Development of tools to integrate GPS, GIS, Cartegraph data conversion and asset data for all traffic infrastructure management system

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Project Objective
The project is primarily focused on the signalized intersection data. The proposed project will develop a system to track work orders for the traffic signals in the CCDPW jurisdiction. This will be achieved by converting the existing paper based work tracking process into an automated system that is easily accessible over the Internet, and demonstrate the use of such tools. The project will also develop interfaces to electronically store and interconnect existing CCDPW paper-based data. The scope of the project may also include other public works related data such as street signs, streetlights, school flashers, speed limits, crosswalks, lane markings etc.

Project Orientation
Data Conversion and Display

Project Abstract
The rapid growth in the population of Clark County, Nevada during the last two decades has had a direct impact on the travel demand and transportation system performance. The growth and its associated infrastructure maintenance costs in the county, have led Clark County Department of Public Works (CCDPW) to look for innovative solutions and strategies to better maintain, manage, and allocate its resources. The success of these strategies will have significant impacts on the business and economy of the region. Access to data is vital in the design of these strategies. In public works, such data relate to the traffic, construction, and development services. Traffic related data includes crosswalks, speed limits, streetlight poles, school flashers, signalized intersection data, street signs, truck routes, etc. Other data of interest include work order information, traffic volumes, proximate population, demographic characteristics, land use characteristics, etc. Data collection, storage and retrieval plays a key role in the operation and management of systems developed to support resource allocation.

The accuracy and timeliness of the data are critical for managing resource allocation support systems. Here the term management includes planning, design, construction, operations, maintenance, and rehabilitation of the system. Agencies such as CCDPW that have jurisdictional responsibilities over regional transportation systems/networks are required to account for their infrastructure and develop a maintenance management system. The practice has been to use the “traditional” paper based mechanisms for this purpose. However, there has been a move to adapt computerized tools and systems such as Geographic Information Systems (GIS) and Geographical Positioning Systems (GPS) for transportation infrastructure management. Advancements in technology have led to new ways of collecting, analyzing, managing and disseminating data. GPS is one such technology used to collect data based on the geographic location of a point of interest. GIS is commonly used software to manage and analyze spatial data, and to disseminate such information. Adoption and incorporation of such technologies can help improve the effectiveness of CCDPW’s activities related to data collection, storage and display. CCDPW-Traffic division receives data related to traffic studies for various locations in the county. The data received are typically in hardcopy/paper format. Hence, it is tedious
labor intensive and time consuming to analyze such information either on a location specific or on a regional basis. Converting such data into digital format provides the user better access to the information for further analysis. Also, the possibilities of using such digitized traffic volume data as inputs for traffic simulation software would be valuable. Figure 1 shows a paper format of the traffic signal problem report, and Figure 2 shows a computerized interface application that could replace the hard copy form shown in Figure 1. This interface was developed with the ArcPad application builder software. Similar interfaces can be built using other software such as GPS Pathfinder software.

![Traffic Signal Problem Report](image1.jpg)

Figure 1 Paper format of Traffic Signal Problem Report
Figure 2 Application Interface for Traffic Signal Problem Report

For roads under the jurisdiction of Clark County, the department of Public Works Traffic Management Division (CCPW-TMD) is responsible for conducting the studies to determine what traffic control devices are needed, as well as designing, overseeing the installation and maintenance of these control devices. In addition, the CCPW-TMD also maintains streetlights, and supports the investigation of the fatal and serious injury vehicle crashes within unincorporated areas of Clark County. Such activities require access to information related to the transportation system and factors influencing transportation demand.

The database maintained by CCPW-TMD can be quoted as an example of the transportation database which needs to be maintained by a local governmental agency with jurisdiction over road networks. This central database may contain several component sections such as right-of-way inventory, roadway and pavement characteristics, traffic characteristics, roadway and roadside infrastructure inventory etc.
One such section is the traffic signal inventory maintained by CCPW-TMD. From 1990 to 2007, approximately 376 new traffic signals were installed under CCPW-TMD’s jurisdiction. This is an increase of 190% over the signal systems installed between 1965 and 1990. Presently CCPW-TMD maintains about 490 signals, as well as 130 emergency and school flashing beacons. In the year 2007, 26 new traffic signals were activated, 9 new flashing beacons were installed and 61 existing signal systems were modified under CCPW-TMD’s jurisdiction. To maintain such a large system of traffic signals, it is important to have an effective database.

In addition, there is a need to study traffic related data from other sources and formats, such as Cartegraph and to research potential (cost-cutting) methods to convert these data into a common GIS data format (digitized data). Figure 3 show the data interface developed in Cartegraph for the traffic signal related information.

Figure 3: Cartegraph interface of Signal Group related information

Digitized data and computerized tools can help facilitate communications among the CCDPW staff. This includes the exchange of information to improve level of coordination within the CCDPW and other agencies. The internet mapping application previously developed by Transportation Research Center (TRC) for CCDPW in the past
is a good example of an application to exchange information among various departments in CCDPW as well as to display the information for the public display. This system is also of interest to elected officials, the general public and the private sector organizations because of its tremendous impact on public safety, quality of life, business and economy of the region. The focus of this project is thus to develop tools to convert some of the key non-GIS traffic related data at CCDPW into GIS format. In addition, the project is to maintain and update the internet mapping project data developed for CCDPW in a timely manner.

The project team at the University of Nevada Las Vegas – TRC, has experience and expertise in the relevant software envisioned for the project. The TRC has worked on several internet applications projects, data applications, and web-based programs, which involve use of programming languages, computer hardware and field data collecting equipment.

**Project Task**

To achieve the objectives of this study, the following tasks are proposed:

Task 1: The project team will coordinate with staff at CCDPW to identify the key data at CCDPW that need to be incorporated into digital formats.

Task 2: Review the format(s) of the key data identified in Task 1.

Task 3: Identify options to convert key data from paper based records to digital format.

Task 4: Study paper based work order process to understand the data needs of the new system. This task also includes detailed identification of data elements required for the system.

Task 5: Develop tools for conversion of the traffic related data such as turning volumes etc., from hardcopy-paper based to digital form.

Task 6: Study available options to associate other non-spatial data (such as beacons, photos in the signalized intersection database) with GIS system.

Task 7: Develop interfaces/tools for CCDPW staff to add or edit data in the new work order management system.

Task 8: Develop an interface for the traffic signals data (new data as well as existing data), that queries and generates reports based on those queries. The output of the application can be either in a tabular or a map format.

Task 9: Demonstrate the completed application (the interfaces and tools) along with data converted from paper records.
In addition, if allowed by county policies, the project team will create, maintain and update the signalized intersection data, traffic volumes, crosswalks, speed limits, streetlight poles, school flashers, street signs, truck route related information on the Internet mapping website.


**Project Milestones**
The duration of the project is 12 months. First 3-4 months will be dedicated to the data elements identification, data sources study, and other data related issues such as conversion, development of new databases etc. Also, current work order management system at Clark County Public Works – Traffic Ops division will be studied. Next 3-4 months deal with developing interfaces to deal with the data issues and the final 3-4 months will be used to demonstrate the product to the county officials, training and deliver the final product.

**Total Budget**
The proposed budget for development of tools for data creation, maintenance and conversion for traffic management for the Clark County Department of Public Works (CCDPW) is $99,115. UNLV- University Transportation Center (UTC) is expected to contribute $20,000 with 0% overhead (indirect costs).

**Project Duration**
Start Date : 2009-02-01
End Date : 2009-12-31

**Student Involvement**
One student will be involved in this project.

**Relationship to Other Project**
None

**Technology Transfer Activities**
None

**Potential Project Benefits**
This project aims at enabling the CCDPW to switch from paper-based data to an automated database system. The project benefit will also include development of interfaces to electronically store the existing CCDPW data related to street signs, streetlights, school flashers, speed-limits, crosswalks etc.

**Project Keywords**
Infrastructure Management, Las Vegas, GIS, Cartograph