Mapping Capital Improvement Program Projects
and Making an IMMPACT at the City of Austin

Abstract

The CIP feature class is a cross-departmental solution for mapping Capital Improvement Program (CIP) projects at the City of Austin. An FME workbench is used to append several departmental feature classes together as one polygon feature class; create a one-project to one-feature relationship; and connect to the project management database for information used to coordinate CIP projects. This feature class is the first successful City-wide effort to map CIP projects, and does so while allowing departments to track information independently, applying mapping standards, and obtaining source information from project managers.

The CIP feature class is available to GIS and non-GIS users alike, and is a main source for the City's new web mapping application, IMMPACT (Infrastructure Management, Mapping, Planning And Coordination Tool). IMMPACT allows users to identify and resolve conflicts between CIP projects, permitted activities, and planned special events. Additionally, users can set up individual queries for projects, or navigate by using a map.

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Biography: A recent fan and student of the world of GIS, Charles Purma has worked for the City of Austin's central IT organization for nearly ten years. He primarily manages web and software development initiatives, with the most recent being a tool for the public to locate and learn about bond-funded capital improvement projects. He also supervises a small team focused on collaboration, agile project management, and innovation services. Originally from small-town Kansas, he now lives in the growing big city of Austin, Texas with his wife and two children.

<u>Background</u>

The Capital Improvement Program (CIP) is a multiyear plan of capital projects that provide benefits to citizens such as replacement[1] of public facilities and infrastructure, purchasing equipment, acquisition of new facilities or land to accommodate future growth. These capital projects (also known as CIP projects) are funded by bonds (debt), grants, cash, transfers from departmental operating budgets, interagency agreements, developer contributions and fees, donations, sale proceeds (including utility rates and user fees), and interest earnings on investments (City of Austin: http://austintexas.gov/department/capital-planning/faq#dept_page_blocks-panel_pane_25-6). CIP projects may include construction and renovation of recreation centers and libraries, acquisition of parkland, repaving of streets, replacement of water and wastewater lines, provision of power for residents and the purchase of new fleet vehicles and IT networks. These projects vary in scope and costs, and can include both short-term and long-term efforts. On average, there are approximately 500 active CIP projects sponsored by the City of Austin at any given point during the year (City of Austin: http://austintexas.gov/department/capital-planning).

At the City of Austin, Project Managers from various departments are required to store information about their assigned CIP projects in a Capital Project Reporting and Information System, known as eCAPRIS, and then update that information on a monthly basis. While eCAPRIS contains a large amount of project-specific information, its current configuration does not allow for a spatial component of the CIP projects. After many years of rudimentary and "word-of-mouth" coordination efforts, a need was identified to add a spatial component to CIP projects in order to support an inter-departmental coordinated Asset Management strategy and create 'dig-once opportunities'.

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[1] The City of Austin funds repairs of facilities and infrastructure through a Maintenance & Operations Budget, which is funded by various infrastructure user fees collected through utility bills.

An Evolutionary Process

Prior to the creation of the CIP feature class, a single corporate-level effort was made to digitize the project locations. This effort automatically generated the locations based on project location information, but this was a one-time effort and was missing a long-term strategy for maintaining the geographic project features. As time progressed, CIP projects represented by features were completed and/or closed, and new CIP projects were created without spatial features.

A few years after that effort, the Public Works Department hired one centralized GIS person to assist with coordination efforts of CIP projects. This centralized resource was tasked on a monthly basis with producing presentation maps of CIP projects currently in construction within the downtown limits. After a few of these requests, it was realized that not only was copying the data from eCAPRIS to GIS attribute tables was too much data entry management, but that effort was also removing the responsibility of CIP project information management from the Project Managers and placing that responsibility on the GIS editor. With this in mind, the CIP project attributes were examined against key pieces of information needed for coordination purposes. The centralized GIS person worked with other City staff to create an Access database that would copy the key coordination information from the eCAPRIS database on command. A new process was established where the Project Managers would contact the Public Works' centralized GIS staff and provide the approximate limits of construction for their project as well as the project's unique identifier (the "Sub-Project ID"). After digitizing project features, the GIS person would then manually join the key coordination information with the GIS features based on the sub-project ID and make the feature class of CIP projects available for GIS users and applications on a monthly basis.

It was soon recognized that the four main departments that provide infrastructure services to the City of Austin (Austin Water Utility, Parks & Recreation Department, Public Works Department, and Watershed Protection Department) were duplicating project mapping efforts separately, which led to an opportunity to combine mapping efforts. A team of CIP and GIS coordinators

from each participating department worked together to identify process improvements. The existing process was updated to include all four departments. In order to accomplish this, the departmental feature classes representing CIP projects were appended into a centralized line feature class and also a centralized polygon feature class (depending on the original features' geometries) on a monthly basis. These features were then joined to the Access table of eCAPRIS information. Appending multiple feature classes together into separate line and polygon feature classes, and then joining those feature classes to the eCAPRIS project information proved to be too tedious of a task and an automated process was needed. About the same time, the City of Austin purchased licenses for data conversion software called FME, or Feature Manipulation Engine. All of the participating departmental GIS and CIP coordinators worked together to see if FME could provide an automated solution for creating one centralized CIP feature class.

With the goal of automating a single centralized CIP feature class, the GIS and CIP departmental coordinators worked together to establish a consensus on the design and process for creating the CIP feature class (Appendix A: The CIP Feature Class Mapping Procedures). It was agreed to maintain project features as approximate limits of construction so that the GIS coordinators did not become responsible for project metrics and neither replace nor compete with civil engineering and project management. Furthermore, the scope of a project could change throughout the lifecycle of a project, so it was established that only the approximate limits of construction are needed for project coordination purposes. Both line and polygon feature classes were maintained by the participating departments to represent project features. The line features generally represent linear projects such as roadway, water/wastewater main, storm drain, bicycle facilities, and sidewalks/trails; whereas the polygon features generally represented area projects such as facility and parkland improvements. In order to have one centralized CIP feature class, it was decided that the feature class needed to have polygon geometries. Additionally, the identified key coordination information from eCAPRIS needed to be updated on a nightly basis using FME so that if project information was changed in the source database, those changes

would be seen in GIS by the next calendar day. Finally, it was decided to use the eCAPRIS project type field to determine the symbology of the CIP projects in maps. Over 100 different types were identified in the project type domain, so it was decided to use a "look-up table" to assign specific project types from eCAPRIS to more generalized symbologies, also known as the CIP Project Type field. The domain values and symbolization of the CIP Project Type field were adopted from the American Public Works Association (APWA) Uniform Color Code, a national standard (http://www2.apwa.net/documents/About/TechSvcs/One-Call/COLORCC.PDF).

After the processes were established, the FME workbench was designed (Appendix B: The FME Workbench Design). First, the departmental contributing feature classes are queried for data and attribute fields are mapped, including audit fields that track the feature class source and feature loaded date. Then, a tabular view of eCAPRIS project information is queried and is merged with the GIS project features. After this join, point and line features are buffered by 20 feet to create polygon features and represent a 40 foot right-of-way. After the features are converted into polygons, several 'clean-up' transformers are used to remove unneeded attributes, removes attributes with null or empty values, and ensures coded values match domain values. Also, features are dissolved on the Sub-Project ID in order to create a 1-feature to 1-project relationship. Then, change detection transformers are used to compare the incoming features against the existing features and determine whether insert new features, update existing features by geometry and/or attributes, or delete existing features if those features no longer exist in the source feature classes. Finally, the FME audit fields are populated so that end users know when features were added or updated and can identify the contributing source feature class for GIS features. Deliverables of this process include the CIP feature class, a sequence table for maintaining the primary key on insertions, and two log files of both the GIS source features missing Sub-Project IDs and the GIS source features Sub-Project IDs not matching eCAPRIS data.

<u>Applications</u>

A subset of the CIP feature class is available to all GIS users and is also available to non-GIS users via an application built by City of Austin staff called IMMPACT (Infrastructure Management, Mapping, Planning And Coordination Tool). IMMPACT is a coordination and reporting application for infrastructure activities including capital improvement projects (CIP), permits, special events, and annual maintenance plans/work orders. Using SQL Server, the CIP feature class and the permitting database are queried for features that have assigned construction dates nightly. Through these queries, IMMPACT provides the end user key coordination information for active infrastructure CIP projects and permits in a geographic and temporal context. This application marks the first time data from the capital planning, right of way, GIS, and infrastructure systems of record have been brought together in one place to allow for deep, meaningful coordination. Several City of Austin departments provide the content and data necessary to strengthen these coordination efforts. Public information specialists provide information to citizens, decision makers leverage the tool to coordinate dig-once-opportunities between CIP projects and permits both within the City and with other agencies, and managers use IMMPACT to resolve conflicts/opportunities for their assigned project, permit, or work order. By increasing dig-once opportunities, IMMPACT not only saves the City of Austin millions of dollars, but also acts as a spider database to bring together information from several disparate databases with GIS foundations.

<u>Learning Opportunities</u>

Over the course time, several learning opportunities arose from creating the CIP feature class. First, it is highly recommended to identify the person(s) responsible for maintaining information and always use the database of record to query that information. In the case of the CIP feature class, the GIS editors remained responsible for maintaining mapping standards while the project managers maintained their project information. Also, when the FME workbench was originally deployed, multiple departments could participate in the same project and thus the same project was digitized by multiple departments. When first examined, it seemed that several CIP projects

were in conflict with each other, but it was actually the same project overlapping itself from each of the contributing source feature classes. Therefore, a dissolve process was added for the Sub-Project ID in order to create a 1-project to 1-feature relationship. Additionally, the departments originally chose the buffer distances for their point and line features, but some features were hard to see on a map due to small buffer sizes. Since the goal of the feature class is just to show approximate limits of construction, it was agreed to standardize the buffer distance so all projects are represented in the same manner in a map. Finally, automating the overall process greatly reduced the time scrubbing the dataset for production.

Future Use

Creating the CIP feature class allows the City of Austin to begin a historic record of project locations. Furthermore, while only those projects with assigned construction dates are used in IMMPACT, plans are in place to create other data sets from the CIP feature class. For example, a data set of active CIP projects without assigned construction dates will be used to create a data set of planned projects in order to increase planned coordination efforts. Also, by adding additional fields from eCAPRIS, new data sets can be created that reflect bond programs and project portfolios. These program and portfolio data sets can be used for reporting to the public on how and where bond funding is spent. Moreover, the FME process used to create the CIP feature class can be applied to assign geospatial information to site plans and subdivision cases in order to capture planned private development.

The project team for the IMMPACT application is currently working on a public-facing component so that citizens can identify and query future, ongoing and completed CIP projects, permits, special events, and work orders in a geographic context. The team is also working on a registration view so that partnering municipalities and agencies can collaborate with the City of Austin on dig-once opportunities. IMMPACT strives to not only create a culture of cooperation between City of Austin departments, but extend that culture to partnering municipalities and agencies while providing information to citizens on how their city is performing.

Appendix A

CIP Projects Feature Class
Mapping Procedures
March 3, 2013

Introduction

A GIS feature class on the SDE GISMAINT1 and GISDM servers, **STRUCTURE.cip_projects** has been created to show generalized limits of construction of COA CIP projects. A Feature Manipulation Engine (FME) service has been set up so that GIS coordinators from various City departments can append their CIP projects into the feature class. The feature class then displays corresponding project information from eCAPRIS, which has been set to refresh the information on a nightly basis. This feature class will be available to both COA GIS users and various GIS-related applications, such as IMMPACT.

Objectives

1. Identify the types of CIP projects that need to be mapped
2. Establish cross-departmental mapping/digitizing standards for CIP projects
3. Create a process for mapping projects
4. Populate the CIP feature class on the GIS SDE servers on a monthly basis

Procedures

1. Identify the types of CIP projects that need to be mapped
    a. All projects in eCAPRIS need to be mapped

2. Cross-departmental mapping standards for CIP projects:
    a. Only one single or multi-part feature represents one sub-project.

    b. Features need to represent generalized limits of construction. Details such as lane closures can be captured in the attribute table.

    c. What is the buffer distance applied to each sub-project type? For all projects, a **20** foot buffer is recommended for visualization purposes in web maps in order to show a 40 foot right-of-way/general limits of construction. Furthermore, using the same buffer distance for all projects assists in aesthetic consistency for projects.

    d. **Symbology** – the *immpact* tool will allow users to have one symbol for all CIP projects, or symbolize projects by CIP project type, which includes: Land, Reclaimed Water, Roadway, Storm Drain, Wastewater, and Water. The CIP project type is determined from a translation table used for the eCAPRIS Sub-Project Type (Appendix A).

    e. **How is the project digitized?**
        i. AWU – assets are assigned a Sub-Project ID
        ii. PARD – sub-projects are drawn in a FC
        iii. PWD – two FCs are on MAINT1 (PW_ADMIN.cip_projects_line and PW_ADMIN.cip_projects_poly)
        iv. WPD – sub-projects are drawn in a FC

3. Create a process for mapping projects
    a. Is the project mapped when it is created in eCAPRIS?
    b. Project hand-off between sponsor and project manager
    c. How do sponsors or PMs check mapped projects? (use *immpact*)

4. Populate the CIP feature class on the GIS SDE servers on a daily basis using the FME service:
    a. Departments currently participating: AWU, PARD, PWD, WPD
    b. Departments to reach out to: AE, EGRSO, PDRD

5. Check the CIP feature class for errors
    a. Duplicate sub-project ids – a dissolve tool is now run to create a 1 sub-project to 1 feature relationship. The updated FC is STRUCTURE.cip_projects_overview
    b. Missing construction dates from eCAPRIS – the project will not appear in *immpact* if it does not have construction dates. Project Managers are responsible for populating the proposed construction dates in eCAPRIS.

6. New Updates:
    a. Facility mapping of multiple projects at one site
        i. Use the lot or parcel boundaries for the affected area
        ii. In IMMPACT, the map tip will say "1 of __" projects
        iii. EX: Davis Water Treatment Plant
    b. PWD will add two new FCs for the FME workbench: bicycle_facilities & sidewalks
    c. New facility types proposed:
        i. Separate Facilities from the Land category
        ii. Separate Bicycle/Pedestrian/Trail projects from Roadway category
        iii. Others?

CIP Mapping Responsibility Table

	Identify types of CIP projects to be mapped	Add the CIP project location to the managing department's GIS feature class	Verify that a project is mapped
CIP Coordinator	R	I	I
GIS Coordinator	I	R	C
Project Manager	I	C	R

R = Responsible party
I = Informed party
C = Consultant

CIP feature class	
Project Type translation table	
Last Updated: 3/29/2012	
eCAPRIS Sub-Project Type	**CIP_PROJECT_TYPE****
current type in the Feature Class	**Generalized Type to Symbolize By**
ADA	Land
Annexed Area	Land
Austin Clean Water Program	Water
Aviation	Land
Bicycle Projects	Roadway
Building Addition	Land
Building Remodel	Land
Building Renovation	Land
Demolition	Land
Drainage Improvements	Storm Drain
Erosion Control	Land
Flood Control	Storm Drain
HVAC	Land
Integrated Watershed	Land
Lift Station	Water
Mechanical, Electrical & Plumbing	Land
New Building	Land
No Project Type	Land
Other	Land
Pedestrian Projects	Roadway
Playscape	Land
Pool Renovations	Land
Pump Station	Water
Rehabilitation	Water
Relocation	Water
Reservoir	Land
Road/Intersection Improvements	Roadway
Road Construction	Roadway
Roofing	Land
SER Reimbursements	Water
SS - Facility Improvements	Land
Sidewalks	Roadway
Street Overlay	Roadway
Street Reconstruction	Roadway
Streetscape	Roadway

Trail Construction	Land
Transmission / Distribution	Water
Treatment Plant	Water
Utility Adjustments	Roadway
Wastewater Collection	Wastewater
Wastewater Interceptor	Wastewater
Water Quality Structure	Water
Water Reclamation Initiative	Reclaimed Water
Waterproofing	Land
(no value entered)	Land

Appendix B

The FME Workbench Design
for the CIP feature class in GIS