pricing structure. This fee structure, in which there is a 17% mark-up (a regional information system maintenance fee), is based on competitive market rates. Very few customers have had debate with the 17% markup. Instead, customers understood there is a need to maintain the system. Additionally, according to SANDAG, the MPO is improving their ability to estimate total cost. SANDAG expects $500,000 in revenue for 2005, of which roughly $85,000 will be put towards geospatial technologies.

SANDAG, whose main client is private developers needing traffic models, is also now writing rigorous scopes of work (SOW) and has developed better discipline to live within budgets. The MPO has also streamlined its contracting process. SANDAG uses SOW templates for projects under $2,500 and $50,000 respectively.

Other aspects of SANDAG's business model follow:
- Agency has a future view
- Serves a single county with 18 cities (many have GIS programs) and 19 voting members
- Mandates participation
- SourcePoint – public, non-profit organization

Key Take Home
SANDAG's "key take home" was to understand how partnerships function. Over many years, SANDAG developed a close relationship with SANGIS. Due to this relationship, SANDAG has not had to partner much with private organizations for geospatial technology data and/or analyses. The MPO has worked to make the partnership institutionally based and not simply personally based.

The partnerships that have been most successful for SANDAG are those that have occurred when there is a specific project. In California, SANDAG works closely with California Geographic Information Council and SANGIS. Most interaction with Federal agencies has been with US Fish and Wildlife Service, US Census Bureau, and USGS. Work with Homeland Security would require additional funding.

Benefits of partnering include:
- Reduced cost per agency;
- Projects that are likely cost-prohibitive for one agency are perhaps feasible through partnerships;
- Possible to gain broader use and acceptance of data and results;
- Data standards are promoted
- Good data and staff are also required to successfully implement geospatial technologies.

Evaluating Against Moving Targets
A well-defined need can lead to the implementation of technology. This implementation should lead to its evaluation, which helps refine and better understand needs. After evaluation of technologies, adjustments may need to be made. Historically, evaluations have been difficult because organizations often lack sufficient baseline/benchmark information and are sometimes evaluating against "moving targets."

SANDAG Geospatial Technology Application Examples (see handout)
SANDAG is currently integrating several of its geospatial systems. The MPO – and other public agencies – are operating their web-based applications as part of a joint telecommunications network usage memorandum of understanding. Some example of SANDAG geospatial applications include:

- Use for traffic forecasting for 2030 (TFIC) – SANDAG is integrating its travel forecasts with GIS data. It is using GPS to show more accurate representations of trip data (as compared to surveys and trip diaries). The MPO has found that the public under-reports trip activity on surveys by as much as 20%.
- Automatic Vehicle Location (AVL) – police department considering using this for breakdown location identification
- Performance Monitoring System (PeMS) – This Caltrans performance monitoring system developed by UC Berkeley provides real time data (updates every 30 seconds) from inline loops
- View2Transit – View2Transit is a customized ArcView tool for transit planning. It enables the non-GIS professional to easily query demographic and transit ridership data, and to produce

their own customized reports on current and forecast transit ridership, population, housing, and employment for user-defined areas around transit facilities, bus stops, or transit routes.
- eStops – eStops displays transit stops and routes on a base map of the San Diego region, enabling users to identify precise stop locations in the context of streets and roads. Operators can view the information on-screen, or download it in the form of customizable reports.
- Regional Economic Development Information System (REDI) – REDI is a web-based Internet application intended to assist industrial land developers, economic development analysts, small business owners, community planners and others to explore land development opportunities. REDI helps users visualize the relationships between existing land use, planned land use, vacant land, traffic volumes to assist in determining the development potential of land in the region.
- HabiTrak – HabiTrak spatially tracks the habitat losses and gains that occur with each development project, and prepares a set of standardized tables and maps summarizing the information for each year.
- US Customs and Border Protection web-based real border wait time tool
- RideLink – provides carpooling information to help reduce congestion
- ITS – coordinating geospatial operations into a comprehensive transportation management system.

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS (SCAG)

RICHARD MADEN, LEAD GIS ANALYST
PING WANG, SENIOR GIS ANALYST/PLANNER
Day 1 – October 24, 1:30 pm – 4:30 pm

Mr. Maden and Mr. Wang provided background on SCAG and its recent and planned geospatially enabled projects.

SCAG Background
- Serves all of Southern California except for San Diego County (6 counties total)
- Land area covers 38,000 square miles – roughly the size of Kentucky
- 187 participating cities – total population approximately 17 million people
- Regional council acts as governing board.

The SCAG Business Model
- Is often reactionary to board's day-to-day issues
- Limited partnering
- Has short-term focus as compared to SANDAG.
- Maintains desire to use low cost tools
- Sometimes has trouble spending its funds by fiscal year end

Geospatial Technology Implementation
SCAG's implementation of geospatial technology has been a successful decision-support tool. Below, several applications of geospatial technology at the MPO are summarized.

Compass 2% Strategy
In an effort to provide local decision-makers with the tools they need to plan more effectively for the six million new residents projected to live in Southern California by 2030, SCAG undertook an growth visioning initiative called Southern California Compass. The objective of this innovative effort was to develop a comprehensive new vision for Southern California over the next 30 years by taking a more all-encompassing, inclusive approach to planning at both the local and regional levels.

Geospatial analyses (which predicted reduced congestion and improved air quality) under the strategy has led to the recommendation of encouraging policies that would result in a small growth concept as opposed to the construction of a fifth ring around Los Angeles. The studies have

suggested that development should be focused around transit routes and that 2% of the region's area should accommodate 40% of its projected growth.

Geospatial technology has also played an important public involvement role in the initiative. At public meetings, maps that illustrated how land use and transportation infrastructure may interact in the future were used as drawing boards for the public. Citizens at the meetings were allowed to use stickers and markers to draw on the maps, helping to build in them an understanding of how transportation improvements might impact their respective neighborhoods. This has been a major benefit; the visualization tools that geospatial technology has afforded SCAG have given the community the ability to focus in on important areas quickly and easily.

Socio-Economic Growth Forecasting
Growth forecasts are a required input into regional transportation plans and air quality plans. At SCAG, the Forecasting Section, under the Community Development Division, Planning and Policy Department, is responsible for producing socioeconomic projections and developing, refining and maintaining the region's small area forecasting models.

The Section has used GIS for many years to provide the geographies over which regional growth projections can be distributed. The GIS provided a minimum planning unit for grid analyses of population and employment trends for travel demand models.

MAGLEV – 3D Modelling
During the SCAG presentation, the speakers demonstrated SCAG's use of Google Earth Pro, ArcScene, and ArcGlobe to model a proposed MAGLEV in the Los Angeles Metro area. The 3D visualization the software enables has allowed SCAG to create a better visual presentation/representation of proposed MAGLEV routes.

A comparison of Google Earth and ArcGlobe was given:

Google Earth	ArcGlobe
Free or expensive	Costly
Free high resolution imagery	Must buy images
No customization capabilities	Requires high-charged computer and hardware to use software
A visualization tool only	Has analysis capabilities
Easy to manipulate	
Products can be shared with those without GIS software	

In each software's case, SCAG GIS specialists have been able to draw the attention of both the public and decision-makers. The visualization capabilities make it more likely that 1) members of the public can understand how proposed projects impact them and 2) a champion for a project (and/or future geospatial technology application) be built. (SANDAG agreed that visualization is becoming increasingly powerful).

EIR Airport Noise Model
Van Nuys Airport is one of four airports owned and operated by the City of Los Angeles Department of Airports (LADOA) and is also the busiest general aviation airport in the world. SCAG has adopted policies and actions in its Regional Transportation Plan (RTP) that relate to adoption of a master plan at Van Nuys Airport. One aspect of the RTP is the development of a noise model in response to potential environmental justice issues of proposed airport expansion. SCAG has used to geospatial technology to model the noise fields of several expansion scenarios.

SCAG Challenges
- More accurate display of travel demand model (TDM) results. Currently, display is restricted to traditional links. In the future, geospatial technologies will likely improve presentation of TDM results.

- The development of a cross-reference between the TDM and centerline file. Some obstacles have been 1) the vendor-supplied centerline, which is updated annually and 2) the complexity of the TDM. Additionally, since vendor-supplied data is licensed, SCAG cannot share base maps across sub-regions
- Complexity of web-based mapping – staff workload issues
- Integration with legacy applications
- Data quality / Inconsistent base maps – SCAG's governing body is not currently making standards/policies concerning data standards. The land record, cadastral layers, and parcel layer data are contentious issues.
- Future transportation research question – How does one make lines represent the area/lanes that are actually present?

CALIFORNIA DEPARTMENT OF TRANSPORTATION, DISTRICT 11

ROGER EWERS, TRANSPORTATION SYSTEM INFORMATION DIVISION, OFFICE OF GIS
BILL FIGGE, DEPUTY DISTRICT DIRECTOR
MAURICE EATON, TRAVEL DEMAND MODELING/FORECASTING BRANCH
PAT LANDRUM, GIS/PROJECT DEVELOPMENT SUPPORT BRANCH
Day 2 – October 24, 8:30 am – 10:00 am

History and Challenges of the Caltrans GIS Program

- Early on, Caltrans used ArcInfo and C++ softwares, and USGS data. In the late 1990's, the use of aerial photography exposed inaccuracies in the data the department had been using. Now using ArcGIS.
- The DOT contracted Thomas Bros. to build maps with Caltrans data. The consultant would create postscript maps, then ship them to Caltrans. There ended up being copyright issues.
- LRS is the foundation of Caltrans geo-spatial program. It is currently developing a new LRS that is not software or road data specific. This has been a big investment, but it will soon be the standard. A key challenge has been conveying to managers what the LRS is and why it is important.
- District 11's geospatial work "hit the ground running" as it was able to partner with SANDAG, an organization that had access to high quality data. Personal connections also helped early on. A challenge to partnerships, however, can be that budget cuts in partner agency can affect partnership balance.
- Many States use GIS as an analytical tool. At Caltrans, it has this purpose and more. Specifically, Caltrans emphasis is placed on using GIS as a data-drilling tool. The Department uses spatial data to pull out larger volumes of data and give access to project managers more quickly than ever before. A challenge has been determining how best to transfer the wealth of Caltrans information onto commercial geospatial software/tools so that is most useful (for activities such as planning early on in project development).

Status of Current and Future Statewide and District Efforts

- Caltrans has recently moved its GIS training in-house. The Department's own staff now conduct introductory and intermediate training themselves. LiveCampus is also used at reduced cost.
- Caltrans explored developing its own road network, but did not have the staffing or funds to do so. Currently, Caltrans is developing a California road database with TeleAtlas using a database with information in it that interests the department. A risk of this is that TeleAtlas could be bought out, changing company policies.
- Caltrans is a forward-looking, collaborative leader in State government GIS and will continue to public-private partnerships.
- A problem was occurring that deputies were being brought together at several different times for several different topics. It made it difficult to have the deputies meet again to discuss GIS issues. In response, Caltrans has created a Decision Support Steering Group, or GIS Coordination Group. The group helps to set the direction for geospatial activities at the

Department. Members include those above the division chief level. The group meets three times per year.

- Revisiting job descriptions for GIS staff. Because GIS is becoming increasingly dependent on IT skills, job classifications will not likely change to require IT experience but would likely include it in the duty statement. Caltrans continues to need a wide range of expertise, including IT staff, CAD staff, environmental planners, research analysts, transportation engineers, among others. GIS literacy among these groups is also important. Additionally, Caltrans is looking for opportunities to partner internally, publicly, and possibly privately to enhance knowledge transfer.

  Presently, Caltrans GIS has worked to become partners with Caltrans IT staff. It has also developed a survey to reach out to District branches to better understand their GIS needs. Results of the survey will be reported to directors to aid in planning future direction.
- A need – to educate in-house staff that X & Y can be done in-house, while other tasks need not be done in-house.
- Caltrans is transitioning to enterprise implementation of its GIS

Lessons Learned and Important Issues

- GIS implementation directly supports Caltrans' Business needs. GIS should support processes and deliverables. GIS should not be used for the sake of using GIS.
- Determine a common interest around which partnerships are to be developed.
- Assess what things are important enough to continue investing in and what things can be partnered for. Is the application serving a valuable business need? Look at the purpose for which the application was developed and determine whether it meets that purpose … then how it might be deployed to external stakeholders.
- Emergency response is not county-by-county work. It requires a statewide (or nationwide) effort and good geospatial systems are essential.
- Create a high-level oversight group – executive support is critical to implementing a successful program.
- Support traditional uses of geospatial technologies. This can help to manage expectations and avoid alienation of certain staff groups.
- It is difficult to quantify the benefits of geospatial technology implementation on project delivery.

ESRI

TERRY BILLS
Day 2 – October 24, 10:10 am – 12:00 pm

Mr. Bills provided an overview of technology initiatives at ESRI, described common challenges faced by State DOTs, and discussed the private-side perspective of working with DOTs.

ESRI Initiatives

New software release

During the 2nd quarter of 2006, ESRI plans to release a major update to its most recent ArcGIS software. The new release, ArcGIS 9.2, has several improvements. Some of these include:

- Use of a file-based geodatabase model that supports LIDAR and double precision coordinates
- Improved transaction management – allows for non-versioned editing. The GIS and GIS database can share data and changes will be able to be made across slow networks; there will also be rules-based synchronization of computers on a network.
- Significant cartographic improvements – the new software can display data in a number of different ways in the geodatabase. Users will be able to create publishable maps in the software itself (no exporting to image editing softwares).
- Will have advanced CAD support – 9.2 will allow users to more easily move data between CAD and Arc softwares

ImageServer

- This software will provide for server-side, on-the-fly image processing, thus reducing the time traditionally needed between data acquisition and dissemination.

Development of USGS National Standards for cadastral/parcel data to link State level and National level data

- There has been renewed interested and support for the continued development of the Geospatial Bluebook. The Geospatial Bluebook begins the process of identifying practices that have served other communities; the intended goal is to offer a set of national implementation specifications for communities that choose to adopt those specifications. The Bluebook focuses on successful multi-jurisdictional programs that leverage partnership opportunities and use geospatial information to support government programs.

  The Bluebook would provided a consistent set of standards for local organizations to follow, allowing for local databases to be aggregated regionally.

DOT Challenges

- Systems Integration, especially between engineers and planners – new software is making it significantly easier to have systems "talk" to each other.
- Staffing and Technical Competence – From its initial implementation, GIS required significant geography knowledge. It now requires sophisticated IT and knowledge. Often DOTs do not have the staff classifications and job descriptions to hire staff possessing these skills jointly.
- Locus of GIS in DOT – If the GIS is in an IT division, the staff likely has the skill set necessary to support success. However, they may not be responsive or qualified to address user-side issues. If the GIS is in a planning division, funds are likely more flexible, but tighter. This means that new applications may be harder to implement (smaller budgets). In each case, the participation of IT directors and/or the CIO is likely required.

  The most successful DOT effort in joining these departments in terms of GIS implementation is at Oregon DOT.
- Linear Referencing System (LRS) – Many DOTs have multiple LRS's, and they are tough to navigate.
- Significant upfront costs
- Moving to the next level, the enterprise implementation of GIS. Historically, there has been a decentralized development of GIS at State DOTs. Typically, the GIS group in a DOT does not have the institutional authority to implement the GIS at more enterprise level. GIS need to be developed in a structured, life-cycle manner, and project teams need to have project managers, IT people, and GIS people.

Best Practices

Interagency Coordination

Sacramento Association of Governments has coordinated with its cities and counties to pool resources to do joint data development for the centerline file. This is particularly helpful for emergency response issues. Currently, building footprints are being digitized. The MPO will be using web-based tools to allow each coordinating city/county to update and maintain the geospatial data over time.

The Houston-Galveston MPO is following a similar path. Texas' natural resource data is being pulled from MPOs and TXDOT to create a statewide centerline coverage.

Development of Web-based Portals

- SAP in San Diego. The system can forecast when maintenance is going to be needed. This information is then linked to the financial system, so that it can be planned on timesheets. Continuing to integrate GIS with enterprise resource systems (HR/safety programs/operations/etc). A few DOTs have begun to integrate their financial systems with the GIS.

- VDOT's Transportation Information Portal, which includes a web-based TIP. All agencies can access the TIP, in efforts to coordinate, in real time.

- Maryland – Maryland has integrated pavement, roadway, and HPMS data on an intranet. This is helped to coordinate the activities of the State's highway response team. The State's 511 program also has a web-based component that allows users to access information about all modes (freeway conditions/estimated drive times/etc) from one website.

Enterprise Content Management (ECM)/GIS Integration
Document management should be integrated with the GIS. Project team members should be able to access GIS data and documents related to these data/projects together. Many State DOTs have developed document management systems but have not yet linked them to the GIS

Individual Applications
- Maryland's Asset Inspection – fields entered by voice response
- Rapidis' Travel Demand Forecast – A Danish travel demand model that is embedded into an ArcGIS Model Builder
- MTA (Los Angeles) Incident Management System – Without manual intervention, the system automatically captures the location of an incident from which a phone call is received. The system then geocodes the incident based on severity. After ranking an incident's severity, the system notifies all relevant agencies, such as, for example the police/fire departments, Hazmat, tow-truck service, coroner's office). There have been very few misclassifications of accidents.

Recommendations for Next Five Years
- Focus on the business factors that lead to success and what accomplishments are desired. Often these factors do not involve the latest technology, but successful implementation of existing technologies. Technology development is not a limiting factor – getting an agency organized correctly is.
- Begin to incorporate GIS into existing business processes. ESRI is working with CH2MHILL on developing ways that this process can be streamlined. ESRI is working to publish more understandable How-To manuals so DOTs can explain to decision-makers what can be done with GIS and how a transition to an integrated GIS-Business Process can be facilitated.
- Implement GIS at an enterprise level. To begin, a business case must be made to the Agency director and senior managers. Be equipped with hard number for returns on GIS investment, as IT does with its investments. One argument for enterprise GIS implementation is that everyone across the department will have better access to information. Because IT directors may have less access to lead decision-makers, DOTs planning directors could be the ones taking this message up the organizational ladder.

SANGIS

LISA STAPLETON, EXECUTIVE DIRECTOR
Day 2 – October 24, 1:30 pm – 3:30 pm

On Day 2 of the San Diego Scan, Ms. Stapleton gave a presentation on the responsibilities of SANGIS, the products they offer, and the services they provide. A brief history of SANGIS is available at www.sangis.org/sangis/About_History.htm.

SANGIS has its roots in the Regional Urban Information System (RUIS), a system developed to improve productivity, reduce costs, and provide accurate and timely geospatial information. Over 100 layers were created and standards were documented. In 1995, the City and County of San Diego called for a strategic plan, and one was developed over the next two years. The plan:

- Protected the geographic database
- Reduced costs to the city and county

- Provide public access to data
- Established partnerships
- Documented roles and responsibilities

SANGIS was created in July 1997, as a Joint Powers Agreement (JPA) between the City and County of San Diego. After 13 years of working together on data and application development, the City and County decided to formalize their partnership in GIS by creating the SanGIS JPA. Finding that access to correct and current geographic data was considered more important than application development to County and City departments, SanGIS focuses on ensuring that geographic data is maintained and accessible.

Revenue is generated from the sale of geographic products (maps).

Current use of Geospatial Technology
At SANGIS, data maintenance is the predominant application. This data maintenance is funded 1/3 by the City, 1/3 by the County, and 1/3 by external entities. Since 1984, the City and County have each respectively given SANGIS $500,000. SANGIS is trying to develop a business model that would allow it to stop charging external users due to public information concerns.

The land base SANGIS maintains originally came from a private electric company. SANGIS spent several years "polygonizing" the lines from the electric company's data. Eventually, the County indicated that all new sub-division maps must be tied to a known coordinate system, so SANGIS converted their land base data to the correct place. Currently, the land base data SANGIS maintains serves as a centralized land base for San Diego County in its entirety.

Responsibility Areas
- Data maintenance – 400 layers, including orphan layers; creation of user-friendly fields; user account management; acquisition of data (through licensing and partnering)
- Provision of public access
- Marketing
- Data warehousing (gathering data from several departments and publishing on a shared server)
- Member support – ad hoc mapping, geocoding, data/ortho extractions

Benefits of SANGIS
- Low cost land base maintenance for public and private use
- Provides a standard regional land base – enabling cross-agency sharing (65-68 public agencies currently using data)
- Provides centralized public access (450 layers in the SANGIS geospatial "warehouse")

Experience/Challenges
- The work SANGIS, whose customer base is very technologically sophisticated, does was begun to help manage systems workflow better. Its customers cannot do their work without the service SANGIS provides. For this reason, the question of 'has the application saved money/time?' is impossible to answer.
- SANGIS has created simple, inflexible rules regarding the fees it charges customers for products. By ensuring that there is paying support to keep the business moving forward, SANGIS has been able to maintain control over the data.
- Usefulness of the program breeds high expectations. It is increasingly difficult to manage these expectations. Faster and better cannot always be delivered.
- SANGIS cannot move forward with updating its warehouse of spatial data until all of its users upgrade to the next version of ArcGIS.
- GIS is much more IT centered than ever before, and increasingly so.
- Advice for others: Start with small victories. When SANGIS was starting out, it conducted roughly 300 interviews to assess the community's geospatial needs. This was a big undertaking.

- Organization structure facilitates geospatial technology implementation more than the technology itself. Technology does not stand in the way of progress; politics and people present the biggest challenge.
- In the future, SANGIS aims to add clients directly to its network instead of mailing out CDs of updates.
- Current challenges – migrating to ArcGIS 9.1, re-writing batch processes in Python

GOOGLE ENTERPRISE SOLUTIONS, INC.

ANDREA MCCOOL

Day 2 – October 24, 3:30 pm – 4:30 pm

To conclude the San Diego segment of the Executive Scan, Ms. McCool Demonstrated Google Earth, a program that combines satellite imagery, maps and the Google Internet search engine.

Google Earth Characteristics

- Originally Keyhole (2000) software that was funded by SONY, NVIDIA, In-Q-Tel. Early users were realty companies. October 2004 Google acquired Keyhole and in June 2005 released the free version. Versions available now include Free, Pro, HTML, and Enterprise. Google Earth Enterprise is a customize version that allows for secure data distribution and the use of a user's own data.
- Uses Keyhole markup language, or KML, a code roughly based on XML.
- Capitalizes on an intuitive interface, but does not support analysis. Visualization/communication tool only.
- Uses lat/long WGS 84 coordinate system

Lessons Learned

- There are many different notions of what "good" or "pretty" imagery is.
- Google has developed its Earth system up so that an uninitiated user could set it up and use within 45 seconds. Beyond this length of time, a product or features is not compatible with the business model was.

What's Next

- Increased coverage – especially international data
- Easier importing of own data

Summary from End of Each Day

Overall Importance/Benefits of Geospatial Technology

- Allows for more effective decisions
- Helps ensure accountability
- Aids in monitoring effectiveness of programs/policies
- Some transportation applications can help mitigate traffic congestion
- Improved assessment of environmental impacts
- Improved assessment of risks, hazards, disaster potential
- It is an enabling technology, as it provides for the quick integration, analysis, and dissemination of large amounts of data.
- Easier to show X, Y, Z scenarios to decision makers/elected officials
- Imagery is powerful; it can instill enthusiasm in decision makers/elected officials
- Not all data needs to be field checked (labor hours saved)
- Public service benefit
- Technology innovators providing tools/resources that makes it easier for non-GIS/public to be involved
- Agencies are building policies/resources enabling them to change partnerships/companies and data sharing

Challenges

- Convincing decision makers to invest more funds in geospatial technologies. Sometimes difficult to make decision makers aware that their decisions are based on results of geospatial analysis. Policy makers do not always understand the promise of geospatial technologies.
- Articulating the value of geospatial technologies. Intuitively we know the technologies are useful, but a clear case for investment is not always made or documented. It is sometimes hard to make the case for geospatial technologies before their use because the payoffs are not immediately apparent.
- Difficult to quantify the ability to do new analyses. If the kind of analysis desired is known, the geospatial tools can be tailored to that particular analysis.
- Technology changes expectations
- Too much time is required/spent updating data
- Sense of "chasing the technology" – difficult to hire staff required and/or that is interested in jobs such as traffic demand modeling.
- Development of data standards
- Bringing disciplines together effectively
- Accuracy is sometimes compromised to maintain budget.
- Funds to maintain and operate systems are not always available
- Public service agencies are not always effective in collecting revenue from GIS products. It can be more effective to have private, non-profit serving this role. Need for streamlined contracting.
- Must overcome inconsistent basemaps.
- When tied to a vendor, data (such as centerline data) cannot always be easily distributed.
- Research Question: Are more complex models more beneficial? More complicated models, in the transportation world, may not provide better results.
- What is the total cost of ownership and how to link it to your financial system
- Decision process needs to include real-time program structure
- All of the systems need to talk to each other or decision makers won't know how to make decisions in the real world
- Expand beyond things normally tied to geography, e.g. expand to financial systems
- How do you effectively partner with the IT section?
- How do we learn from IT and their processes?
- How do we build a team with the essential skills for GIS Enterprise Systems Development
  - Project mgt
  - GIS
  - IT (Java, .Net)
- Find a way to tap into tech-savvy kids and bring into GIS/Transp. Workforce
- Partnerships at three levels
  - Within the organization
  - Between organizations
  - With private sector
- Need to understand realistic time frames for data currency (How often do I need to invest in new/updated data?)
- Because of issues related to Homeland Security and emergency response/recovery, DOTs may be required to play a larger role in providing data normally from the locals.

Lessons Learned

- Secure maintenance/operations funding. Systems can be built, but without maintenance and operating funds post-development, their effectiveness can be limited. The development and use of geospatial technologies is not a one-time shot. There is a need to refine and update systems continuously. Must acquire long-term commitment to implementation.
- Have a champion
- Demonstrate successes along the way
- GIS supports a lot of different business activities. The technology will not drive processes that do not exist. Know what you want to do and design the application to do it; big payoffs are likely organizationally based.
- Hire skilled/interested staff

- Understand how partnerships function
- Formalize commitments (e.g. SANDAG's MOU for joint telecommunications network usage)
- Maintain cross-discipline communication/Multidisciplinary collaboration
- Leverage resources
- Don't over-promise
- Promote innovative thinking (breakdown compartmentalization of geospatial technologies in agencies)
- Create "smarter" applications – know what data is important and extract it efficiently
- Define performance measures for the investments we are making through GIS deployment
- Develop understanding of what policymakers need and inform them as to what can be provided in a given amount of time.
- Educate policymakers that GIS is not maps; it is an analysis tool. Bring results of geospatial analysis to policymakers in line with policy choices they are facing.
- DOTs should think like entrepreneurs. They should involve the public more by using geospatial technologies to explain sometimes obtuse terminology and concepts. Technologies should be visual, fast, agile, and inclusive of public; the citizenry wants to be involved.
- Once you organizationally separate the data from the applications it gets hard to charge for the data. (SanGIS)
- Value data that's worth paying for\
- GIS applications and data have reached a level of maturity where organizations need to think about whether they need to develop or maintain everything or whether they need to partner with other agencies or commercial sector.

Expectations for Harrisburg PA visit

- Get policy person together with GIS specialist (What is the problem you were trying to solve? What is the tool used to solve it?)
- Expand the presentation to include safety, operations, maintenance, other business areas of transportation that benefit from geospatial technologies
- Reduce time for private sector presentation. Expand time for State DOTs & MPO presentations
- Summarize notes from San Diego Visit
  - Scan Team review
  - Send to PA presenters
  - Conference call with team and presenters and discuss the type of information we are looking for
- Think about ways for distributing information obtained from scan
- Initial thinking, reaction, involve bigger group
- Need top-level answer of what can this do for me if I invest? What are the payoffs? What needs to be done so I can get one of 'these'?

LOCATION: PENNSYLVANIA DEPARTMENT OF TRANSPORTATION (PENNDOT)
DATES: NOVEMBER 30 – DECEMBER 1, 2005

PARTICIPANTS

Cassandra Allwell
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Ben Williams
FHWA Resource Center

PRESENTERS

GeoDecisions
Ali Detar, Jesse Jay, Don Kiel, Tom Pietropola, Jon Pollack, Bill Schuman, and Brian Smith

Intergraph
Mitch Stevens and Hank DiPietro

New York State Department of Transportation
Brian Rowback (*presenter/participant*)

Ohio Department of Transportation
Dave Blackstone (*presenter/participant*)

Pennsylvania Department of Transportation
Ira Beckerman, Allen Biehler, William Crawford, and Frank DeSendi

Virginia Department of Transportation
Dan Widner (*presenter/participant*)

Harrisburg, Pennsylvania AGENDA Day 1

Tuesday, November 29, 2005 — Travel Day
Meet for dinner in hotel lobby — 6:00 pm

Wednesday, November 30, 2005
Meet in Crowne Plaza Hotel lobby — 8:00 am

Pennsylvania Department of Transportation *(Keystone Bldg, 400 North Street, Harrisburg, PA 17120)*

Welcome and Introductions — 8:30 am – 8:45 am
Ysela Llort

Review of San Diego Visit — 8:45 am – 9:15 am
Roger Petzold

Executive Challenges Round Table Discussion — 9:15 am – 10:30 am
Brian Rowback

- New York State DOT Experience
- Challenges of clearly communicating the benefits of geospatial technologies

Break — 10:30 am – 10:45 am

Pennsylvania DOT — 10:45 am – 12:00 pm
Frank Desendi

- Overview of PennDOT GIS Program and Activities
- Management Challenges
- Future Vision

Lunch — 12:00 pm – 1:30 pm

Pennsylvania DOT (continued) — 1:30 pm – 3:15 pm

Break — 3:15 pm – 3:30 pm

Intergraph — 3:30 pm – 4:30 pm
Mitch Stevens

- Private-side perspective working with DOTs,
  - South Carolina
- What should state DOTs look for (technology trends, etc.)?

Review of Day — 4:30 pm – 5:00 pm

Harrisburg, Pennsylvania AGENDA Day 2

Thursday, December 1, 2005

Meet in Crowne Plaza Hotel lobby — 8:00 am

Travel to **GeoDecisions** *(209 Senate Avenue • Camp Hill, Pennsylvania 17011)*
Jesse Jay, Bill Schuman, Ali Detar — 8:30 am – 12:00 pm

- Overview of IRRIS
- Private-side perspective working with DOTs,
  - Delaware
  - Oklahoma
  - Iowa
  - Vermont
- Technology Trends

Lunch — 12:00 pm – 1:30 pm

Pennsylvania Department of Transportation *(Keystone Bldg, 400 North Street, Harrisburg, PA 17120)*

Virginia Department of Transportation — 1:30 pm – 2:30 pm
Dan Widner

- Program and Activities
- Management Challenges
- Future Vision

Ohio Department of Transportation — 2:30 pm – 3:30 pm
Dave Blackstone

- Program and Activities
- Management Challenges
- Future Vision

Break — 3:30 pm – 3:40 pm

Overview of Scan — 3:40 pm – 5:00 pm
Ysela Llort

- Observations / Comments
- Preparation for Workshop on February 27-28, 2006

Friday, December 1, 2005 — Travel Day

WELCOME, INTRODUCTIONS, AND REVIEW OF SAN DIEGO VISIT

YSELA LLORT, FLORIDA DOT
ROGER PETZOLD, FHWA HEADQUARTERS
Day 1 – Wednesday, November 30, 8:30 am – 9:15 am

To begin the second leg of FHWA's Executive Scan on Geospatial Technology for Improved Decision Making in Transportation, the Scan Team chairs gave a welcome and introduction. New Scan Team members were introduced, the purpose of the Scan was reiterated to the hosts, and a brief review of outcomes from the San Diego visit was provided. Expectations for the Harrisburg visit were also described.

Purpose of Scan
To improve transportation decision-making through the application of geospatial technology.

Objectives:
a) Identify effective applications of geospatial technology in transportation
b) Identify emerging geospatial technology that will be implemented in the next 5 years
c) Identify effective business models and public-private partnerships to support enhanced GIS in transportation

All of these objectives will lead to the development of an action plan for future initiatives to enhance transportation decision-making through the successful implementation of geospatial technologies.

San Diego Visit Recap
The two predominant topics of discussion in San Diego were 1) business models for successful implementation of geospatial technologies and 2) geospatial technologies and trends that are expected to emerge over the next five years.

Expectations for Harrisburg Visit
In Harrisburg, the Scan Team hoped to:
- Continue the San Diego dialogue regarding successful business/partnership models and technologies that are surfacing over the next five years;
- Expand the presentation to learn how State DOTs are using geospatial technologies to benefit in business areas such as safety, operations, and maintenance; and,
- Hear top-level views on how business cases for investing in geospatial technologies can be successfully made.

Thinking Points
- What practices are successful in helping geospatial technologies survive different administrations?
- How should the Scan successes be diffuse into a broad, diverse community?
- Consider following up with AASHTO on the Scan learning after the Harrisburg visit.

EXECUTIVE CHALLENGES ROUND TABLE DISCUSSION

BRIAN ROWBACK, NEW YORK STATE DOT (NYSDOT)
Day 1 – November, 9:15 am – 10:30 am

NYSDOT has set out five priorities for the Department: Reliability, Safety, Security, Environmental Health, and Economic Competition. Many Departmental decisions center on improving the conditions of these priorities. In order to show executives improved results in delivering these priorities, NYSDOT uses strategies founded in performance-based outcomes.

Many decisions and a lot of work at NYSDOT are done with a backdrop of geospatial information and the use of geospatial technologies. To measure the effectiveness of geospatial technologies

and to justify the budget for their implementation, NYSDOT has tried to link application performance to decisions made along various regional corridors, e.g. Intercity corridors, Community Corridors, Tourism Corridors, General Use Corridor, and Trade Corridors. Since how transportation serves a community is often a localized issue, using a "Corridor Approach" to geospatial technology implementation – as suggested at the Executive Scan – can help decision-makers develop context sensitive decisions.

In the future, NYSDOT anticipates developing geospatial applications that integrate with other systems to help navigate travelers and goods managers through a particular corridor. As geospatial technologies, such as GPS, become more and more ubiquitous – perhaps in cars and/or cell phones – NYSDOT is positioning itself (through partnerships) to be able to use this data to help with this task; will require partnerships.

- In NYSDOT's Central Office, the GIS section is in the Information Technology (IT) division. In the regions, GIS work is done in planning divisions. An executive management team makes NYSDOT's corporate GIS decisions. The Department has begun to hire more GIS full-time employees in efforts to improve in-house GIS capabilities and to reduce costs (fewer GIS-related contracts).

Applications

Winter Travel Advisory – NYSDOT's Winter Travel Advisory system is a radio-based system – since there is no GPS in trucks – that allows dispatchers to enter roadway information directly from truck, police, toll-booth operator, and other call-ins. The advisory system (www.travelinfony.com), offers winter travelers access to real-time traffic and weather information, including a color-coded map of state highways denoting their real-time surface conditions. Individuals using the Winter Travel Advisory can learn which state roads are snow covered, ice covered, wet, dry, experiencing white-out conditions, or closed.

NYSDOT is investing in wireless network, which, if implemented would likely provide for the facilitated analysis of response time after an event occurs (year round).

Oversize/Overweight Vehicle Routing Tool - The New York State Vehicle and Traffic Law establishes limits as to the size and weight of vehicles allowed to travel over public highways. The New York State Department of Transportation, the New York State Thruway Authority and the New York State Bridge Authority have each established procedures for permitting vehicles that are over legal dimensions and/or weight across the highways that they own and operate in a manner that ensures public safety.

The Oversize/Overweight Vehicle Routing Tool, which is being developed based on comments of oversize/overweight vehicle customers, will capture and store every permit route applied for. It will also assist in the routing of oversized and overweight loads. It is expected that the tool will feed future capital improvement decisions – which can be viewed in another tool, Executive Capital Program Viewer tool.

Integrated Incident Management System (IIMS)– In efforts to address unprecedented traffic levels in New York and to provide real-time information on traffic flows, NYSDOT is deploying an incident management system that enhances the communication of incident data among incident managers at operations centers and incident response personnel at the incident scene. The Department, which is aiming to add geospatial information to traveler information, expects the IIMS to improve incident management and emergency response. With IIMS, dispatchers will have precise location information for incidents. Performance will be measured by whether emergency response is shortened.

For more information, see http://www.dot.state.ny.us/reg/r11/iims/proj_desc.html

Geospatial Technology Challenges NYSDOT Faces

- The Department does not have all points of application manufacture and distribution locally.
- Must answer the question of what to do with the information once an application is available or website is live.
- Difficulty in developing filters to weed out some CAD information.
- NYSDOT interfaces with the State's 911 system. A statewide wireless service has been developed, and it is hoped that it will help in having a statewide dispatch system. However, 911 systems have been given to the local governments in New York (56 counties) and now many partnerships will need to be put in place – a potentially time- and resource-intensive endeavor.

Geospatial Technology Benefits at NYSDOT

- Safety Improvement – Geospatial technologies facilitate the collection of real-time crash data and assessment of pavement condition to determine maintenance needs and to do accident analysis for possible geometric re-engineering prior to repaving.
- Ability to more easily assess performance.

NYSDOT Lessons Learned

- Makes little sense to run ahead and wait for others to catch up;
- Need to be an organization of information managers. Need a process on the GIS/IT side to help HR side get this activity in place;
- Barter;
- Build institutional knowledge around experiments;
- Adopt existing technologies and make slight modifications to address new questions or problem;
- Show how data is being used. Simply having it is not the goal;
- Geospatial technologies are not "the world of everything." There are many levels of information and a line should be drawn about how much is needed;
- Bring the right skills into a project instead of spending many months re-organizing

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

IRA BECKERMAN, WILLIAM CRAWFORD, AND FRANK DESENDI (PENNDOT)
Day 1 – November 30, 10:45 am – 12:00 pm

Overview

PennDOT's Office of Planning, which serves key roles in many of PennDOT's activities, is responsible for the Transportation Improvement Program (TIP), development of a 12-year plan, collection of HPMS and traffic data, and research, among other efforts. The Department's GIS program – including operations related applications – is also located in this office. By keeping GIS work in planning, PennDOT has been able to use SPR funding to support some of its geospatial technology implementation efforts (personnel hirings and applications development).

PennDOT does not want GIS to sit to the side as a technology. The Department wants to the technology to be a service to its customers. To accomplish this, PennDOT has tried to keep its geospatial projects "small and affordable." By doing so, it is easier to show people when and how successes have been delivered. In the past, during the initial stages of geospatial application development at PennDOT, many of the geospatial decisions did not reach the executive decision level, remaining "under the radar." Now, when geospatial applications are being considered for development, a list of proposed applications is presented to the Deputy Secretary and application priorities are established based on the Departments current goals and project timeframes. Having a list of all the projects helps to manage executive expectations. With priorities in place, the development of many applications is approved during the budget approval process.

GIS staff recognizes the importance of having the ability to articulate the value of geospatial investments to top-level management. One performance factor where interventions for

performance can be measured is safety. GIS can help to analyze safety data and answer very specific questions such as: where are right-angle accidents occurring? This type of information is key to obtaining executive buy-in at PennDOT.

Keys to PennDOT's Success

- PennDOT has established voluntary and informal "district workgroups" to meet periodically to discuss GIS issues. There is one workgroup in each of PennDOT's 11 districts and consists of members from Rural Planning Organizations (RPO) and 20 Metropolitan Planning Organizations (MPO) that are located in a particular district. Each of the 11 districts has a GIS Coordinator that will communicate new geospatial applications to the other districts. In the past, the workgroup has been able to secure group training rates for various geospatial technology professional development courses;
- Explain to application builders why different aspects of the data are important and how they feed the ultimate goals. Likewise, application builders should explain to users how the systems work so that users know what questions can and cannot be answered;
- When approaching major tasks, project management personnel/skills that have been helpful at PennDOT include 1) business people who can verbalize requirements and can stay involved throughout and 2) having IT staff who can think with a business understanding – who can explain the practicality of what others are asking for;
- Decentralization of GIS work to the districts;
- Upper-level management understanding that geospatial applications are not built overnight.

Challenges/Obstacles

- Sometimes there is a question as to who should be developing the applications? IT may be inclined to develop a tool to address IT needs and not necessarily geospatial needs. However, IT skills are increasingly necessary for the successful implementation of geospatial applications;
- In some of the geospatial partnerships in which PennDOT participates, there is increasing gray area as to what "transportation" is. PennDOT may now be funding projects in only marginally related fields;
- Differing business requirements – Roughly half of Pennsylvania's 67 counties have a GIS program. Another portion of those counties have separate 911 systems that are not integrated. It is becoming increasingly onerous for the Department to coordinate with these distinct systems – especially since some 911 systems are wanting to PennDOT to use a particular 911 system's data;
- Some agencies cannot view PennDOT applications due to the security settings at those agencies;
- Users' imaginations are often a step ahead of what can currently be done;
- Sometimes the quality of external data sets is questionable;
- As the use of effective geospatial technologies has grown at PennDOT, it has begun to permeate the Department – underlying many of the Department's decisions. However, this growth has also caused PennDOT to face an increasing number of data-sharing requests (including requests for data that is not PennDOT's). The volume of these requests threatens to become unmanageable.
- Standards for how GPS data is collected and stored have not been set. With such standards in place, the need for a linear referencing system could be eliminated.

PennDOT Applications

Crash Data Analysis and Retrieval Tool (CDART) – At PennDOT an "accident" is a crash that required a towing or had an injured person. In efforts to identify the types and causes of accidents for given locations, the Department developed CDART. The system, which stores detailed information about crashes that have occurred in Pennsylvania over the last 10 years, is updated weekly based on new crash records. It is also linked to current information on roadways, traffic reports, highway maintenance, project management, road safety, and bridge data. Users can link directly to crash-related documents – such as law enforcement officer reports – that are stored in

the Electronic Document Management System (EDMS) and create maps that identify the locations referred to in the documents.

Other CDART benefits include:

- Provides immediate and up-to-date crash data to help traffic safety engineers reduce the frequency and severity of crashes;
- Can lead to crash potential modeling;
- Allows trends/problems to be identified at a glance;
- Has changed the way PennDOT invests in safety. Allows top-level decision-makers to know where money should be directed.

A challenge the tool has faced has been a lack of complete aerial photo coverage for the State. However, upon having the entire State covered, PennDOT is considering exploring integration opportunities with Google Earth.

Cultural Resources GIS (CRGIS) – CRGIS is a partnership between the Pennsylvania Historical & Museum Commission (PHMC) and PennDOT, with funding from the FHWA, the Baltimore District of the Army Corp of Engineers, and the Pennsylvania Department of Environmental Protection. The application is Web-based and provides analytical, mapping and reporting tools to pinpoint known cultural resources within a planned project area.

CRGIS was developed in response to frustration at the difficulty in finding and accessing the historical/cultural resources paper records needed for DOT projects. Previously, these records were stored in Harrisburg, PA and often requiring agencies across the State to plan time-consuming and costly travel to search for records. With CRGRIS and its inherent "Ask ReGIS" feature, users can now use their personal computers to query the underlying databases in a variety of ways to narrow the records data to the sites of interest. PennDOT estimates CRGIS, which is an ongoing initiative, saves roughly $200,000 per year.

The Department expects the partnership to continue and has plans to add images of sites as well as original documents associated with the sites.

Videolog – The Videolog allows users to view three-part, panoramic images of Pennsylvania's state highways. The interval and speed of video playback can be adjusted. The Intranet version proves information about pavement, shoulder, and guide rail conditions.

Internet Traffic Monitoring System (iTMS) – This application provides users with traffic volume data for roadway segments generated by searching for place names, ZIP codes, street names, etc. Users can learn where traffic is without having to call PennDOT. The application is available on Internet and Intranet.

Interactive Straight Line Environment (ISLE) – ISLE allows users to search and view aerial photographs and USGS Topo maps of Pennsylvania. The application is available on Intranet only.

GIS Brochure – PennDOT has also created a GIS Web Applications for Transportation Data Management Brochure that describes various geospatial technologies the Department has developed. The brochure has been a tool to provide executives brief, clear, and easily understood information about PennDOTs geospatial applications and the benefits of using the applications.

INTERGRAPH

MITCH STEVENS AND HANK DEPIETRO

Day 1 – November 30, 3:30 pm – 4:30 pm

During the Intergraph session, an overview of technology initiatives at the firm and descriptions of common challenges faced by State DOTs were provided. The presenters also led a discussion focusing on the private-side perspective of working with DOTs.

Intergraph, the founder of CAD software, is a firm that provides core technologies, or foundation technologies on which business applications can be built. Geospatially-enabled security, military, and infrastructure software services are offered. Intergraph works to capture, manage, analyze, and integrate data for four main focus areas:

1. Transportation
2. Public safety
3. Military security
4. Federal solutions

Within the Transportation focus area, Intergraph business initiatives center on transportation management, intelligent transportation, and transportation security.

Core Development Areas and Business Drivers
One of Intergraph's core capabilities is a multi-level linear referencing system (LRS). A concept since the early 1990's, a multi-level LRS allows data coverages with different sources, naming conventions, measurement methods, and geometries of scale to be integrated into the same network. This facilitates cross-discipline analysis. Currently, it is not widely used because there is a need to keep historical data; its maintenance cost is comparatively high; edits affect multiple layers; and, conflation becomes even more difficult.

Intergraph also works to develop service-oriented architecture. By doing so, geospatial enterprise applications that can be on all staff desktops are possible.

Business drivers moving these efforts forward include:

- A belief that geospatially oriented business data allows it to become information;
- An understanding that DOTs are facing increasing interagency information exchange challenges;
- A view that people do not want to wait for information any more;
- There is a struggle to manage complex, one-off systems designed to integrate a diverse business system

Applications
Intergraph has developed Road Inventory Management Systems (RIMS) for several State DOTs. The systems allow users to load external entities' data; query data; generate HPMS reports; reflect changes in the roadway/route redesignations.

South Carolina DOT RIMS
Information about South Carolina's 41,000 miles of state-controlled road inventory has historically been maintained in a mainframe-based application, with limited user access across SCDOT. Reports were mostly written and maintained by programmers or by users with extensive knowledge of the mainframe reporting languages. In order to make the data more easily accessible to more employees, SCDOT sought an application that simplified management of the inventory and associated roadway assets, and that would allow users to generate their own queries and reports. Upon completion of the RIMS project, SCDOT anticipates there will be between 800-1000 employees using the RIMS application every day. RIMS will include a Web-based map interface that allows users to access data from point-and click queries generated from the map.

Tennessee DOT RIMS
TDOT manages over 88,000 miles of roadways and 20,000 bridges. Since 1973, the inventory for the roadways and bridges has been maintained by the Tennessee Roadway Information Management System (TRIMS). In the past, inventory data was only accessible to around 20 employees, and a great deal of knowledge about the structure was required to access the information. It could sometimes take hours or days for users to receive the reports needed to

support day-to-day operations. With the new Intergraph system, roughly 700 TDOT staff statewide has easy, understandable access to the roadway data.

Some RIMS modules are listed:

- I/TransInfo – allows user to query against more than one enterprise application
- I/TransTools – foundation for I/Enterprise logic and can support interactions between three softwares.
- I/TransShare – allows rights for user accounts to be defined.

Next Five Years

Over the next five years Intergraph expects is software will be able to serve thick, thin, and robust clients; provide the ultimate distribution application environment; remove stovepipes; and lower in costs. In general, these improvements should continue the movement towards giving non-GIS specialists more and more ability to use GIS. Additionally, the improvement of web-based services should enhance the interoperability of systems between and among agencies.

GEODECISIONS

ALI DETAR, JESSE JAY, DON KIEL, TOM PIETROPOLA, JON POLLACK, BILL SCHUMAN, AND BRIAN SMITH
Day 2 – Thursday, December 1, 9:00 am – 12:00 pm

To begin Day 2 of the Harrisburg Scan, representatives from GeoDecisions gave a presentation on the products it offers – including the Intelligent Road/Rail Information Server technology – and the services they provide. A brief history of GeoDecisions is available at http://www.geodecisions.com/framesabout.htm.

Intelligent Road/Rail Information Server (IRRIS)

IRRIS technology, which was developed for the Military Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA), is an enterprise Web portal that supports transportation security and logistics. The system integrates and displays worldwide infrastructure data, live-vehicle tracking, real-time weather, and active route conditions in a map format through a single, secure interface. IRRIS, a modular system that can be tailored to a specific State's needs, draws transportation infrastructure information from over 150 data sets (most of which is from Federal sources), providing current data on roads, bridges, tunnels, road conditions, construction, and traffic incidents (adapted from GeoDecisions handout).

The current version of IRRIS allows users to share maps among many users, add notes to those maps, and export them directly to PowerPoint. Alert notifications can also be

Keys to Success

According to GeoDecisions, keys to success include:

- Having an energetic, talented, highly motivated, and results-oriented development team;
- Maintaining a flexible but agile approach to development methodologies (e.g. short development cycles, iterative requirements document, etc.);
- Secure both an IT visionary champion and a planning visionary champion who are committed to working together.

In GeoDecisions' view, to have successful public/private partnerships in transportation:

- Both private and public sides should adopt a team mentality for the long haul;
- Strong project management on public and private sides. Project management education can be part of a kickoff meeting;
- Conduct quality reviews and establish a rapport that allows for honest assessment of project management;
- Have transportation experts on public and private sides;
- Foster an enterprise approach as opposed to a niche approach;

- Balance standardization and creativity;
- Establish a work plan as a measure of schedule completion and follow it rigorously;
- Consider pooled funding agreements. GeoDecisions worked with Vermont and New Hampshire to develop an agreement concerning pooled funding for a cross-State geospatial analysis. The application was built for Vermont, and now any update made for Vermont is shared with New Hampshire;
- Build partnerships around corridors.

DOT Challenges from GeoDecisions' Perspective

- Funding availability - GIS staff may not know how to locate all funding sources and/or market geospatial technologies within the agency. Additionally, upper management does not always share information about funding opportunities down to project leaders;
- The Request For Proposals (RFP) process can sometimes be lengthy, limited to certain times of the year, and generally frustrating. Sometimes agencies put many proposals into one larger RFP effort to minimize the number of times they have to go through the process;
- Sometimes DOTs are not patient and are expect near-term successes early in the term of a longer contract;
- Project managers who are assigned to a project mid-stream often have no "ownership" over the project;
- Software vendors set unrealistic system expectations, while DOT staff oversells ideas to management only to receive minimal funding;
- Data is not clean and provisions must be made in contracts to accommodate for data cleaning;
- Traditionally, geography specialists who would learn IT were hired by DOTs. Now, IT staff who learn the geospatial aspects of the work are being hired. However, private firms are still finding that DOTs have few on staff who understand programming. Therefore, in some cases, DOT staffs need to be strengthened with skills matching those necessary to make partnerships and/or application development contracts most effective. Unfortunately, DOTs often seem to have a hard time keeping trained staff on board;
- State DOTs do not often plan for application maintenance up-front;
- State DOTs need to identify common modules. Their similarities are not necessarily marked by region, because geospatial application development occurs at different times. It is important for States to find other States developing applications at the same time and that address similar topics.

Geospatial Technology Trends Over the Next Five Years

GeoDecisions indicated that over the next five years there would likely be an increase in Web services, as well as the development of portals and portlets that allow for the sharing of specific application components. It is also expected that there will be the continued growth of

- Google Earth-like technologies, and
- Use of AJAX, a system that users a middle tier server to shorten rendering speed between database servers and web servers.
- Use of Scalable Vector Graphics (SVG), object oriented software (e.g. .Net and Java), and GML (database driven vectors).

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

ALLEN BIEHLER, SECRETARY

Day 2 – December 1, 1:00 pm – 2:00 pm

The Secretary of PennDOT held a brief question and answer session on Day 2 of the Harrisburg Scan. Mr. Bieler's introduction and responses to questions are summarized below.
According to the Secretary, PennDOT has a long history of strategic planning and is always looking to improve its processes. When Mr. Biehler became Secretary, there was already a strong foundation in geospatial technologies. Now, geospatial technologies are permeating PennDOT, and they are helping staff gain an understanding of where the Department has been and where it is going.

In what areas can geospatial technologies help you?
Geospatial technologies help provide "smart transportation." They help to ensure the design of roadway improvements is done in the most appropriate way.

They can also help staff make land use projections. PennDOT has informally decided it cannot solve congestion, so the Department is using land use projections from geospatial applications as a new communication tool for communities.

The existing GIS model at PennDOT could be expanded to do more multi-modal work.

What are effective ways to make executive decision-makers aware of and engaged in geospatial technologies?
If a State DOT plans on developing a GIS application, it is important to understand completely what it will be used for, because it is a big investment. To begin to engage decision-makers, however, ask them:

- If they are aware of the technologies and how the agency is currently using them?
- Do they know what the technologies *can* do?
- Are they aware of what others have done?
- Do they know from where data for decisions comes?

Link the application to a problem statement. Inform decision-makers of the costs associated with implementing the application. Then, show that the application can save money or that it can help spend existing money in the best manner.

Suggestion: Use the AASHTO Spring Meeting as a forum to feature geospatial technologies, or add the topic to a Standing Committee meeting.

What are areas geospatial technologies are likely to play larger roles in over the next five years?

Over the next five years, geospatial technologies are likely to play bigger roles in freight issues. In Pennsylvania, there has been truck traffic growth despite a stable population. Geospatial technologies can help PennDOT address this issue.

VIRGINIA DEPARTMENT OF TRANSPORTATION

DAN WIDNER
Day 2 – December 2, 2:00 pm – 3:00 pm

During the early stages of geospatial technology implementation at VDOT, the Department secured $1.4 million through VDOT IT and Federal SPR funds. At the time, the Department, which wanted to start an enterprise GIS, believed the available technology from a single vendor lagged behind desired functionality. To address this concern, VDOT studied what other States and local governments had been and were doing, so that VDOT could better refocus on an available solution as opposed to a new, custom solution.

The resulting application was the GIS Integrator (1998-2001), a tool that had access to over 100 layers, 1.7 Terabytes of data in one large repository, and supported multiple applications. During this period, a considerable amount of time was spent at VDOT doing geography-related tasks. This is not the case so much nowadays. At this point, the Department is taking a more "IT-centric approach," often hiring web-developers or other IT skills who are interested in learning GIS.

Business Practice

During the first 100 years of VDOT existence, the Department worked to build and maintain roads. Over the next 100 years, VDOT expects to shift to a customer-oriented, operations culture. The Department anticipates building partnerships and being able to provide geospatial information around the clock, supporting mobility and providing for easier performance measurement.

According to VDOT, asset management is moving away from decision-making based on history. Now, there is an increasing need to understand how the road network is performing at all times and what interventions can be made. GIS is playing a larger role as a core, backend component of doing this. At VDOT, location-based Information is key to achieving the following:

- Reduced vehicular accidents;
- Improved traffic flow and travel time;
- Reduction in clearing time of incidents;
- Development of relevant traveler information systems;
- Provision of customer service and management of expectation.

VDOT Challenges

- There are sometimes GIS and IT systems integration inconsistencies. Solutions are now based upon integration – a "one map" concept. However, currently there are many disconnected applications and various levels of location-based technologies.
- In some cases, VDOT is now paying more for things it used to do itself.

Who sets VDOT's Geospatial Priorities?
IT managers typically try to meet to determine geospatial application priorities at VDOT; usually, this involves a discussion of how to shift resources to meet customer needs. The IT managers also meet annually with VDOT chiefs to further talk about priorities and how they can be best implemented. Additionally, monthly status reports are sent to the chiefs to inform them of project progress.

Applications
Comprehensive Environmental Data and Reporting (CEDAR) – CEDAR is a spatially enabled project management tool that provides project management capabilities, a mechanism to track project progress, and a way to improve internal, interagency, and consultant communication. The application enable users to notify users in other groups or agencies with questions and concerns, track projects, send email notification, and assign roles and responsibilities. Next steps for CEDAR include implementation of web accessibility so that resource agencies and environmental consultants can also use the system. VDOT expects that providing access to resource agencies and consultants will enhance communication in the NEPA process.

Performance Dashboard – The Dashboard is a project management tool that contains information on all active construction projects and projects scheduled to be advertised for competitive bids. Both the public and project managers are able to view where jobs are at risk of falling behind schedule or going over budget. The application helps keep project managers focused on the performance of their construction projects, thus making the process more to the public.

OHIO DEPARTMENT OF TRANSPORTATION

DAVE BLACKSTONE
Day 2 – December 1, 3:00 pm – 4:00 pm

ODOT's GIS is organizationally located in the Planning Division. In the early days, this GIS was used predominately to show crash-related data. Over time, ODOT began digitizing and analyzing other data sets. At the time, there was a need to set up criteria for giving budgets for geospatial technology implementation to the regions. Key to the development of these criteria and the expansion of ODOT's GIS was a trip some staff took to Florida to learn about that State's decentralized geospatial model. Based on lessons learned in Florida, ODOT decided to decentralize its GIS budgets. Along with this decentralization, the Department instituted an

Organization Performance Index (OPI). The OPI helps ODOT to measure system performance, providing GIS staff a backdrop for justifying bringing the wealth of ODOT-collected data into a GIS.

Executive Interest
At ODOT the Director is interested in learning where road network deficiencies are. In response, GIS staff drove every mile of the state road network and GPS marked each incidence of litter, potholes, vandalized road signs, ditch obstructions, missing pavement markings, vegetation obstructions, etc. These data – or "deficiencies" – were entered into the Department's GIS so that they could be tracked over time. ODOT can now determine if the number of deficiencies is being improved and if not, then why not.

Geospatial Priorities
In 2001, ODOT held a GIS strategic planning session that had the Department Director and other high level executives present. Over three days, the attendees came up with a list of geospatial needs and ranked those needs. Now, most of those needs have been completed and ODOT is likely to revisit the priorities soon.

Applications
Pavement Management System
ODOT's pavement management system is used to track statewide and district maintenance operations, and pavement and bridge conditions. ODOT uses its OPI to monitor progress in attaining the established goals in each of these areas. Each OPI measure highlighted in this section has a direct bearing on the department's ability to achieve its overall performance goals. The state highway network is divided into three policy systems: priority (interstate and four-lane divided highways), urban (state highways within municipalities), and general (primarily two-lane highways across the state). These systems are evaluated annually using a 100-point Pavement Condition Rating (PCR). Priority system pavements are deficient when the PCR is below 65 points. Urban and general system pavements are deficient when the PCR is less than 55 points.

The pavement management system can make PCR forecasts and map deficient areas of the State. This information can be tied to the OPI and a determination of whether the number of deficiencies had been improved can be made.

Crash Information System
ODOT has an application that allows users to view all crash information. All law enforcement officials are required to fill out crash reports, which are scanned for inclusion in ODOT's system.

Mine Location Data
Ohio's Department of Natural Resources (DNR) had mapped the location of old, underground mines using USGS maps. Through a partnership agreement, the DNR gave the data to ODOT, so that the Department could develop a risk probability model for road collapsings. This partnership, and subsequent model, was developed in response to the Governor asking to know where road collapsings might occur.

ODOT Next Five Years
There is a need to provide GIS data and tools to people without GIS expertise. This is a trend that is likely to continue. For this reason, web-based services will likely continue to be a focus of development. This also means increased, seamless integration with other systems.

ODOT also anticipates continuing to keep its LRS up-to-date, including partnerships with local areas to develop needed data sets.

Summary from End of Day 1

Challenges
- Need to have analysis of response after an event
- Creating filters to weed out some CAD information

- Ranking/prioritizing IT investments
- Need a process on GIS/IT side to get HR to hire appropriately skilled staff
- Lack of comfort level in criteria used for making IT decisions
- A grey area in partnerships with non-transportation groups can develop as to what "transportation" interest is
- Differing business requirements (e.g 911 example)
- Lack of complete statewide aerial photo coverage – usefulness of google / penndot had, but others wanted – sharing issues
- Data quality (Dr. Beckerman application example) / external datasets
- Timing/compatibility of Software upgrades with others
- No one wants to wait for information any more
- Difficult to develop complex, 'one-off' applications and to integrate them into the diverse business system.
- Data sharing requests can become unmanageable
- Users' imaginations are often a step ahead of what can currently be done.
- Transition to hiring new skills
- Having enough repeatable applications that private industry can develop software (as opposed to acting as a consultant)
- This isn't the world of everything – applications should be linked to critical objects – don't look at everything at once.

Business Case

- Put geospatial applications on the radar of executive decisions
- When keeping geospatial applications small and affordable it is easier to show that things have been delivered along the way.
- Develop the ability to articulate the value of investments
- Show application builders the world of cause and effect – of why different aspects of the data are important and feed the ultimate goal.
- Geo-spatial technology should be based in performance-based outcomes because executives are interested in improving results. Decisions should be made based on improving conditions of assets.
- Geospatial technologies are not the world of everything. There are levels of information and lines should be drawn about how much is needed.
- Need understanding from decision-makers that it takes time to develop applications and they may not work perfectly from the start.
- Have ability now to gather information from other integrated systems – we're now looking at how systems developed for different activities can provide relevant info across applications/analyses

Implementation

- Plan work so asset management plans are linked to a corridor (from the 'corridor approach')
- Align customer needs with structural analysis and program planning for transportation system improvements
- Building partnerships within and between agencies
- SPR funding has been a good funding (through planning) source for geospatial applications and positions – Research portion of SPR should be able to develop applications
- Providing training - Training required to analyze, manage, interpret mass of information
- Bring in top-level in org to develop priorities for geos. apps. -
- Bring the right skills into a project instead of spending a long time reorganizing
- Quantify costs and benefits through performance assessment
- Have a plan for how to use information once the application or website it running
- Barter
- When approaching major tasks the skills needed on the project management team include, but not limited to: 1) business people who can verbalize requirements and who can remain involved throughout 2) IT people who think on the business-side
- Build institutional knowledge around the geospatial applications

- 'rogue' applications are sometimes the most creative apps. Remember bigger picture that these rogues must fit into / align with. In some cases, States developing rogue applications for national-related information--- with no core framework or standard for interoperability and/or data exchange in other States etc; customer for this should be external customer. National approach to interstate solutions

Future
- Real-time information flow will likely be an area where geospatial applications grow
- Besides ITS, may see flood of geo-spat. Aware devices/activities that'll be reflected in use of GIS
- Continued lowering of hardware and storage costs
- The importance of geospatial applications is likely to continue to grow within DOTs. It is likely to be a backdrop for most decisions within DOTs.
- Continued development of web services – should improve interoperability of agencies' systems and lower the costs of implementing them
- Sharing successes and experiences within and/or among State DOTs
- Transportation agencies need to partner to have privates develop applications. Pool funding discussion
- College curriculum implications
- Private data suppliers increasingly common / more complicated data application and governance. Provides opportunities as well. Will need information managers (a new discipline?)
- Geo-apps more and more viewed as customer service
- There is a need for prof. capacity building
- Shift from GIS manager to info facilitator
- Evolutionary process vs. revolutionary
- Roles are shifting – consider different types of partnerships.
- Not productive to move ahead and wait for partners to catch up

Summary from End of Day 2

- GIS is increasingly becoming a tool of the desktop, accessible to many. Outputs from geospatial technologies are now endemic to the work of State DOTs.
- There is a need to develop continuity of terminology across an agency and administration.
- Multi-state corridors could be used a unifying factor for tying State DOTs' geospatial applications together.
- It is important to have the ability to articulate the value of geospatial investments to top-level management.
- A forum or other tool for State DOT executive decision-makers to learn about what other States have done or are doing to implement geospatial applications would be useful.