Paper 1243

A Down-to-Earth GIS Plan

Paper Abstract

How the City of Phoenix, Street Transportation Department developed a comprehensive GIS Implementation and Data Conversion Plan based on a simple set of concepts and a checklist approach to problem solving.

With an initial investment of six months time, the City of Phoenix, Street Transportation Department put together a comprehensive five-year GIS implementation and data conversion plan based on a simple set of concepts and a checklist approach to integrate organizational data silos under a GIS umbrella.

The Street Transportation Department GIS Team found that developing a GIS implementation plan doesn't have to be a frightening or overwhelming task. By using just a few simple planning techniques, you can build a high-level plan that is understandable by management, while blueprinting the design complexity essential for technical staff to effectively implement.

The presentation will reveal techniques used to empower first-time GIS implementation planners.

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BACKGROUND

In April 2002, the City Of Phoenix published a Geographic Information System Strategic Plan that articulated the strategic goals and objectives of the Geographic Information System (GIS) Implementation within the Street Transportation Department. The Strategic Plan recommended an approach consisting of four phases:

- Phase I Implement "Low Hanging Fruit"
- Phase II Develop Implementation Plan/Conversion Specifications
- Phase III Data Collection and Business Process Integration
- Phase IV Implement Additional Applications.

This Implementation Plan describes the recommended direction for deployment of a Department-wide GIS environment to support the primary business processes of the Street Transportation Department.

The major goal of GIS in the Department is to provide a means for the integration of disparate right-of-way and street data using linear reference methods as a common link. Linear reference methods locate right-of-way objects and events relative to a position along the street network. Using this integration framework, applications can be developed to track department infrastructure and operations as well as facilitate improved workflows and decision-making activities.

The GIS Strategic Plan provided a vision for making spatial information accessible and useful to users across all business areas of the Department. An extensive set of data demands were identified and implementing these requires a significant investment in the acquisition and maintenance of spatial data and GIS technology. An architectural strategy is required to ensure that the overall implementation of the GIS is successful and can continue to evolve with the changing needs of the Department.

IMPLEMENTATION APPROACH

A Department-wide GIS implementation is a collaboration of project, divisional, enterprise, and public access GIS implementations. Key spatial data layers such as streets, street assets, right-of-way and right-of-way assets will be created, maintained and stored in a central repository for efficient distribution across the Department, external agencies and the public.

The implementation of the Department GIS requires an architectural strategy to ensure that the overall implementation of the GIS is successful and can continue to evolve with the changing needs of the Street Transportation Department. This strategy includes:

- Three business application suites providing functions to support the asset management, work management and project management processes
- A GIS application framework providing common functions for spatial data management, access, display and reporting
- A GIS data architecture providing a model for integrating and sharing geographic information across applications
- The GIS technology infrastructure providing the necessary hardware and software platforms.

There are five principal components that must be considered in the implementation of the Department GIS:

- Data
- GIS Software
- Applications
- Organization and Staffing
- Hardware and Network.

The business drivers for the GIS implementation are derived from the four primary demands facing the Street Transportation Department.

- Management of the City's Right-Of-Way Assets
- Citizen Service
- Service Improvement
- Changing Infrastructure Demands.

While cognizant of the Department's business drivers, the GIS implementation must take into account the priorities, budgets and available resources within the Department. These constraints include:

- Available Funds
- Changing Priorities
- Operational Processes.

The GIS Implementation plan must balance these constraints against the benefits of delivering effective solutions to assist the Department in meeting its obligations to the public and its employees. Therefore the proposed approach is to conduct three parallel efforts:

- Data conversion and collection
- Data maintenance application development
- GIS applications development.

Components of each of these efforts, together with the implementation of SAP, are allocated into five stages. Each stage delivers a part of the asset management application set that applies the data model and is incremental, building on the work done in the prior stage.

The schedule for implementing this Plan takes into account three primary factors:

- The Department already has a substantial store of geospatial data that requires a minimal amount of processing to be useful as GIS data
- Certain data are more generally useful or more quickly prepared for GIS use than others and
- The budget to perform any Department-wide GIS building operations is limited.

The plan assumes fairly constant year-to-year funding for GIS system expenditures. The plan front-end loads the GIS implementation with goals that are easy to attain and provide maximum data return for the time and cost investment.

The proposed Implementation Plan articulates five stages to be completed by 2006. The **first stage** includes commencement of the implementation, finalizing the database and organizational design for the Street Transportation Department GIS. The primary objective is to create a functional Street Transportation GIS repository for the conversion of existing right-of-way and street data. Subsequently, data creation applications to acquire data not available from existing data sets will commence. Additionally, the first stage will focus on the development of interface programs to link the GIS repository to external systems such as CityServe. This stage will provide address validation functionality to the external applications and include for the design, development and implementation of GIS applications to meet the display, analysis and reporting requirements of the data provided through these interfaces.

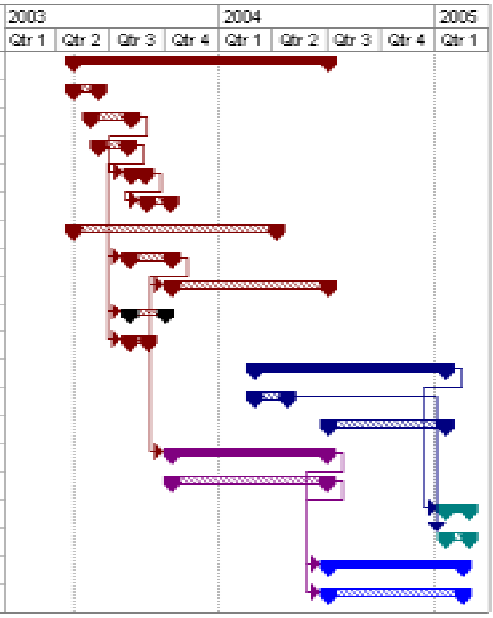
The **second stage** provides for the design, development and implementation of GIS applications for the acquired base data. This stage also provides for the development of data creation and maintenance applications to acquire and maintain asset and spatial attribute data not available

from existing data sets that were considered to be of high and medium priority as determined by the priorities set forth in the Asset Data Requirements.

While the **third stage** provides for the implementation of SAP within the Department as the repository of asset data, the **fourth stage** provides for the development of data creation and maintenance applications to acquire and maintain asset and spatial attribute data not available from existing data sets that were considered to be of low priority. The **fifth stage** provides for the implementation of SAP within the Department for work management and project management.

A summary of the Implementation Project Plan follows

ID	Task Name
2	Stage One
3	SDE Server Implementation
10	Data Model Implementation
21	Interface Design, Development and Deployment
25	Data Quality Validation
30	Data Conversion
36	Data Acquisition
46	Application Design, Development and Deployment
55	Base Map Layer Implementation
135	GIS Software Installation
141	GIS Training
159	Stage Two
160	Interface Design, Development and Deployment
165	Application Design, Development and Deployment
179	Stage Three
180	Implement SAP Asset Management
225	Stage Four
226	Interface Design, Development and Deployment
230	Stage Five
231	Implement SAP Plant Maintenance



The implementation of a Departmental GIS will assist with coordinated spatial asset management. The benefits from this process are articulated as follows:

- Data is available in a standard format that simplifies use
- Data duplication is reduced, saving on redundant work, file management and backup requirements
- Existing data can be located by systematic electronic searching or browsing
- The qualities of existing data can be determined from their metadata
- Integrated data managed in a GIS means analyses can be accomplished more quickly than with hard copy materials and manual overlay
- More precise analyses are possible
- Complex spatial analysis problems can be modeled and quickly altered
- High quality, flexible map production by a larger number of users
- Data users will spend less time finding and assembling data for analysis
- Divisions and Sections can share of their data with other Department users.

REQUIREMENTS REVIEW

In June 1999, the Governmental Accounting Standards Board (GASB) established new financial reporting standards that fundamentally change the way State and local governments report their financial results. Among other provisions, GASB Statement 34 (GASB 34), "Basic Financial Statements and Management's Discussion and Analysis for State and Local Governments," requires that major infrastructure assets acquired or having major additions or improvements in

fiscal years beginning after June 15, 1980, be capitalized in financial statements. In addition, the cost of using the assets must be reflected.

To ensure compliance with the GASB 34 asset identification and asset management requirements, the Implementation Team identified the major assets maintained by the Department in the right-of-way. The following roadway classifications and right-of-way infrastructure asset types have been determined as necessary to support the asset management and asset maintenance requirements of the Street Transportation Department.

Street Classification

- Major Arterial
- Arterial
- Collector
- Minor Collector
- Local
  - Street
  - Access Road
  - Alley

Asset Types

Bridge	Pavement
Crosswalk	Retaining Wall
Curb Cut	Shoulder
Gutter	Sidewalk
Median	Sign
Bus Bay	Signal
Curb	Storm Drain
Guardrail	Street
Lane	Street Light
Outfall	Stripe
Parking Meter	Traffic Count Station

The Street Transportation Department will utilize SAP as the database repository for managing assets and their associated attributes. Utilizing SAP will take advantage of the substantial investment the City has already made in infrastructure and expertise to support the SAP environment. The SAP solution will also eliminate the need to purchase a commercial off the shelf asset management system, and the hardware to support it. In addition, SAP will allow the flexibility to implement the Work Management and Project Management modules following a successful GIS/SAP Asset Management implementation.

In order to ensure the successful implementation of SAP asset management functionality in the Department, the Implementation Team defined the GIS/SAP application functionality required for the asset management, work order management and project management business processes of the Street Transportation Department. The Finance Department SAP Team reviewed the requirements and performed a Fit Gap Analysis that determined that SAP supported the documented requirements.

LAYER REQUIREMENTS

The GIS Strategic Plan identified spatial data set requirements to be included as part of the Implementation Plan. During the implementation planning process, a number of additional spatial data sets were identified as necessary to support the business processes of the Department. Spatial data layers that currently exist within the City can meet a number of the defined requirements. These layers are maintained by various departments and are posted to the enterprise GIS database by the Information Technology Department. The enterprise GIS

data layers will be linked to the Department's GIS. The remaining requirements will necessitate the creation of additional spatial data layers.

ASSET DATA CUSTODIANS

The asset types previously identified have been allocated to specific Divisions and Sections as custodians of the accuracy and currency of the asset data. The Division Data Technician, working with the data custodians, will be responsible for preparing to move the data into the Department GIS Data Repository. When a Data Technician has a data set considered to be ready for use by others in the Department, the Department GIS Analyst is advised. The GIS Analyst, in cooperation with the Data Technician, will review the data set and ensure that it is in the correct format for submission to the Department GIS Repository.

AFFECTED SYSTEMS

In order to understand and document the requisite data conversion and system interfaces required for the implementation, the Implementation Team conducted a review of the appropriate existing systems within the Department that will be affected by the GIS Implementation. A strategy for either replacing or interfacing to the existing system was developed on completion of the review.

RAD PROJECTS

The GIS Implementation Team has been developing GIS projects, tools and applications during the implementation planning process utilizing a Rapid Application Development (RAD) methodology. A rapid application development environment affords the Department the opportunity to provide GIS capabilities that can be rolled out to a larger user community and more quickly than previously possible. These initiatives were undertaken in order to begin to implement the "Low Hanging Fruit" identified in the GIS Strategic Plan and will serve to introduce the power of GIS to Division users by demonstrating the flexibility of combining traditional data querying techniques with spatial querying techniques to retrieve the most relevant information for analysis and decision-making.

The RAD Project initiatives include:

- Bridge Geocoding and GPS Data Collection
- Cultural Resources Management
- Foliage and Tree Collection
- Historic Streetlight Preservation and GPS Data Collection
- Medallion Streetlight Relocation on Central Avenue
- Natural Resources 404 Permits
- Noxious Weed Location
- Outfall Locations
- Pavement Measuring Application
- PDP Project Documentation
- Residential Parking Permit Application
- School Sign Inventory Prototype
- Street Resurfacing Data Conversion and Application Development
- Vector Control Data Collection.

DATA ACQUISITION VEHICLE PILOT PROJECT

The accurate and timely inventorying of right-of-way assets is key to the effective management and maintenance of the City's street infrastructure. Traditional methods of inventorying have proved difficult and an inefficient use of the Department's limited resources. Right-Of-Way assets require accurate measurements of the asset's position with respect to an intersection, the offset from the edge of the street, and the height of the asset above the pavement as well as asset specific data. To measure these parameters is a time consuming and costly manual process. It is also necessary to periodically verify that the asset has not deteriorated to the point where its purpose is compromised.

To adequately address the need for inventory and measurements, the Implementation Team is examining the viability of utilizing a mobile right-of-way inventory/measurement system, known as a Data Acquisition Vehicle that will visually capture and accurately locate right-of-way assets.

The expected advantages of this technology are:

- Inventory and measurement data is captured efficiently, reducing the delay between identifying a feature and incorporating it into a database
- Data collected will be more objective, more accurate, and uniformly reported
- As the digital images created are maintained as image data in a database, measurements can be repeated at any time, by re-analyzing the images without returning to the field
- The efficiencies provided will offset the capital costs.

The Street Transportation Department is conducting a pilot project with a private vendor to inventory fifty miles of street on both sides. The results of this pilot will be evaluated to determine the efficacy and cost benefit ratio of utilizing this technology to inventory the right-of-way assets in the City's approximately five thousand miles of streets.

DATA ACCURACY

Information that is incorporated into the GIS repository is organized into two categories; spatial data and tabular or attribute data.

Spatial data is data that describe spatial, geographic, map, and/or infrastructure features. Spatial information features or map features are classified as points, lines, or polygons.

Tabular data contains information frequently referred to as attribute information. The attribute information is descriptive information, usually stored as traditional data fields or records in tables. These tabular data item(s) can be linked to the point(s), line(s) or polygon(s) that make up the spatial data.

Data acceptance criteria are necessary to ensure that the data contained within the GIS are consistently portrayed and meet defined standards for accuracy and functionality of the data. These standards apply whether the data is collected from existing sources within the Department, City or County, such as parcel maps and existing digital Orthoimagery or purchased from outside sources.

The data acceptance criteria will be developed to answer specific questions regarding the level of data accuracy, both spatial and completeness, that can be achieved given the project's projected budget, scope and timeframe. The data acceptance criteria will also define the levels of data accuracy that are required to meet the current and future needs of the GIS end-users.

Federal standards that assist in documenting and transferring data sets recognize five important components of data quality:

- Positional Accuracy
- Attribute Accuracy
- Logical Consistency
- Completeness
- Lineage.

DATA STANDARDS

The following are preliminary recommendations for key data standards:

- **Coordinate System**
  A standard coordinate system is essential for the efficient use and distribution of spatial data across the Department. The Arizona State Plane Coordinate System, North American Datum of 1983 is the City of Phoenix standard coordinate system.

- **GIS Metadata**
  Metadata is traditionally known as data about data. Just as attributes are metadata of data elements, so too are the attributes of datasets. In this context, metadata refers to the date or timeframe in which the data were compiled, the method in which the data were collected, or the projection in which the data exists.

DATA CATALOG

To facilitate locating existing data and to prevent duplicating efforts, a data catalog will be established. Once completed, the information will be made available to all Divisions and Sections. Associated metadata will detail the origins of the data.

The spatial metadata to support the catalog will be as follows:

- Data Set Identification
- Thematic Description Of The Data Set
- Location Description Of The Data Set
- Temporal (Time frame) Description Of The Data Set
- Source Characteristics Of The Data Set
- Spatial Framework of the Data Set
- Quality Characteristics Of The Data Set
- Media/Product Characteristics Of The Data Set
- Supplier/Producer Characteristics
- Additional Characteristics Pertaining To Image Data Sets.

DATA MAINTENANCE

There are a number of data maintenance issues to consider. The **first** issue is to help ensure that the current GIS data has the highest level of completeness possible. In particular, the master street address layer has to be created and implemented in Divisions participating in GIS to assure location consistency.

The **second** maintenance issue requires determining policies and procedures to ensure data is accurate, complete, and up-to-date. This may involve such things as adding an additional step to the project development process that requires project managers or contractors to provide as-built information to the Technical Services GIS Analyst.

The **third** maintenance issue involves establishing data input conformance standards to the GIS database design. When addresses are entered into a Division database, verification rules will ensure that an existing address is being input. The verification will allow all new data to be properly downloaded into the Department database when updates are made.

The primary approach involves the usage of ArcGIS software to maintain the Departmental GIS data. This approach will be effective when the updates are available either as paper maps, tables or CAD drawings. The ArcMap application of the ArcGIS software suite has the requisite tools to manually maintain both the geometry and the attributes of ArcSDE based data layers. Domains that have been included in the data model will assist in validating attribute edits. Custom tools that will automate some of the editing processes will be developed.

The effective implementation of ArcGIS based data maintenance would require the training of the appropriate departmental staff on the usage of ArcGIS software for the editing of data layers.

The GIS Implementation Team realizes that some amount of fieldwork could be involved in the maintenance of some GIS data layers. The GIS Implementation Team is currently studying the usage of handheld mobile devices for this purpose. Data custodians would download certain portions of their data layer(s) to a mobile device and update it while in the field. ESRI's ArcPad software installed on a Compaq iPAQ with a GPS receiver is being considered as a possible solution. All the updates performed in the field would be uploaded to the ArcSDE database upon their return to the office. The implementation of this approach would require the following:

- Procurement of handheld devices and GPS receivers
- Procurement of the required number of ArcPad licenses
- Training of departmental staff on the usage of the software and device
- Development of custom ArcPad applications to facilitate the field data update process
- Development of custom applications to download data from and upload data to the GIS database.

ADDRESS VALIDATION

Implementing a Geographic Information System affords the Department an opportunity to compile and reconcile the various address data in the existing application systems to a master address database. The master address database will enforce address standards, reconcile existing addresses, and enable access to valid address data to help ensure accurate location information. The benefits of a Master Address File include:

- A pick list for validating address information
- A source of actual address ranges for street segments
- A source for establishing addressing grids and other standards.

The Street Centerline dataset maintained by the Fire Department will be the primary source of address data. The Information Technology Department is developing a standard street name database and will be the primary source of street name data.

Street address sources will be compared and combined to build the foundation for the master address database. The database will be structured to allow for simple migration of address updates from original Division and City sources to the Department master address database.

The Department GIS will utilize the following address standard:

- Address Number
- Address Prefix Direction
- Address Street Name
- Address Suffix Direction
- Street Type.

LINEAR REFERENCE SYSTEM

Geographic locations can be described in one of two ways, either by a direct spatial reference like a latitude-longitude or an indirect spatial reference such as a Linear Reference System where the location of an object is described relative to any other known location. Linear Reference Systems are used with linear data such as Streets, Pipes and Transmission Lines. A Linear Reference System uses a single measurement instead of an X & Y coordinate pair to describe the location of an object.

Linear Reference Systems can be built over linear networks by identifying each unit of the linear network uniquely and associating a measurement system to it. Every street in the city will be a unit of the street network and will have a start and an end point. A measurement system will be associated with the street that can be used to locate objects along the street.

A Linear Reference System provides major advantages for maintaining the Street Transportation Department's data. Maintaining assets as indirect spatial references rather than storing their geographic coordinates means that the amount of data required to store a street feature in the database is smaller. A Linear Reference System is advantageous from a data maintenance perspective as well. If the geometry of the street network is changed, the amount of graphic edits to reflect this change to the street segment and it's associated reference assets in the GIS is smaller.

DYNAMIC SEGMENTATION

Dynamic segmentation is a method of partitioning lines or arcs in a GIS database to reflect their underlying attributes. It is an efficient method for managing line feature data particularly when the values of different attributes change at different points along the feature.

Dynamic segmentation software can store, display, query and analyze the information associated with linear features without modifying the underlying linear data coordinates. Examples of associated data related to a street network are pavement quality, speed zones and school zones.

Maintaining information about linear networks can be difficult. Often, the data describing one attribute of a network feature does not apply to the entire length of the feature. Dynamic segmentation provides the ability to display and analyze any portion of a linear feature without modifying the base map. Dynamic Segmentation also provides the facility to use units other than the unit of the base map to display and analyze portions of the linear feature.

Supporting both point and linear attributes, dynamic segmentation enables monitoring of incidents occurring at points, such as accidents at particular spots in a street, and tracking pavement type as it varies over the length of a highway. The distributed attribute information is stored in a Linear Referencing System based on distances along the network, allowing an accident on a street to be stored as a distance from the street origin or from some known point on the street. Dynamic segmentation uses the linear network location data as stored in the database for graphical display of the distributed attribute.

DATA MODEL

The GIS data model details how data elements (e.g. street centerlines, assets) will appear and behave within the GIS. The data model contains definitions for all aspects of each data element portrayed as a linear, polygon or point feature. The data model also defines relationships between different types of data elements. These definitions will be created for every asset and infrastructure element that has been identified in the asset data requirements process. As the GIS expands and the Department users become more sophisticated, more data elements may be identified for definition and inclusion in the data model.

The ArcGIS Transportation Data Model developed jointly by ESRI and the University of California was modified to suit the requirements of the Street Transportation Department.

The Street Transportation Department's GIS Data Model is an object-oriented data model containing six logical groups of related objects. Each grouping has objects that are either related by function or by type. A general rule that is applicable to all groups is that every group contains a set of object and feature classes along with the relationships between them. Each object or feature class consists of a descriptive name and a set of attributes that define the object and all the data model objects inherit properties from one of the basic object types that are available in ArcGIS.

DATA CONVERSION

Data from existing systems that are to be replaced shall either be converted or geocoded to populate the GIS Data Repository.

APPROACH

The major tasks in the conversion are:

- Document the standards that should be followed throughout the conversion effort
- Prepare the conversion environment for the development and testing of the conversion programs
- Map legacy data files and elements to the Geodatabase table(s) and columns
- Define procedures for manually converting applicable data through new applications

- Design how the conversion programs should be coded
- Specify test procedures to be followed for performing conversion unit and GIS tests
- Develop conversion programs based on the Conversion Program design
- Test the performance of each of the individual conversion program modules
- Test how the converted data performs within the GIS application
- Install the conversion programs that have been coded and tested
- Convert data that has been verified by the users before production operations commence.

Technical Standards and Architecture

The conversion plan will be developed subject to:

- Any governing Information Technology Department platforms strategy and standards
- Any governing Information Technology Department technical architecture plan
- Architectural connectivity issues in linking the Street Department environment to the Information Technology Department environment.

Risks and Contingencies

Identified conversion risks include the following:

- Incomplete definition of the data to be converted
- Lack of legacy resources to identify, document, and extract legacy data
- Poor data quality
- Lack of adherence to required key data translation, cleansing, and transformation criteria.

Conversion Components

Conversion Data Mapping

The data mapping process provides detailed lists of the data sets and data elements that will need to be moved into the GIS data model during the data conversion. During this process, some decisions will need to be made with regard to obtaining information needed by the GIS application that may not be present in the legacy systems. Default settings, user input, and new data entries are some of the issues that must be addressed during this phase.

After the conversion data mapping is complete, it can be determined whether there are inconsistencies between the legacy data types and the requirements for the ESRI data types. If there are translations that need to take place, these translations will be performed on the legacy system prior to creating the extract or in an interface table.

Geocoding

Geocoding, also known as address matching, is the process of creating geometric representations for descriptions of locations in order to display these locations on a map and perform analyses. In other words, Geocoding is the process that assigns a latitude-longitude coordinate to an address. Once a latitude-longitude coordinate is assigned, the address can be displayed on a map or used in a spatial search.

The Street Transportation Department currently has a large number of databases that refer to locations in the city by their street addresses. The data available in these databases is critical to the business processes of the department and spatially enabling this data will be beneficial to the department.

Two types of location information are available in the Street Transportation Department, either an exact street address or the nearest street intersection. The process that will be used to geocode both kinds of information are described as follows.

To geocode address information available in the various databases of the Street Transportation Department, two server-side geocoding services will be created. One geocoding service will be used to locate street address and the other will be used to locate parcels corresponding to an address. The Street Centerline data layer will be used as reference data for the Street Address geocoding service. The Parcel data layer will be used as the reference data to create the Parcel Address geocoding service.

DOWNLOAD PROGRAMS

Download programs will be developed to extract the identified conversion data elements from the current systems to an appropriate file format. The files will match the design of the interim tables.

UPLOAD PROGRAM

Programs will be written and run to move data, validate data, and insert/update standard values into default fields. A single loader program is written for each data table being loaded.

INTERFACE TABLE

An interface table that mimics the production table into which the data will eventually be loaded into is defined, allowing the manipulation of the data as needed before loading the legacy data into the production tables.

TRANSLATION PROGRAMS

Translation programs will be developed to translate data from the existing system format into useful data for the GIS Data Model.

VALIDATION REPORTS

Validation reports will be generated from the legacy systems to be compared later with the converted data.

CAD INTEGRATION

The Street Transportation Department currently maintains thousands of engineering drawings in AutoCAD. The drawings provide the details of all the street projects that have been undertaken by the department in the past. Plans of future projects are also available as AutoCAD drawing (.dwg) files. The drawing files are classified as S, G or P, for Signal, Geometric or Paint respectively, based on their contents.

The current business processes of the Street Transportation Department require staff members to view and maintain these drawings daily. Therefore, it is important that these drawings are integrated with the GIS database so that users will be able to view AutoCAD drawing files while working with the GIS application or database.

The Street Transportation Department currently uses two applications, the FastLook DBMS version 2.0.0 & FastLook Plus version 10.0.13, from Kamel Software, Inc. to search and view AutoCAD drawings from a network file server. A Microsoft Access based database containing details of the existing drawings is associated with the FastLook application.

The Street Transportation Department's GIS Implementation Team will integrate the existing CAD drawings utilizing the concept of Dynamic Segmentation. Each CAD drawing will be associated with the Department's linear referencing system by the creation of point events representing the

spatial location of the drawings. The point events will then be displayed using any standard GIS application. The original CAD drawing will be displayed when a user clicks on the point representing the location associated with the drawing.

DATA SHARING OPPORTUNITIES

Spatial datasets such as streets, bridges, storm drains, etc. are of value to not only the Street Transportation Department, but also to other Departments in the City. Initiatives to cooperatively develop and share spatial datasets can eliminate costly redundancy and facilitate communication between organizations. The Department is working with the following Departments / Organizations to maximize the City's investment in GIS.

- Fire Department
- Information Technology Department
- Water Services Department
- Engineering And Architectural Services Department
- Development Services Department
- Arizona Public Service
- Salt River Project.

HARDWARE AND NETWORK ARCHITECTURE

The GIS will function within the existing City of Phoenix Information Technology Department and Street Transportation Department hardware and network architecture.

STAFFING REQUIREMENTS

The Department's GIS will be organized as a balanced, distributed system, with both the Divisions and the Department GIS Implementation Team working together to ensure the efficacy of the GIS. The Department's GIS Implementation Team will perform the majority of spatial database development and GIS application development. The majority of the data maintenance, analyses and mapping will take place within the Divisions. The Divisions will have the flexibility to organize their GIS support staff to meet their mission goals and fulfill their commitments to the Department GIS.

EXECUTIVE SPONSORS GROUP

The GIS Sponsors Group consists of executive level division heads or their designees, who will implement GIS within their respective organizations. The Department's IT Manager will assist the Sponsors Group with any information and logistical support necessary for the Sponsors Group to successfully carry out its functions and responsibilities. Responsibilities include:

- Provide overall oversight for the GIS Implementation
- Establish priorities and recommend long-term goals
- Receive and review technical recommendations from the Implementation Team and provide direction from a Departmental perspective
- Approve the recommendation of issuance of Request for Proposals and the award of contracts for GIS work
- Make policy and budget decisions concerning GIS to guide the Management Services Administrator for the Administrative Services Division and the GIS Implementation Team.

IMPLEMENTATION TEAM

The Implementation Team is charged with providing technical guidance for issues related to the implementation, and operations and maintenance of the Department GIS. The Implementation Team has a critical role in formulating recommendations on policy issues to the Executive Sponsors Group and making technical decisions concerning the long-term and daily operations of the GIS. Led by the Department IT Manager, the Implementation Team:

- Serves in an advisory capacity to the Executive Sponsors Group on GIS policy issues
- Defines and implements spatial and tabular database design, development, and update standards for the GIS
- Identifies the spatial and tabular databases to be supported in the Department GIS

- Defines the responsibility of the maintenance of the spatial and tabular databases supported in the GIS
- Assists in the prioritization of database development, application development, training needs, and GIS hardware and software acquisition
- Assists in identifying GIS education/training needs
- Defines standards for GIS hardware, software and application development
- Provides resolution of technical problems related to the implementation, and operation and maintenance of the GIS
- Assists in the development of Request for Proposals (RFPs) and the evaluation and selection of contractors needed for GIS related services
- Assists in the development of implementation plans, business plans, data standards, GIS operating procedures and GIS guidelines
- Provides input and assistance in the development of departmental GIS budgets
- Manage the enterprise GIS technology infrastructure
- Provides spatial data, technology and applications support to end-users
- Administers the spatial databases and user access rights
- Manages the integration of GIS with other Department applications.

GIS Coordinator

The GIS Coordinator has overall responsibility for the Department GIS architecture and development framework. The GIS Coordinator also has overall responsibility for the technical implementation, deployment and support of spatial applications to end-users. The GIS Coordinator will help to facilitate and coordinate GIS activities across the Divisions and with external data partners. The GIS Coordinator will be the technical lead throughout the implementation project. The Coordinator will be responsible for identifying additional applications that need to be built to fulfill the needs of the users. The Coordinator will lead the coordination between the Department and other government agencies for such things as creating data sharing agreements and the exchange of data. The Coordinator will be the point of contact with contractors hired by the Department to provide services on any part of the GIS Implementation Project.

GIS Analyst

This role will be responsible for the planning, design and implementation of Department and/or Division-specific GIS applications and projects. The GIS Analyst will also assist users within their Division with the development of additional datasets within the Department GIS Data Model. The GIS Analyst will provide front-line technical support to the Department users and work directly with Division representatives to maintain standards throughout the Department. In addition, the position will be responsible for the development of standards and procedure manuals, the documentation for the data dictionary and symbol library and maintaining the GIS Data Model, Data Acceptance Criteria and the Data Maintenance Plan.

GIS Data Technician

The GIS Data Technicians are the individuals assigned to the Divisions who function as the primary maintainers of the GIS data. The Data Technician is responsible for the ongoing maintenance and dissemination of spatial data, end-user support and the generation of maps and other GIS data products. These individuals, as part of the Implementation Team, will help to determine priorities and discuss issues regarding data capture, data quality and maintenance. This role will be responsible for the mapping and integration of new and updated GIS data. The GIS Data Technician will also assist users within their Division with accessing existing GIS data and the manipulation of data to generate maps and reports. In addition, the GIS Data Technician will be responsible for the documentation of Division or Section-specific databases.

GIS Power User

GIS Power Users are employees for whom GIS will become a major function in their day-to-day job performance. These users, while not necessarily maintaining or adding data to the GIS, will be performing queries and analyses on the existing data sets. The Power Users will be using the more sophisticated tools and applications that will be part of the GIS. These users will gain an intimate knowledge of how the different datasets work together, and as they gain experience, will be key in recommending what new applications will need to be implemented.

GIS Application User

GIS Application Users are employees who will have occasional need for the GIS, but will not rely on it as a major component of their daily work performance. These users will primarily be using the GIS to obtain the data required to produce specific reports or maps on a regular basis. The application users do not need to do analysis on the GIS layers, and may only need to access those layers that are pertinent to their immediate needs. The application users do not maintain spatial data and do not have a need for daily use of the GIS layers.

User Matrix

The expected allocation of these user types in the Divisions is articulated in a Department User Matrix. This allocation forms the basis for the expected software, hardware and training requirements necessary to support their business needs.

Software Requirements

The City has standardized on the ESRI ArcGIS suite of software to support the GIS implementation. Each user type, as defined in the staffing requirements above, will require different components of the ArcGIS product suite to support their GIS requirements. The software requirements have been articulated as a table.

Hardware Requirements

The hardware requirements of the Department wide GIS Implementation have been articulated as a table based on the ESRI recommended minimum hardware configuration required to support the primary GIS software of the Department.

Training Requirements

The GIS implementation will require five categories of training:

1. Data capture and maintenance training
2. End-user training
3. Software update training
4. Application development training
5. System and database support training.

Training for the Power users, the Data Technicians and the GIS Implementation Team will be provided by ESRI or its business partners. The GIS Analyst will develop in-house training classes for the Application users.

Project Plan

The Project Plan cannot be viewed as final but rather as a dynamic document that will require regular review and update. The Department's changing priorities, needs and technology will determine the timeframe required for continued implementation of GIS applications.

As indicated in the Project Plan, the GIS Implementation Team intends to start the Department wide GIS Implementation in July 2003. The Team intends to use the time available in May and June 2003 for activities such as:

- Completing the Data Acquisition Vehicle Pilot Project
- Conducting in-house GIS training of the Technical Services Staff
- Building the infrastructure required to support the GIS Implementation
- Making presentations about the Implementation Plan to the Department Management.

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