Biographical Information

Carey Mann
Vice President of Marketing, Geospatial
Bentley Systems, Inc.

Specific Responsibilities

Carey Mann is Vice President of Marketing, Geospatial, at Bentley Systems, Incorporated.

Past Experience

Previously, Mr. Mann was Vice President, Industry and Product Marketing at Bentley.

Prior to joining Bentley, Mr. Mann was the Chief Operating Officer of HMR Inc., a leading provider of imaging software for mapping and engineering, and executive vice president of Morgan Technologies, an electronic cataloging software vendor for building materials manufacturers.

Educational Information

Mr. Mann holds a Bachelor of Arts degree in history from McGill University, and an MBA from the University of Ottawa.

Professional Memberships

Member of GITA

THE NEXT LEVEL IN INTEGRATED MUNICIPAL ENVIRONMENTS

Carey Mann
Vice President of Business Development, Geospatial
Bentley Systems, Inc.,
685 Stockton Drive, Exton PA 19341

Abstract: Local governments seek the ultimate integrated environment where their departments, other agencies, and the public can access municipal information. The range of Geospatial information spans databases, engineering drawings, spreadsheets, documents, and other information in various forms. Logically, this information is related by the spatial location or area to which it applies. This presentation explores the requirements and workflows associated with managing and distributing the comprehensive set of information desired in an integrated municipal environment.

WHY IS A MANAGED ENVIRONMENT FOR MUNICIPAL PUBLIC WORKS IMPORTANT?

The Record of Constructed Infrastructure

The creation of maps, engineering drawings, architectural drawings, specifications, contracts, and other municipal information predates the fountain pen. Most municipalities and utilities have drawings created before the computer was invented—on paper, Mylar, and cloth.

A project like the New York subway illustrates the enduring value of such information. Built a century ago, the first 21-mile four track route opened in 1904. Many of the drawings and other documents used in the original construction are valid today.

Essential Lifeblood for Ongoing Operations

Today, the New York Transit Authority, the operator of the New York Subway, oversees the most extensive urban transit system in the world. The system is in service around the clock and carries over seven million passengers daily along 25 subway and 234 bus routes. The subway includes 230 miles of routes and over 400 miles of single track. Construction is not finished.

Infrastructure of this magnitude generates thousands of documents and requires collaboration of hundreds of people in dozens of organizations over decades of time. And with each year, the subway is extended, renovated, and maintained. The inventory of drawings grows. And people come and go.

Throughout these cycles of constant change, the subway remains the lifeblood of the city. It is as New York as the Yankees and as Manhattan as the Empire State Building. It is as valuable an asset as the city possesses.

A Volume of Varied Content

The NY Transit Authority has an inventory of over 600,000 drawings. Over 50,000 new drawings are added each year. The content includes vector files, models, scanned drawings, documents, contracts, spreadsheets, information held in databases, and much more. All this content has one thing in common—the information can be related spatially to a point or region of interest, or to an asset within the New York Subway system.

The Transit Authority cannot operate without the context of what it has already built. As it operates the subway, it relies upon the drawings and documents of record. This information is the basis for everything new. And the Transit Authority is just one of many agencies managing the infrastructure of this great city and its surrounding region.

THE NATURE OF MUNICIPAL INFORMATION FLOW

Municipal Workflows

Bringing order to the range of municipal information is no simple matter. The volume of information and the variety of data types are daunting. But effective management of such information is critical to efficient operations.

A traditional GIS architecture that manages data in a database to a rigidly defined schema is an insufficient paradigm to support the full scope of municipal operations. While well suited for attribute centric analysis and reporting, a GIS does not address the workflow and data management issues that span planning, property management, surveying, civil engineering, facilities construction and operation, asset management, citizen inquiry, and other technical and administrative functions.

A municipality manages property, assets, and infrastructure, in the context of delivering a variety of distinct services to its constituents. A typical process can require coordination of many different departments and external stakeholders. The building of a school, for example, may start with planning, eventually move to construction of the facility and required ancillary infrastructure, and end with the operation of the facility and the assets within it; the planning step alone may require maps, surveys, preliminary engineering, and proposed architectural design, all supported by appropriate demographic and impact studies.

A managed environment for local government must therefore support collaborative workflows among all stakeholders involved in the design, construction, and operation our urban infrastructure. A managed environment guides participants through processes, and helps them find the appropriate information at each stage in a process. A managed environment helps participants to find information quickly, share it, and make quick, effective decisions.

KEY CAPABILITIES OF A MUNICIPAL MANAGED ENVIRONMENT FOR INFRASTRUCTURE AND PUBLIC WORKS

A municipality requires many different systems to function effectively. Processes, however, cut across systems boundaries. A solution that manages information about infrastructure – maps, engineering drawings, models, database information, and so forth – must operate across a broader organizational ecosystem. Collaborative use of information about municipal infrastructure can be complex without a solution that manages access, tracks changes, maintains revision history, and allows quick and easy retrieval of appropriate information.

The unfettered use of PCs has weakened controls that have been around for over a century. The sign and seal and the disciplined exchange of paper documents, while manual, was a highly controlled process. A managed environment reinstates such discipline into the digital management of AEC and geospatial content.

The common misconception that the GIS might be the operational system of choice in a municipal environment ignores the nature of other critical systems used in mapping, engineering, public works, and many non-technical tasks essential to municipal workflows. Each of the solutions typically requires proprietary file types or data management implementations. These systems need to interoperate and the workflows across them managed; homogenizing the data is not a practical solution.

A municipal managed environment, therefore, requires five critical core capabilities:

- Integrated mapping and AEC
- Change management
- Intellectual property management
- Information query and retrieval
- Interoperability

Integrated Mapping and AEC

In historical context, maps are symbolic, two dimensional representations. With infrastructure, however, the map is geometry in 3-D for physical infrastructure. It is large scale and highly accurate, and is the setting for engineering, architecture, and other content that occupies the physical urban setting. It is not surprising, then, that mapping professionals, surveyors, engineers, and architects need to work closely and iteratively during the creation and operation of infrastructure.

That we have disjointed solutions to solve different aspects of the problem has more to do with the competing and proprietary technologies than with what is logical or expedient. A municipal managed environment should break down such barriers and encourage collaborative sharing of a common data repository. And it should encourage systematic capture of the as-built record, so that our understanding of the urban setting remains valid over time. The implication of this requirement is one common geometric model for the land base, architecture, roads, utilities, and other infrastructure.

Change Management

Municipal information can only be effectively maintained if it is systematically managed. It is important to determine who can add or change information, and under what circumstances. Knowing who has access to what, and when, is critically important.

A managed environment provides system and content access controls so that desired workflows can be implemented securely and reliably. To maintain the integrity of content, it is important to track who did what and when and provide a comprehensive audit trail of project history.

Intellectual Property Management

Municipal information content is an asset, and is as essential to infrastructure as steel, bricks, and concrete. The system must manage who can do what to the content. It must support digital rights, capabilities that verify the author and seal changes and that bring sign-and-seal discipline back to the digital age

Information Query and Retrieval

A managed environment is of little value unless it enables effective use of municipal content. All content within a municipal managed environment must be indexed and attributed so that content can be easily retrieved through navigation of files, database queries, hyperlinks, and, most intuitively of all, map based spatial navigation. These capabilities must serve diverse needs including the production work of mapping professionals, engineers, and architects, answer routine questions from a variety of municipal employees, support interaction with contractors and other interested stakeholders, and provide answers to inquiries from the public.

Interoperability

No system addresses all needs, no matter how extensive its intent or how broad its capabilities. A municipal managed environment will manage a considerable volume of information, but will be one of several critical systems to the municipal enterprise. Professionals who design and manage infrastructure will require information from other systems as they conduct their work, and they will need to provide the information to other systems that require the information they create. Such exchanges of information should be at the semantic level and as unobtrusive as possible to the workflow; in other words, these exchanges should be managed.

.

A SPATIALLY ENABLED MUNICIAPL MANAGED ENVIRONMENT

Spatially Enabled Municipal Content

At first glance, finding things spatially seems the exclusive province of a GIS. But is it?

By definition, a GIS is self contained and rigidly defined spatial index of assets, and maintained entirely within a relational database. The strength of GIS is in the analytical capabilities that such a paradigm enables.

Municipal workflows are rarely self-contained. Work is conducted by countless collaborating players, typified by perpetual work in progress, involves distinct departmental and specialized systems, and relies heavily upon drawings and models in sequenced, document-based workflows.

In a municipal setting, moreover, the map is not only a navigational construct; it is a highly precise spatial setting, in three dimensions, for the scaled geometry of physical infrastructure. It is large scale to reflect the scope of the infrastructure, yet very accurate at any given point.

To illustrate, the new Wilson drawbridge, to span the Potomac and join Washington D.C. to Virginia, has distinct spans that will be independently constructed. Once in place, the spans must close to within 1/8th of an inch. Outside of this tolerance and the bridge will be inoperable.

A spatial context for municipal content is critical and distinct from a GIS. While each leverages a spatial index, the information that is indexed—and the way that information is used—is very different. A GIS is a record of the current state, while the municipal managed environment needs to maintain the iterations of legal documents of record that have culminated in the current state. A GIS is database centric; a managed environment federates all data types and data stores.

Methods of Defining Spatial Location

Giving spatial context to disparate data types is challenging. Spatially enabling database information is a problem that has largely been solved. But this information is but a fraction of the content that can be related to location, and ironically some of the content is graphic geometry where location is inherently known.

The key to enabling a spatially enabled managed environment is the practical creation of a universal spatial index, an index that incorporates documents and files in the form intended by their originator. With such an index a truly federated view of all information in a spatial context becomes possible.

A “spatial location” is geometry (point, line, or polygon) specified in a coordinate system or some cartographic projection. When a spatial location is associated to a document, the document can be retrieved, based upon spatial attributes, and displayed. Since all infrastructure exists in true geometric space and elevation is critical in engineering and mapping, 3D spatial locations are also indexed.

An ideal solution allows for 1:n relationships between a spatial location and a document or folder. Once a spatial location is assigned to a project folder, all contained documents such as design files or specifications inherit the same location.

Coordinate System Support

Source documents originate from many sources and use different coordinate systems; in fact, projects routinely require the use of source information stored in different coordinate systems.

It would be an undue burden to require that all documents be transformed into the same coordinate system, and therefore a universal coordinate system is highly useful. Each document would be indexed to this universal index; however, the original coordinate system of each document would be preserved.

This implementation enables search of documents across the boundary of different coordinate systems. Searches can then be very fast, even with thousands of documents.

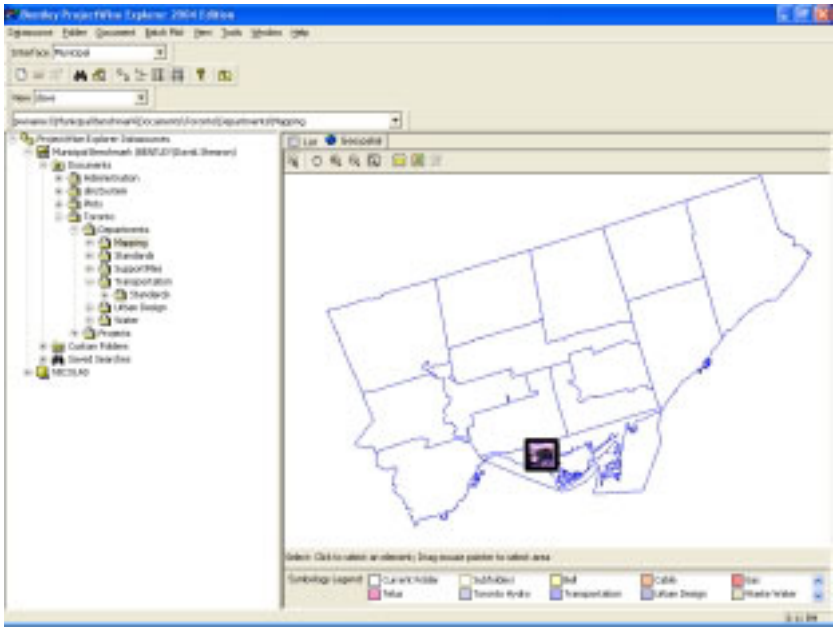
Practical Capture of Spatial Location

It is critically important to capture spatial location as unobtrusively as possible, using a flexible process that minimizes user intervention. For documents with inherent coordinate systems – Design files, GeoTIFF images, shapefiles, etc. - the location can be automatically deduced. For documents that are a-spatial, such as MS Office documents, the document may inherit the location of its folder, the location of any other folder or document; or a user may interactively choose a location.

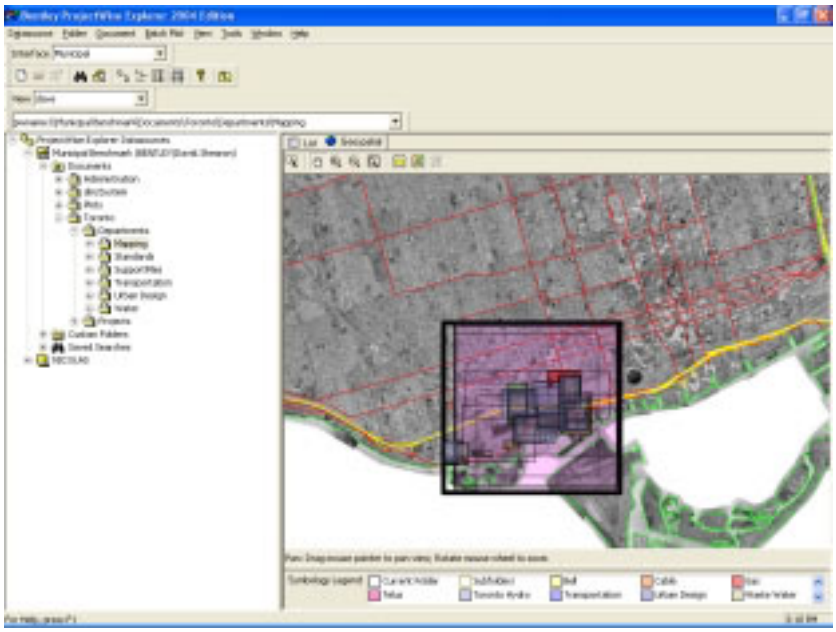
Spatial Navigation and Query

Once spatial locations are registered, documents, or related sets of documents, could be located through intuitive queries. Any mix of spatial and a-spatial attributes could constrain a query, and be used in combination with spatial navigation.

Typically, the user would use readily available spatially related attributes such as address, place name, postal code, area code, or coordinates. Or map navigation could be used to aid in identifying the location of interest. Once the map is zoomed to the appropriate level of detail, a circular, rectangular or polygonal area of interest could be specified and the query submitted.



The result could then be displayed in a list, or graphically on a map:



Dynamic Environment

At display time, maps and drawings of vector, raster or hybrid format would be re-projected and accurately superimposed upon each other, automatically, no matter the originating coordinate system. Files could be displayed with centroid placed icons, or by their physical geometric extent.

THE BENEFITS OF A MUNICIPAL MANAGED ENVIRONMENT

A managed environment provides immediate access to municipal content. It makes intuitive and instantaneous what seems now problematic, complex, and time consuming.

If a tunnel were to collapse, think of the information that must come together to properly address the situation. Location and access routes are key. Traffic will need rerouting, and security requirements will need to be quickly determined.

The information to support such work will need to be accessed by dozens of coordinating agencies and contracting firms: maps; hydrology and engineering of the related water systems; structural drawings of the tunnel; schematics of electrical systems; designs of surrounding highway systems; and much more.

Such immediate access to information is a critical requirement for the rapid response required in emergencies. But, it is an equally important to removing impediments to workflows in everyday work. Most every municipality, after all, conducts dozens of small and large projects at any one time.

Access to the right information at the right time can streamline interrelated processes, save time, reduce costs, and considerably increase the efficiency of all participants.

While the focus of this paper was on the spatial organization and navigation of municipal content, the managed environment has many other tangible advantages. It unifies workflows that span all relevant geospatial, engineering, and architectural disciplines. It brings collaborative workflow and defined structure to streamline complex processes. And it brings a secure environment to protect and manage information important to extend and maintain critical infrastructure over its lifecycle.