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Automating Attribute Data Capture Using COM Objects and Stored Procedures

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An arduous task cities perform is identifying and prioritizing Capitol Improvements programs (CIP). This process takes a significant amount of resources to track project changes. These changes occur to attribute and spatial data. The City of Fort Worth has developed a process that enables departments to input CIPs via the intranet. COM objects then take the spatial information and create geographic features. These features are used to populate the CIP database with additional geographic information including council districts, planning sectors, neighborhood associations, and redevelopment zones. Additionally, an ArcIMS site displays the most current CIPs.
**Background**

Periodically, cities need to overextend their spending capability to acquire necessary equipment, perform timely infrastructure improvements, and provide services. The City of Fort Worth is no different. With over 340 square miles of incorporated area that serves a population of over 540,000 citizens, identifying how to fund and allocate these improvements can be a logistical nightmare.

In recent bond elections, this task has been performed using spreadsheets, static maps, and conducting a multitude of meetings. In order to efficiently acquire, maintain and update information on these capital projects, an information system that covers all aspects of bond interests needed to be created.

One of the major sources of confusion with organizing bond projects is the hierarchy they are grouped by. Using this multi-tiered approach eventually makes it easier for the voter, but can be difficult for city staff to compile. The levels used in the City of Fort Worth Capital Improvement Program (CIP) include:

1. **Proposition** – Largest grouping of projects, Fort Worth is currently considering nine propositions including street & sewer improvements, public events facilities, parks and community services, police, fire, library services, telecommunication projects, facilities, and aviation.

2. **Category** – This is the second level by which projects are grouped. This scope specifies a particular type of improvement. An example would be new community centers. Even though there may be several community centers needed at various locations throughout the city, they are grouped together as a specific category of improvement.

3. **Project** – This is the lowest level and represents a specific improvement task. To continue with our community centers example, this would be a particular community center to be built or improved.

**2004 Capital Improvement Process at Fort Worth**

The CIP program for 2004 began in the Fall of 2002. The schedule is broken down in the figure below. This schedule allows time for the projects to be compiled, several chances for public input, review by the City Manager’s Office (CMO) and the City Council, and to put the program up for election.
<table>
<thead>
<tr>
<th>Staff Formulation Phase:</th>
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<tbody>
<tr>
<td><strong>Mid Sept 2002</strong></td>
<td>Departmental staff submit recommended bond program projects to CMO;</td>
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<td><strong>Nov 2002</strong></td>
<td>Staff presents Council with financial feasibility models for CIP;</td>
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<td>Staff presents <strong>Preliminary 2004 CIP</strong> to City Council for consideration and endorsement to proceed with citizen input;</td>
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<tr>
<th>First Formulation Phase:</th>
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<tr>
<td><strong>Dec 2002 - Feb 2003</strong></td>
<td>Public Hearings are held in each Council district to get feedback from citizens regarding projects to be included in the 2004 CIP (approximately 2 hearings per district and one at-large hearing);</td>
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<td></td>
<td>Staff compiles responses/project needs identified by citizens into report for consideration by Council and endorsement to proceed to City Manager’s Recommendation Phase;</td>
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<tr>
<th>City Manager’s Recommendation Phase:</th>
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<tr>
<td><strong>Feb. - March 2003</strong></td>
<td>Based on citizen input, the City Manager and staff make adjustments in the proposed program to reflect priorities identified;</td>
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<td>CMO presents to City Council: updated financial models for consideration; a recommendation for the 2004 CIP; and also delineates projects not recommended for funding.</td>
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<td>Staff seeks endorsement to proceed to second citizens’ input phase;</td>
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<tr>
<th>Second Citizens’ Input Phase:</th>
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<tr>
<td><strong>April 2003</strong></td>
<td>Public Hearings are held at-large to get feedback from Citizens regarding 2004 CIP recommended by the City Manager;</td>
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<tr>
<td></td>
<td>Staff compiles responses of citizens into report for consideration by Council and endorsement to proceed to Mayor and City Council Adoption Phase;</td>
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### Mayor and City Council Adoption Phase:

**May-July 2003**  
**Special Council Workshops:** Council will review City Manager’s recommendations and make adjustments as deemed appropriate;  
At conclusion of workshops, Council will adopt **final 2004 CIP program** with specified projects and funding level by proposition;  

**End of July 2003**  
City Council adopts an ordinance calling for and ordering an election on the question of the issuance of bonds and endorses proceeding to Public Awareness Phase;  

### Public Awareness Phase:

**Aug. – Oct. 2003**  
Community Informational Meetings: Series of community meetings to provide information on 2004 CIP adopted by Council. These meetings are provided upon request to neighborhood, civic, and community organizations, business associations, etc.;  
Staff prepares CIP Booklet and other literature; establishes Bond Program Hot Line;  
Mayor and Council coordinate with Citizens’ Bond Committee;  

### Election Phase:

**Nov. 4 2003**  
Bond Election: City holds municipal election to submit bond program for voter consideration;  

**Nov. – Dec. 2003**  
If approved, staff develops Implementation Schedules for voter approved projects and submits to City Council for consideration and approval;  
Staff executes financial procedures for funding/accounting arrangements and seeks endorsement to proceed to Implementation Phase;
Implementation Phase:

Jan. - Feb. 2004

Initiation of bond projects for first year of implementation schedule approved by City Council.

Compiling CIP Data

Since the 2004 bond proposal initially contained over 2000 individual projects, a substantial database was developed to handle all the information associated with each item. Information necessary to making informed decisions on projects included:

- The total estimated costs involved with the project.
- The category of each project.
- The location of each project, either it’s specific address or a range of addresses. If at the time of entry the range of addresses was not known but could be defined by intersecting streets, this could be used to create the associated feature.
- The projects funding status.
- Requesting department’s priority ranking.
- Which employee last updated the information and on what date.
- The geographic information overlays.

The database was created by the Applications Division, of the Information Technology Solutions Department in Microsoft SQL Server 2000. Using this database allowed us the ability to use stored procedures to call update programs to automate certain data maintenance tasks. Of particular importance to GIS was the updating of the geographic overlays.

Information needed to be entered by every department for the projects they wanted to put forward for consideration. Since this information needed to be obtained from 24 departments, it was no longer feasible to do this using the traditional method. In past bond elections, the budget office worked with each department to obtain spreadsheets of CIP information. The data was then compiled into the categories and propositions needed to organize this information for the public and the City Council. Any updates and changes to these projects required the department contact to resubmit the information and the budget department staff to manually replace the data in the master list. This required a lot of time, not only entering this information (as projects were constantly changing) but also numerous checks and balances to make sure that all reports reflected the changes.

Not only was it necessary to maintain attribute data, it was essential to maintain the geographic data. Every time a new project was added, changed location, or extent, the geographic information had to be updated. This was not only done for the features representing the location or extent of the project, but for the overlay information as well. It was only feasible to represent all projects by a point feature class on the map even if it covered an area or distance.
This new database allowed the various departments to input data independent of one another, allowing the budget staff to focus on overseeing the input process instead of doing this task themselves. Data integrity measures were also used to make data entry easier and more consistent between departments. Since the reporting structure for the bond program accesses information from the database, reports could be generated with confidence that it was the most accurate and up-to-date information. The data entry forms, project review and update procedures all were provided via a series of secure intranet pages. This provided a thin-client solution to the data entry and maintenance issue, rather than installing new programs on many computers over many departments.

Maintaining Geographic Overlay Information for CIP

One of the key categories of information that decision makers and voters need to know is where projects are located and will it help, benefit, or harm the area. With the implementation of Fort Worth’s Enterprise GIS plan, accessing geographic information has become easier for the decision making process. In addition to the actual location or extent of projects, there were ten layers of information that needed to be identified. These layers included:

- **Neighborhood Associations:** Fort Worth currently has 194 neighborhood associations. These associations are essential entities when planning for Fort Worth’s future and actively sought for their input.
- **Neighborhood Empowerment Zone:** These city-designated areas are part of a state program that helps promote affordable housing and economic development.
- **Commercial Corridors:** These are predominately commercial streets in the city that have experienced economic blight in recent years. In concert with urban villages, plans are being developed to re-energize these districts and improve their economic health.
- **Urban Village:** Urban villages are part of the Commercial Corridors study. These villages are areas of high (re)development potential that can help foster (re)development along blighted commercial streets in Fort Worth.
- **Historic Districts:** This layer includes city designated historic districts as well as state and federal historic districts.
- **Central Business District:** This is the main office and commercial area of the city; typically known as “downtown.”
- **Planning Sectors:** In order to arrange the city to help the comprehensive planning process, planning sectors were created to identify areas that are not only geographically common but have similar planning issues.
- **Council Districts:** The city is separated into eight council districts for citizen representation.
- **Mixed-Use Growth Centers:** These are areas identified in the Comprehensive Plan as places that are good candidates for mixed-use development. This type of development is a useful and often desired way of increasing density and creating an active urban community.
Central City Boundary: The central city boundary is an area that is typically known as the inner or older areas of the city. A great deal of effort in the past decade has been focused on redeveloping this area.

In past bond elections only a point on a map represented each bond project. This was because the ability to find and determine linear features, such as address ranges or length of pipe, was time consuming to create and upkeep with the numerous changes. In the past several years, the city has made significant steps toward improving its GIS capabilities. One of these improvements was implementing ESRI’s Satial Data Engine. This allowed the creation of a street network where features could be extracted based on address ranges.

Another improvement since past bond elections was the use of ArcGIS 8.x. In using this as the city’s GIS program it provided access to the ArcObjects object library. Using Microsoft Visual Basic 6, a COM object was created to automatically accomplish several tasks all behind the scenes:

1. Receive information from a newly entered or updated record.
2. Use the address or address range information to find the location or extent of a project.
3. Create features (either points for single address locations or line segments for distance features) for each project and save in appropriate feature classes in SDE.
4. Overlay these features with the ten overlay feature classes that the Council and City Manager’s Office wanted to identify.
5. Write the proper overlay information for each project back to the bond database.

Accomplishing automation through the COM object

The application that updates geographic information in the database whenever a record was added or updated sits on the same server as SDE. The database, through a stored procedure, passes necessary location information and starts the application. The application must first make a connection to SDE to access the street network feature class. Using the address information passed to it by the stored procedure, the application determines the location or distance a project occupies.

Once this location is determined a feature representing the projects location is added to the appropriate feature class in SDE along with the project identification number. This new feature is then overlayed with the ten layers of interest to determine which layers a project is intersecting. Since some linear projects can intersect multiple boundaries of the same layer (example: a road improvement can start in one council district and end in another) the application must be able to account for multiple features on each layer. Once this information is acquired it is written back through a stored procedure that the application calls each time it identifies a geographic coincidence.
Displaying CIP Information Geographically

An integral part of the CIP process is for departments and citizens to be able to review the projects visually. To accomplish this task an ArcIMS site was created to allow many interested parties to view and acquire information about each project. The IMS site used a modified ASP viewer that provided basic GIS tools, such as: zoom in, zoom out, pan, identify, and geocode functionality.

The IMS site also allowed Council members and citizens the ability to overlay certain layers of information that might be of interest. These layers included neighborhood associations, council districts, orthophotography, and streets.

A simple filter tool was also created to limit what propositions could be viewed. Users were provided with a drop-menu listing the nine propositions and allowing them to pick one and see only those features on the map. Conversely, they could then choose to view all propositions. This tool proved useful for users who were interested in only parks projects or street improvements, etc.
Lessons Learned

Since this was the first application that the city attempted to use a procedure to automate the update of geographic information, there were several lessons learned that help in future applications.

- **Referencing overlay information** – In an attempt to create the most efficient database for this application, a lookup table was created for the overlay feature classes. This table contained the object identifier, feature class, and the boundary name. However, since these layers are dynamic it caused errors when they were changed by responsible departments. One remedy to this issue was to update this lookup table. A better alternative could be to create this table from a multi-versioned view using the tables from the overlay feature classes.

- **Mirroring information** - The project information used in the CIP process is also used in the City’s comprehensive plan. Originally, it was thought that this would be a great marriage of applications to reduce resources. However, it caused several issues with data being changed and affecting both applications. To solve this issue a series of locks were created to allow updates to information only at specified times and by certain staff.

- **Mismatched locations** – Depending on how an address was input, the geocoding procedure in the COM object sometimes placed the address on the wrong section of a street. An example would be if the user did not specify that an address should be on North Main Street it might put the address on South Main Street. To limit these input errors an address verification tool was created in the ASP data input page to determine if an address number and street were correct.

- **Updated streets feature class** – Having the most accurate data in the streets feature class is essential to identifying project locations. If an improvement referenced an address that had not been placed in the streets feature class, it would not find a match. This required that any new address information we received had to be put into SDE right away.

- **Staff Training** – Since the CIP process takes over a year and a half to complete, staff responsible for data maintenance experienced some turnover. With new staff responsible for this upkeep, it became very important to make sure that the departments properly trained new employees on this system.

Although there were some setbacks and pitfalls identified through this process it has proven valuable to subsequent projects. Many of the techniques used in creating the application; linking it with IMS, SQL Server, the intranet, and SDE have been implemented in other applications.