Water Data Model Development Within Charlotte-Mecklenburg Utilities

Abstract

Charlotte Mecklenburg Utilities has recently developed its GIS data model for use in support of its GIS Foundation Project. The project involves the creation of a GIS data repository for water and sewer system data across the entire Utility service area. This paper will focus on the experience and lessons learned from using a previously developed data model as starting point to develop the Utility's model.

Background and History

Since 1992, Charlotte-Mecklenburg Utilities (Utilities) has used GIS technology on a limited basis to support basic map production and analysis functions. Unfortunately, CMU has not tapped into the full potential of GIS for a variety of reasons, chief among them being the absence of a comprehensive strategy to water and wastewater data management, resulting in a fragmentation of data that is incompatible with the GIS.

In response to the growing need for comprehensive water and wastewater system data, CMU launched the GIS Foundation Project. The project forms the framework, or foundation, upon which to build a comprehensive data repository from which users can quickly obtain current and reliable system data. The GIS Foundation will open the door to the development of a whole new generation of business tools that will lead to improved customer service, operational efficiency, planning, communications, and encourage proactive asset management allowing CMU to meet the demands of the future.

Project Goal

The project is to deliver a GIS with the data that represents key system components of the water and wastewater system along with the tools to create, store, view and maintain the data from both a report and geographic perspectives. The purpose for the GIS Foundation Project is to provide CMU with two key components of GIS: data and maintenance processes. Recognizing that maintenance of the data is the key to the successful use of GIS, the GIS Foundation Project will provide for the conversion of water and wastewater system data into a GIS format and establish processes for active maintenance. Only after this foundation is in place can the Department begin to realize the full potential of its GIS investment.

To focus the efforts of the project, and to ensure that it meets the expectations of the client, the following goal was developed.

> Establish GIS as a Department asset comprised of water and wastewater system data that is accurate, complete, actively maintained, supported by standards, and accessible as required.

Drivers for a Comprehensive Data Model

As previously mentioned CMU had historically used GIS on a project-by-project basis resulting in data that is fragmented by limited geographic extents, incompleteness of data and inconsistencies in the methodology of storing data. Many projects within CMU involved some type of geographic data collection and analysis. Unfortunately, various consultants or project managers within CMU that only considered the scope of the project at hand managed any GIS data collection. Many of these projects required the type of data, but there was no central database or agreed upon data format to store the data prior to the Waster and Wastewater Data Models. In addition, this project data would rarely be maintained by CMU. If any maintenance would occur it would occasionally create more inconsistencies in the data since the original data collection method or design was not well documented.

CMU needed a Water and Wastewater Data Model that would include the features and attributes needed by CMU staff while creating a mechanism to maintain data integrity for future editing. The creation of the data models would begin with a core group and increase in complexity as users became more familiar with GIS.

Data Model Approach

Due to the fact that CMU is most familiar with our water and wastewater systems than another other agency, it was decided the data model development would be an internal effort managed by the GIS Foundation Project Managers. The challenges to developing comprehensive data models were to ensure they accurately represented all of the key features maintained by CMU, included all possible values for key features and attributes, and correctly modeled connectivity between system components. In order to ensure these challenges were met, input from the users was our most important asset.

The data model development began with a core team comprised of eight CMU staff that are familiar with system components and how they used to deliver services to citizens in the Charlotte region. This core team was asked non-technical, fundamental questions about the information they needed to their daily tasks. Any questions that the core team was not able to reach a agreement on were taken to other subject mater experts for additional input. Their answers to the questions were interpreted and documented as features and attributes that would later be entered into the data models.

While documenting the features and attributes required by the users, the core team was also asked to research and document data sources that can be used to populate those required items. In addition the source documents were used to create coded value or range domains for certain attributes. The availability, format and condition of the source documents assisted with determining if the feature or attribute would be included in the data models.

To further refine the data model business processes required to maintain the features were identified as existing or a future process to be developed. If an exiting process was identified it was reviewed to ensure the proper data is collected and that resources are in place to enter the data into the GIS data. If a new process is needed it will be assigned to a Business Process Reengineering vendor to develop. A business case will be developed to determine if all attributes will remain in the data model prior to data conversion.

Once consensus was reached, all of the features, attributes, domains and connectivity rules were documented and modeled in a Universal Modeling Language (UML). The UML document was created in Visio2000 Enterprise and later imported in to a GeoDatabase using ArcCatalog. With the data model in a GeoDatabase users were able to see the behaviors of the data and get a better idea of how the data can be used.

Conclusion

A key to protecting any investment made in GIS data conversion is to store the data in a comprehensive and accurate GeoDatabase that will ensure data integrity is maintained. Creating this comprehensive GeoDatabase begins with extensive input from users and subject mater experts who know the water and wastewater system best. Next documentation, communication, review and transfer of that input into a data model are steps that must be taken with great care and precision. Resolving data model issues prior to data conversion will always be a great time and cost saver for any GIS data conversion project.

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