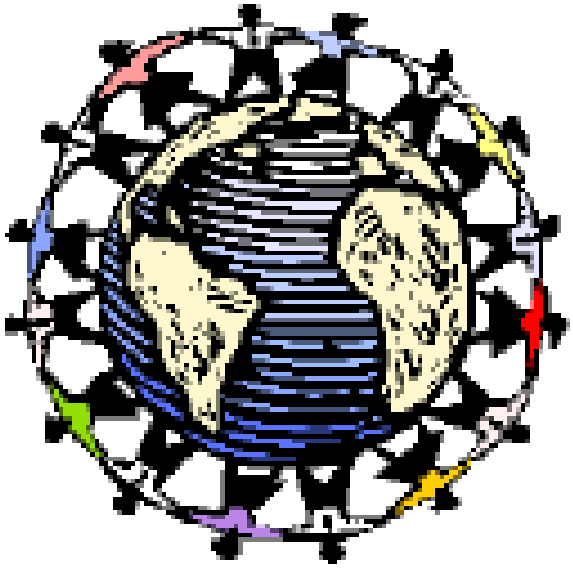
Kansas Department of Transportation

GeoSpatial Enablement Strategy Appendix 1 – Peer Initiatives



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Appendix 1 – Detailed Review of Peer Initiatives

Appendix 1 contains a review of peer Transportation agencies GIS strategic initiatives. The following GIS Strategic plans were reviewed for this study:

1. Kansas DOT GIS Strategic Plan, March 2000
2. Nebraska Department of Roads GIS Strategic Plan Report, January 2001
3. Ohio Department of Transportation Strategic Plan Report, June 2002
4. Pennsylvania Department of Transportation GIS Strategic Plan Executive Summary, 2003
5. City of Charlotte GIS Strategic Plan, 2002
6. State of Kansas GIS Strategic plan (This plan's update is under development and consequently was not reviewed)

1.1 Kansas DOT GIS Strategic Plan, March 2000

This document was written as a follow up to the GIS Directions report done in 1995. A strategy was laid out to guide KDOT's GIS direction between the years 2001 through 2003. In this plan the following components were established:

1. GIS Mission
2. GIS Vision
3. GIS Strategic Goals
4. GIS Management Strategic Goals
5. Identification of Critical Issues
6. Identification of Priority GIS Projects

One of the key attributes of this document was creating a greater awareness of GIS throughout the KDOT enterprise. KDOT has been using some form of GIS system since the latter part of the 1980's but this initiative helped to define a concrete course for future development. Several critical factors were identified for KDOT to address. Among these concerns were organizational constraints, basemap structure, and technology platforms.

1.1.1 Priority GIS Applications

There were 29 proposed GIS applications identified in the plan. These applications were evaluated and rated on series of variables such as level of effort to develop, data that would have to be collected, potential usage of the application, level of importance and the overall Transportation Program Needs. These were prioritized from 1-29. The consultant that prepared the plan costed the applications. In addition, there was a list of 5 priority projects that were to be completed between the years 2001 – 2003. These are listed below:

1. Decision maps (Program Management)
2. High accident location maps (Local Projects/Transportation Planning)

3. Construction and detour web application (Construction and Maintenance / GIS)
4. Network Optimization Maps (Pavement Management—Materials and Research Center (MRC)
5. Recompiled GIS basemap (base network) at a scale of 1:12,000 (Cartography/GIS).

Of these projects the following has occurred:

1. Decision maps – This was in place on the MGE platform and the business processes were successfully moved to the GeoMedia environment. Planning produces these for Program Management.
2. High accident location maps – KDOT currently can plot accidents on the state system only. The ability to plot accidents on the non-state system is still not available; the skills set needs to be realized but the tool are available in-house.
3. Construction and detours web application – This is part of the KanRoad application.
4. Network Optimization Maps – The Materials and Research Center has developed these maps. There decision support structure will eventually be linked into KGATE.
5. Recompiled GIS basemap at a scale of 1:12,000 – The base network has been re-calibrated based on lat/long collected using GPS technology. There is still not a seamless integration with the network created and maintained in EXOR Highways. A GIS/LRS integration study was completed in February of 2003. This research recommended the base network be produced by EXOR Highways and published for the KDOT enterprise to use by dependent applications. This recommendation was made to help eliminate duplication of the same process. The network generated from EXOR Highways is the official network representation for KDOT. It is essential for enterprise wide accuracy and consistency that this recommendation from the prior study be implemented.

6. In addition, there was an accelerated schedule that included five additional applications. The following applications were ranked 6 through 10.

7. GIS-Maintenance Management System (MMS) integration (Construction and Maintenance).
8. Non-state system bridge inventory georeferencing and data integration (Local Projects)
9. GIS-Pavement Management Information System (PMIS) integration (Pavement Management)
10. GIS-traffic models integration (Statewide Planning)
11. Environmental use of GIS (Environmental Services)

Of these projects the following have been completed:

1. GIS-MMS integration – The linear data reference structure (mile markers/ reference posts) has been linked to the enterprise LRS Key so that decision support can be performed. This business process will be integrated into KGATE.
2. Non-state system bridge inventory georeferencing and data integration (Local Projects) – The data must be prepared for enterprise dissemination. The tools are currently resident in house to geospatially enable this data.
3. GIS-Pavement Management Information System integration – This system is in place and KGATE will potentially be used to provide pavement data to the KDOT enterprise.
4. GIS-traffic models integration (Statewide Planning) KGATE will help to serve this to the enterprise
5. Environmental use of GIS – Their data is provided by outside agencies from KDOT. They utilize the 2003 2-meter color imagery, which is critical to their analysis processes. Access to their analysis products will be provided to the enterprise via an interface to KGATE.

In addition, there are several other applications that did not have a high priority but that have been enabled:

1. Traffic and Field Operations view of traffic counts – These are currently broadcast to the enterprise via KGATE.
2. The Bureau of Local Projects' viewer for maintenance agreements – The data is available but not enabled for dissemination. The decision support structure for the enterprise would reside in KGATE.
3. A maintenance viewer application – This would allow Local projects to view the maintenance agreement areas (roadway segments) in a map. This is still in conceptual design and dialog is on going between planning and local projects.
4. Cellular coverage maps for the State of Kansas. Although this was not a GIS application, it was listed in the March 2000 plan. Several maps of the ITS infrastructure have been produced and distributed.
5. Base network support for the Kansas City Scout project, which is an Advanced Traffic Management service to the Kansas City metropolitan area. A separate state system road network was developed (by the contractor) for the KCScout project. Recent dialogue has been established among KCScout staff, KDOT GIS staff, Missouri DOT GIS staff, and others regarding the maintenance of this network and regarding the addition of non-state system arterials to the network to support Operation Greenlight.
6. The Project Optimization System should build on the efforts of the NOS and PMIS programs as part of a phased approach to a full PMIS. This will be integrated with the other PMIS underway within KGATE.
7. Wichita Traffic Operations Center base network. Work is in the preliminary phases. The KDOT GIS team assembled for KCScout project will most likely be involved with the TOC endeavor in Wichita
8. The Construction and Maintenance Unit's QA application should build on the MMS application developed earlier in the cycle.

9. The ability to access legacy data (Bureau of Construction and Maintenance) with a GIS interface received a high importance score, and this application would be especially useful to district offices.
10. The ability to get the strip maps into a GIS-ready form for wider and timely distribution – The strip map represents a design file that conveys the engineering centerline. This file is then drawn and provided to CANSYS for definition of their centerline. This has not completed.
11. The collection of accident data for local projects – This has not been accomplished. The data is not in place to map local road accidents.
12. A maintenance activity reporting database application – A crew report system is currently under development.
13. A new process for updating the county map series - This process is currently under development. There are several issues that are being investigated to allow quality cartographical output to be produced.
14. The development of non-state system road layer for the GIS base network – The digitizing of the rural non-state system roads is completed and has been graphically tied to the state system network. KDOT is currently evaluating which attributes to carry on the non-state system portion of the network. In addition, the decision to create a local LRS is under evaluation (Wichita Prototype for City non-state network).
15. Driveway/access permit application – This currently has been completed.
16. A telecommunications infrastructure database – This is in the planning and implementation stages.
17. A cellular coverage database – See above.
18. A snowplow routing application – No work has been performed in this area.
19. A sign inventory management system – Requirements definition for the sign inventory system is scheduled to begin in the fiscal year 2006.

1.1.2 Critical Issues

There were several other critical issues defined to guide KDOT's future GIS direction. Among these are organizational issues, concerns with the current basemap and the choice of technology platforms to produce the deliverables from the GIS plan. Performance measures were defined for these critical factors. These factors will be discussed in the following paragraphs.

Staffing Support and Skills Set

There were several objectives relevant to GIS staffing in the 2000 plan. KDOT's GIS department was able to fill 6 positions during the 2001-2002 fiscal years. In addition, management continued to maintain a contractor support mechanism that allowed programming support to be acquired outside of the internal KDOT skill set. Instead of an intern system the GIS department uses temporary employees. One of these employees has become a full-time member of the GIS staff. Each of these actions was defined as performance measure in the 2000 plan.

GIS Distribution

One key objective in the plan was to provide widespread hands-on access to GIS functionality, maps, and data throughout KDOT. Several performance measures were established to achieve this. KDOT met the initial measure of evaluating Intergraph's GeoMedia and GeoMedia WebMap version 3.0 in the year 2000 KDOT has continually evaluated and deployed the most recent versions of these products to the enterprise. Currently, version 5.2 of both has been deployed. In addition, KDOT had set a strategic action to disseminate geospatial data to the district offices. This has been achieved by providing web access via KGATE to various geospatial databases. A design plan was never drafted for desktop deployment of GIS to KDOT's enterprise. The KGATE intranet site in part has addressed this. It provides a more cost effective means to disseminate geospatial data.

KGATE provides enterprise wide access to critical business data in a read-only mode. It is structured to provide viewers within the enterprise the ability to execute pre-defined queries of various operational databases that are available for decision support. KGATE does not provide the ability to perform the ad-hoc queries that are required of power users within the enterprise. This type of query would be performed as the SQL or GIS level.

Several strategies and performance measures were established for enterprise-wide education on GIS and KDOT personnel skill refinement. Among the targeted actions to address these objectives were:

1. Conduct one non-technical GIS seminar for KDOT departmental managers by Fourth Quarter 2000.
2. Provide software training for new GIS personnel by Third Quarter 2000.
3. Three technical GIS training seminars at KDOT's Central Office and at one pilot district office by the end of 2000.
4. Participation at least one national/regional/state GIS conference a year.
5. Develop and publish a regular GIS status report/newsletter with a First Quarter 2000 startup date; develop Intranet site by Third Quarter 2000; prepare various GIS presentations by Fourth Quarter 2000. GIS updates could also be featured in the KDOT and BCS newsletters.
6. Prepare and distribute GIS capabilities and services brochures and similar materials by end of 2000.

These were accomplished by the following actions:

1. GeoMedia and GeoMedia Professional training – July 2000
2. MGE training – Jan., Feb. 2001
3. GeoMedia Web Map training – Oct 2001
4. Spatial indexing – June 2003
5. Online GIS (intro to GeoSpatial Theory) class – 10 week online class, Nov. 2003 – Feb 2004
6. ITS classes:
    - Software acquisition – Dec 2000
    - Introduction to Systems Engineering – Dec 2001
7. TerraShare:
    - Pilot (initial skills transfer—overview, metadata, system requirements) – Jan. through April 2003
    - Implementation plan – June through Oct. 2003
    - TerraShare administration (skills transfer - metadata) – Jan. through June 2004
    - Skills transfer for ingesting of line scan data – June through Sept. 2004

Significant investment has been made in properly equipping KDOT personnel for success.

1.1.3 Data Access and Sharing Improvements

The 2000 plan identified the need to improve GIS access to KDOT transportation databases for decision support, visualization, analysis, and data validation purposes. Among the established performance measures were:

1. A design plan for GIS database structures and accessing of the database by Q3, 2000.
2. GIS access to CANSYS II when the latter system is implemented.
3. GIS access to at least one additional data source annually beginning in 2000.
4. Design and deploy at least one GIS tool to promote data error detection and correction by Fourth Quarter 2000.

These objectives were accomplished by:

1. A GIS/LRS integration study dated February 2003 recommended that EXOR Highways publish the network and event tables for linear analysis and GIS exploitation.
2. Additional data sources are continually added to KGATE to extend the enterprise decision support environment.
3. KDOT implemented the GeoMedia Transportation environment. The dynamic segmentation command provides error-checking capability that allows validation of any event data used for linear analysis.

4. A design plan for GIS database structure is under investigation. The network table and major event tables were documented in February 2000.

1.1.4 GIS Management Structure

Another strategic objective of the 2000 plan was to strengthen the KDOT GIS management structure. This was to be done by the following actions:

1. Develop a GIS management plan and organizational structure by Q1 2000.
2. Establish a regular GIS Subcommittee meeting schedule by Q1 2000.
3. Develop a GIS tracking product mechanism/report by Q1 2000.

These performance requirements were met by the following actions:

1. The organizational structure of the GIS department was clearly established in 2001.
2. The GIS subcommittee was established in Q4 2000 and met regularly. It still has active membership but is currently inactive.
3. The GIS management plan has been structured within the KDOT IT Architecture plan.

1.1.5 Development of Realistic, Measurable Goals

Another objective of the 2000 plan was to determine and document realistic, measurable goals for GIS operations through 2002. Several of the measurable means to accomplish this were:

1. Receive guidance and direction from the GIS Subcommittee on GIS action plan.
2. Develop small, affordable “modules” for GIS projects.
3. Have GIS Subcommittee review/revise GIS action plan at least quarterly.

The GIS action plan is still under consideration and currently the GIS Subcommittee is inactive. However, with the geospatial plan update and in keeping with the Kansas IT Project Management Methodology, a plan update Steering Committee has been established with a project sponsor and executive endorsement. Status reports to KDOT ITAC and EXIT committees will also be given. In addition, a task force will be established to help mainstream GIS throughout the agency.

1.1.6 Basemap/Base Network Resolution

Another critical issue defined in the 2000 plan was to construct a revised "standard" GIS basemap layer at 1:12,000 scale for general KDOT application use. The basemap refers to the production network used for linear decision support. The basemap was subsequently renamed the base network. Among the actions and performance measures defined to reach this objective were:

1. An in-house evaluation to define characteristics of the standard network layer by Q2, 2000.
2. Analyze the implications of network conversion between Intergraph format and other formats (i.e. ArcView and TransCAD) by Q4, 2000.
3. Investigate sources for the addition of non-state system roads into the base network by Q1, 2001.
4. Complete base network by Q2, 2002.

These objectives were met by the following actions:

1. Approaches to Improve GIS Base Map Accuracy. Evaluated LRM's, workflows, spatial enablement, and GPS, Nov. 1999 - Feb 2000.
2. GPS Integration Workshop – Incorporation of lat/log into state system centerline model, March-May 2000.
3. Base Map Accuracy pilot. Recalibration of the state system centerline, June 2000 -May 2001, revised Sept 2001.
4. LRS/Base map maintenance workshop. June 2001 – August 2001.
5. Implications of network conversion to other formats addressed by standard export capabilities of GeoMedia Professional 4.0, May 2001.
6. NSDI Transportation Data Model Impacts Nov. 1999 - April 2000.
7. NSDI Framework Transportation Update Jun. 2001- Aug 2001.
8. Participation in the statewide acquisition of second generation Digital Orthophoto Quarter Quadrangles (DOQQs).
9. Purchase of image data management and distribution software (TerraShare).
10. Base network updated (with addition of non-state network using DOQQs for digitizing and data validation) in Q4, 2002.
11. The GIS/LRS study of February 2003 recommended the network be maintained by EXOR Highways and published to the enterprise for decision support analysis.

1.1.7 Data/LRS/Route System Translators

Another objective listed in the 2000 plan was to translate location references seamlessly between multiple LRM's and among multiple database formats. This was measurable by the following criteria:

1. Inventory and document the various LRM's in use at KDOT by Q1, 2000.

2. Document needed databases and formats that have a location reference component by Q3, 2000.
3. Evaluate object-oriented database software by Q4, 2000.
4. Complete LRS/LRM data translation project by Q2, 2001.

The following steps accomplished these actions:

1. The inventory of LRM's and databases was concluded in the GIS/LRS Integration study during Q1, 2003.
2. The implementation of Oracle Spatial as the object-oriented database occurred in Q3, 2003.
3. The LRS/LRM translation project was accomplished through two mechanisms. The first was to build four separate LRM's unto the base network segments to facilitate locating linear data. The second was the implementation of the EXOR Highways system that allows analysis in different LRM's, such as mile markers and lat/long values.

1.1.8 GPS Accommodation

Another objective stated in the 2000 plan was to accommodate the ability to translate between GPS-collected field data formats and GIS linear referencing and base network formats. Strategic actions to accomplish this were:

1. Identify potential GPS uses for field data collection at KDOT by Q1, 2000.
2. Test GPS/GIS data conversions through a pilot project by Q4, 2000.

These were both accomplished through the base network centerline project mentioned earlier. The centerline was collected via GPS devices and brought into a geospatial warehouse and used for decision support.

KDOT needs to publish a standard for GPS data collection and associated metadata required for data collection.

1.1.9 Historical and Temporal Data Management

Another objective of the 2000 plan was to support, manage, retrieve, and analyze historical/temporal GIS data. There were several measurable actions defined to achieve this. Among these are:

1. Identify and document historical/temporal data sources by Q4, 2000.
2. Complete historical/temporal management design plan by Q1, 2001.
3. Deploy GIS temporal analysis tools by Q3, 2001.

These objectives have been met in a limited capacity. The data sources with a temporal requirement were identified in the GIS/LRS Integration study of February 2003.

1.1.10 Software Choice

As part of the 2000 plan KDOT was to evaluate software for relevance in making improvements to existing GIS operations. To this end several actions were taken. These are listed below:

1. Evaluate GIS software to determine course of action for upgrading or changing software.
2. Evaluate object-oriented spatial database products by Q4, 2000.

KDOT concluded the Intergraph's GeoMedia suite of GIS tools would allow for the greatest future growth capacity. The software supports open industry standards set forth by the Open GIS Consortium (OGC) and also provides data server technology to read other GIS vendor's proprietary formats. In addition, KDOT concluded Oracle Spatial would be the spatial data storage that would best serve enterprise requirements.

1.1.11 Data Migration to RDBMS

In the 2000 plan there was an action to review and database conversion projects that are being converted to RDBMS format as part of other KDOT management systems initiatives. This would ensure consistency and usability with any GIS application that required the data. KDOT and the State of Kansas have adopted Oracle as the database standard. KDOT also implemented Oracle Spatial in 2003.

1.1.12 Development of GIS Pilot Projects

Another objective was to identify and deploy three GIS pilot projects annually, commencing in the year 2000. Candidate projects include a GIS interface to viewing the CTP, a project tracking map/visualization tool and a web accessible application for a district office. These were met by the following initiatives:

1. KanRoad is a combination of the Construction Detour Reporting System (CDRS) data entry and the Road Condition Reporting System (RCRS).
2. KGATE is an internal GIS-based web portal designed to connect numerous KDOT databases. The web site provides access to KDOT data throughout the agency that could not previously be shared efficiently. The site provides capabilities to dynamically show geospatially-enabled data like accidents, land use, video log, fiscal, and image data accessed through TerraShare.
3. The Truck Routing Information System (TRIS).

1.1.13 Internet Access to GIS Data

Another objective was to provide Internet to GIS data for by KDOT and external users. The KanRoad application is Internet based. Currently, KDOT is evaluating

extra-net access to KGATE. The targeted audience would be KDOT business partners, such as Metropolitan Planning Organizations.

1.1.14 Intranet Access to GIS Data

Another objective was an access-controlled, secure Intranet GIS application for internal KDOT use. This was accomplished with the deployment of KGATE. The KGATE initiative has aligned KDOT with other peer DOT's for enterprise dissemination of decision support information. The KGATE web portal is comparable to GRIP at Oklahoma DOT, NECTAR at the Nebraska Department of Roads and the web portal at Hawaii DOT.

1.2 Nebraska DOR GIS Strategic Plan Report, January 2001

This report is similar in scope to KDOT. It was written by the same consulting firm that did KDOT's 2000 GIS Strategic Plan. It provided a comprehensive Needs Assessment for the usage and promotion of GIS within the Nebraska Department of Roads (NDOR). The plan addresses the following topics:

1. GIS Benefits
2. GIS Strategic Objectives
3. GIS within the NDOR Enterprise
    - GIS interaction with other business units
    - GIS Committee and responsibilities
4. Success Factors
5. Applications Recommendations

There were 29 application modules recommended to NDOR. The needs/applications were grouped under the three defined Strategic Objective for NDOR. The objective categories were: Organizational (1), Data Management and Access (2), and Methods, Standards, and Procedures (3). The applications recommended are listed below:

1. Establish GIS Steering Committee Structure (1)
2. Strengthen GIS Core Group Staff Structure (1)
3. Hire GIS Core Group staff (1)
4. Intranet-based video logging interface (2)
5. Prepare Design Document and Add Phase I elements to basemap (2)
6. Add Phase II elements to basemap (2)
7. Develop a Data Model and Conceptual Design for Data Repository (2)
8. Pilot of Data Repository (2)
9. Full implementation of Data Repository (2)
10. Design and implement web interface to the Data Repository (2)
11. Expand web interface to the Data Repository (2)
12. Design Document for Pavement Management System (PMS) - GIS Application. This includes program interface, data access/display, and analysis tools for testing and implementation in Central Office (2)

13. Deploy PMS-GIS interface in a single district office as a pilot (2)
14. Implement PMS-GIS interface in all district offices (2)
15. Link Bridge Analysis System (BAS) with MGE project (2)
16. Create BAS-GIS interface for Deployment in Central Office (2)
17. BAS-GIS interface pilot in a district office (2)
18. BAS-GIS interface to all district offices (2)
19. Design intranet Road Closure web application (2)
20. Design internet Road Closure web application (2)
21. Develop GIS Safety Analysis System for deployment in both Central Office and Districts (2)
22. Document road network maintenance workflows (3)
23. Document existing GIS processes and procedures (3)
24. Develop metadata for GIS data (3)
25. Define GIS server filenames and directory characteristics (3)
26. Develop metadata for data repository (3)
27. Design and document standards for GUI's utilized by GIS applications (3)
28. Design and document general operational standards for GIS (3)
29. Design and document standards for web-based development (3)

While some of the resultant applications were different this strategic plan was similar to the KDOT plan of 2000 in that it sought to:

1. Set obtainable goals and objectives relevant for GIS
2. Address the strengthening of the GIS organization
3. Attempt to educate the DOT culture of the value of GIS
4. Categorize and prioritize the most critical needs/application based on stakeholder interviews
5. Move applications to a web based environment where applicable.

1.3 Ohio DOT Strategic Plan Report, June 2002

Another peer DOT GIS strategic plan that was reviewed was from the state of Ohio. The same consulting firm that authored the Kansas and Nebraska plans did the Ohio DOT plan. This report was structured somewhat differently from the prior two. The strategic plan process was divided into 3 distinct task domains. They are as follows:

1. Review Existing Systems - Task 1
2. Identify User Needs – Task 2
3. Development of Strategic Plan – Task 3

1.3.1 Review of Existing Systems

The first task was to perform a comprehensive review of systems with the Division of Information Technology (DoIT), Technical Services, and district offices. An analysis of the following areas was performed:

1. **Databases** – The database management systems used.
2. **Applications** – The application development and implemented programs.
3. **Infrastructure** – The servers, networks, and other technology used for information to flow.
4. **Workstations** – The desktop, user, or client personal computers used for GIS activities.
5. **Districts** – The GIS-related information technologies in the ODOT districts.
6. **Technical Services** – The GIS unit is located within this environment and is responsible for GIS development, system support, and training.

1.3.2 Interview and Needs Summary

This document attempted to collect stakeholder requirements and devise a prioritized list of applications. Three different modes of data collection were used. The first was a workshop, the second was direct interviews, and the third was an on-line electronic survey.

Twenty-nine department and districts were interviewed. In the interviews a description of the stakeholder function, implemented technologies, current usage of GIS, GIS vision and perceived application needs were defined. In addition, a summation of the pertinent issues that were derived from the interviews was provided. Among the key factors uncovered were:

1. Management Issues:
    - ODOT's vision and mission in forefront of GIS actions.
    - GIS coordination through a GIS committee.
    - Custom GIS interface development should be included in IT projects.
    - Expanded GIS skill sets must be developed.
    - Asset management (GASB 34).
    - Sustained marketing of GIS to upper management and legislators.
2. Data Standards:
    - Data Description Catalog is necessary.
    - Linear referencing use is consistent within ODOT.
    - Linear features versus polygons; Intergraph versus ESRI.
    - Adoption of fundamental mapping standards.
3. Data Quality:
    - Data quality throughout ODOT is good.
    - A few problems with the currency of data.
    - Continued investment in Base Transportation Referencing System (BTRS) reliability.
4. Data Uses and Integration:
    - ODOT needs a better method to track construction projects from concept to completion.
    - ODOT is transitioning from data islands to data integration.
    - District offices can be receive great value from integration efforts.

- There are multiple applications that can benefit from real-time data acquisition.

5. Education and Training
   - Continued enterprise wide GIS education.
   - ODOT should investigate multiple modes of GIS training.
   - Immediate project assignment is necessary to enforce and provide the return on investment for training.
   - Conceptual training on geography and GIS concepts are required to move outside of the realm of software.
   - ODOT needs analytical workflow training for business problems.
6. Funding will by tied to upper management "buy in."
7. Staffing:
   - Staffing levels must be appropriate to keep central and district offices synchronized.
   - District "buy" in for GIS is essential to equipping staff for success.
8. GIS Customer Services is generally well respected across the enterprise.
9. System Issues:
   - Oracle Spatial or investigate spatially enabling Sybase.
   - Hardware upgrades problems in District and County Offices.
   - Simpler GIS interface required for the enterprise instead of the "out of the box" GeoMedia.
   - ODOT's Corel Office Suite standard is generally inconvenient for sharing files with the outside world.

1.3.3 Development of Strategic Plan

The actual strategic plan is an encapsulation of the prior two documents. It was written for a 5-year time window. A list of recommended actions were identified for Ohio DOT. Among those are the following:

1. Evaluate Sybase and GIS integration
2. Evaluate GeoMedia Transportation
3. Implementation of database and GeoMedia changes
4. Constitute a permanent GIS Users Group
5. Establish a GIS Steering Committee
6. Develop a GIS career path
7. A formal GIS training/education plan
8. Standardize of coordinate systems
9. Continue updating data description catalog
10. Continue upgrading/standardizing GIS workstations
11. Evaluate upgrades to ODOT's network bandwidth capacities
12. Evaluation of improving cartographic viewing and production interfaces, tools, and output.

In addition, priority applications were identified and recommended for implementation within the 5-year period. Among the highest priority applications were:

1. ELLIS Integration
2. Pavement Management Application
3. Work Plan/OPI/Sufficiency Processes
4. Maintenance Quality System Deficiencies Viewer
5. Congestion Management System
6. Safety Analysis System
7. Enhanced Roadway Inventory System
8. Bridge Inspection
9. Traffic Data Viewing and Analysis Application
10. Basemap Enhancement
11. Bridge Information System
12. Environmental Analysis System
13. GIS Intranet Viewer
14. Public Access Information Viewer
15. Videolog Integration

In addition, there were 12 other applications identified within the 5-year strategic plan window. These were given a lower priority for implementation.

1.4 Pennsylvania DOT

The next peer DOT to be evaluated is Pennsylvania. Penn DOT provided an update to a previous GIS Strategic plan that had been done. The time window the update covers is 1998 – 2003. This plan update provide costing and development time in the following areas:

1. GIS Management:
   - Procedural development
   - Knowledge transfer
   - Cartographic integration
   - Future development tools
2. GIS Distribution:
   - Data sharing
   - Desktop GIS
   - Development tools
3. GIS Applications:
   - Application management
   - Video/Image transfer:
     - Link GIS and video logging
     - Investigate various raster storage solutions
     - GIS and real-time streaming video
     - Acquire digital ortho/satellite imagery

- Data management tools:
  - Analyze multimodal support
  - Study real-time analysis applications
  - Intelligent intersection tools
  - Integration of highway design functions
  - Incorporation of historical data for GIS analysis
  - Incorporate landmark references in GIS
  - Integration of document management with GIS
  - GIS/HPMS data manipulation tools
  - Integration of auto traffic system
  - Integrate ITS data with GIS
- New technology directions:
  - Integrate GPS and GIS
  - Investigation of environmental GIS applications
  - 3D visualization tools
  - GIS and straight line diagram integration
- Future application development

4. Systems:
   - Current system management
   - Knowledge transfer:
     - System administration training
   - Network communications:
     - Incorporation of Lotus notes
     - Implement NT domain access/CADD
     - Remote monitoring/maintenance software
     - Any additional hardware purchases
   - Database management:
     - Database modeling
     - Data maintenance
     - Relational graphics database
     - Data refresh/synchronization tools
     - Select database posting tools
   - System administration:
     - Improve network
     - GIS debugging software
     - Centralize data files
     - Coordination of web server maintenance and support
     - Standardization workstation configurations/software
   - Future system enhancement and development

1.4.1 Future Considerations

An analysis of future trends that would have a potential impact on Penn DOT was also conducted. With consideration to the timeframe this report was written the following is a list of future trends that would impact Penn DOT's GIS strategic objectives:

1. Web-based technology to disseminate GIS data internally and to the general public.
2. Technology to incorporate of detailed photo and satellite images with GIS maps.
3. Advances in Client-Server Technology.
4. Advances in Data Storage Technology.
5. Availability of Large Quantities of Data.
6. Use of GPS.

1.5 City of Charlotte, NC, April 2002

The City of Charlotte was included in this study for several reasons. First, the entire format of the GIS Strategic Plan was completely different from the other peers. Second, the same vendor that did KDOT, OHIO DOT, NDOR and Penn DOT's Strategic Plans did not do City of Charlotte's plan. Third, it had a component for Charlotte DOT that dealt with similar issues on a micro scale that a state DOT addresses on a macro level. Fourth, it was attempting to implement and enterprise GIS architecture similar to a state DOT. Finally, it illustrates there is more to geospatial solutions than the transportation layer, and that geospatial solutions for transportation always rely on non-transportation data as part of the solution.

Below are some of the key components of the enterprise GIS model devised for Charlotte:

1. Executive level involvement and support for GIS technology.
   - Focus Area Strategy Plans
   - KBU Business Plans
2. Direct connection between GIS and the City's strategic objectives.
3. GIS coordination between City departments and other agencies.
4. Effective improvements and cost avoidance by shared applications, hardware, software, personnel resources, and data.
5. Use of GIS technology to improve business processes that span across the organizations.
6. Communication and education among users.

References to Enterprise GIS therefore speak to all City departments, encompassing their interests collectively versus individually. Some key logistical goals that were established for the enterprise strategic plan are as follows:

1. Data
   - Implement spatial data warehouse for enterprise GIS data
   - Data standards for spatial data warehouse
   - Policy for data security, distribution, and other legal issues
   - Establish data stewards/custodians
   - Develop Address Plan

- Establish regional data partnerships
- Establish Land Use QA/QC data
- Develop and implement digital submittal standards with County

2. Applications
   - Apply "Use Case" or modular development for enterprise applications
   - Develop a rapid application development methodology
   - Presents alternatives for prioritizing enterprise applications

3. Organization
   - Framework for City/County GIS working relationship
   - Establishes GIS Enterprise Team responsible for:
     - Collaborating to achieve the best interest of the City
     - Overseeing implementation of the GIS Strategic Plan recommendations
     - Prioritizing enterprise applications
     - Developing data policies and procedures
     - Providing GIS budget recommendations
     - Oversee activities of other GIS committees
     - Communicating with Key Businesses
   - Establishes GIS Infrastructure Committee
   - Establishes GIS Data Framework Committee responsible for the City's GIS data, including data architecture, addressing, data modeling, metadata, symbology standards, and data maintenance agreements
   - Recommends GIS representative on TMT
   - Establishes Office of Enterprise GIS (4 person team)
   - Participates on County Integrated Land Records project

4. Training and Support
   - Develop & implement GIS Training Plan
   - Formalize partnership with TLC
   - Refine user support system, including Help Desk
   - Develop intranet information web portal

A list of primary applications for the City of Charlotte was identified. These applications are identified below:

1. Asset inventory – the basis for all other applications.
2. Integrated project management and information access – track improvements, changes, expansions, etc.
3. Incident and complaint analysis.
4. Forecasting, analysis, and planning.
5. Citizen information access (web based analysis).
6. Intranet application to assist staff in responding to citizen calls for information.

1.6 Peer Comparison

This section will provide a comparison of the peer DOT's. Each of the peer DOT's plan has unique characteristics in and of itself but there are common characteristics among all of them. Variables to be paralleled will be staffing logistics, GIS steering committee and internal promotion strategies, application development, whether the standard GIS software was evaluated, and if an evaluation of the enterprise spatial database occurred. Table 1 compares some of the chief logistical components of the peer review.

Table 1 Plan Logistical Comparisons

Components	KDOT	ODOT	NDOR	PeDOT	Charlotte
Steering Committee	X	X	X		X
Staff Evaluation					
1. Management	X		X	X	X
2. Additional Staff	X	X	X		
3. Career Path Definition		X	X		
4. Decentralized Staff	X	X	X		
GIS Training Program	X	X	X	X	X
Internal GIS Marketing	X	X	X		
Hardware Analysis					
1. Central Office		X	X	X	X
2. Districts		X	X		
Database Evaluation					
1. Enterprise	X	X	X	X	X
2. Spatial	X	X	X	X	X
3. Migration	X	X			
Data Modeling			X	X	X
Software Evaluation	X	X	X		
Data Distribution Evaluation					
1. Desktop	X		X	X	X
2. Web	X	X	X	X	X
Data/System Integration	X	X		X	X
Data Quality/Process Analysis	X	X	X	X	X

Table 2 presents a summary of comparable GIS applications identified from the DOT peer analysis.

Table 2 Common GIS Applications Identified

Applications	KDOT	ODOT	NDOR	PennDOT	Charlotte
Safety/Accident analysis	X	X	X		X
Asset Management Inventory					X
Construction and Detour System (road closings)	X		X		
GIS Pavement Management interface	X	X	X		
Basemap-Base network improvement	X	X	X		X
GIS Maintenance Management System interface	X	X			X
GIS Bridge Management System	X		X		
Environmental GIS	X	X			
Pavement Optimization System	X				
GIS Traffic Model integration (Travel Demand)	X				X
Traffic Data Viewing and Analysis System	X	X		X	
Videolog System		X	X	X	
Web based decision support interface			X	X	X
Work Plan/Sufficiency Process		X			
Congestion Management System - ITS		X			
Roadway Inventory System		X			
GIS-HPMS Interface				X	
Integration of ITS data with GIS				X	
Straight Line Diagrams				X	
Project Management					X
Web based Citizen Information Access System					X

There were several applications not listed on this matrix. The reason is they were specific to a single DOT and did not represent common characteristics across the peer group. It is also worth noting that Penn DOT's plan was an update to a strategic plan done in the mid 1990's. This signifies a different paradigm of how the update to their GIS plan was done. Penn DOT and Ohio DOT are a little more advanced in the deployment of GIS. In addition, both of these DOT's have had a fairly well defined integration process between the LRS and the GIS in place for sometime.