

BIOGRAPHICAL INFORMATION

Brian D. Birk
Senior Manager
Accenture

Specific Responsibilities

Mr. Birk joined Accenture in 2005. He is responsible for the delivery of utility asset management business solution architecture, data architecture, systems integration and process improvement consulting in the Accenture Solutions for Networked Assets (ASNA) practice. Mr. Birk is currently a consulting lead in the High Performance Asset Management group with an emphasis on integrated business solutions for electric, gas and water utilities using spatial technologies. He is a member of Accenture's Seattle community and resides in Vancouver, WA.

Past Experience

Prior to joining Accenture, Mr. Birk had nearly twenty years of experience ranging from early career work in manufactured materials systems and supply chain management with General Motors Truck Group and the former Delco Electronics. Work in utilities began with supply chain and energy delivery operations with IES Utilities, now part of Alliant Energy, while working for EDS. Mr. Birk joined the consulting ranks to work specifically with utility and municipal clients in the areas of asset management, operations, capital program management, and system integration. Prior to Accenture, Mr. Birk held the positions of Solutions Architect with Convergent Group/SchlumbergerSema and Senior Consultant with MWH. He has worked with many clients during his career to provide solution definition, delivery and business improvement using spatial, engineering, capital program management and operations applications as part of integration projects for electric, gas, water, wastewater and public works utilities and municipal entities. Mr. Birk also has experience working with graphical design, work management, outage, and system planning applications for electric and gas utilities.

Educational Information

Bachelor of Science - Computer Information Systems, Clemson University

Professional Memberships

GITA

BIOGRAPHICAL INFORMATION

Jeffery T. Hanna
Senior Manager
Accenture

Specific Responsibilities

Mr. Hanna joined Accenture in 2005. He is responsible for the design and delivery of integrated utility asset management solutions for the High Performance Asset Management group of the company's Accenture Solutions for Networked Assets (ASNA) practice. He is currently focused on asset management and geographical information systems integration for gas and electric T&D organizations. His expertise spans many technologies with strength in technical solution architecture, application and integration design and development, and business intelligence. Mr. Hanna is a member of Accenture's Vancouver community and resides in White Rock, BC.

Past Experience

Prior to joining Accenture, Mr. Hanna had over twenty years of Information Technology experience ranging from custom solutions development to ERP/EAM packaged implementations in the insurance, airlines, banking, chemicals, transportation and utilities industries. His work in utilities began in 1990 with Westech Information Systems, now part of Accenture's Business Process Outsourcing (BPO) for Utilities organization. During his tenure at Westech, Mr. Hanna helped numerous North American utility and energy clients to design and deploy solutions ranging from financial accounting, work management, customer billing, safety management, asset management and GIS. During this time he also headed up the Business Intelligence practice where he began his focus on the field of asset management and integrated information solutions within the transmission and distribution areas of the utilities industry.

Educational Information

Bachelor of Technology - Computer Systems, British Columbia Institute of Technology

Professional Memberships

International Data Warehouse Association (IDWA)
Institute for Certification of Computer Professionals (ICCP)

Bridging the Gap between Operations, Engineering, Maintenance and Geospatial Systems

Brian D. Birk
Accenture
2211 Elliott Avenue, Suite 300
Seattle, WA 98121

Jeffery T. Hanna
Accenture
401 West Georgia Street
Vancouver, BC V6B5A1

ABSTRACT

Electric and gas utility transmission and distribution networks and systems consist of a complex set of inter-related information generated and used across multiple business areas. As today's utilities embrace an enterprise GIS as the record of source for their as-designed and as-built networks, they are faced with the challenge of providing this information to multiple consuming external applications with varying and sometimes conflicting needs. Methods to use enterprise GIS as both a data source and core application for operations, engineering and planning pose problems with creating and maintaining data separation between as-built and as-operated usage. This paper will discuss the business opportunities, benefits and challenges of bridging a utility's asset operations, maintenance and geospatial systems by focusing on the synergies and differences between the operations and spatial characteristics and requirements for an enterprise asset repository and technical solutions for bridging this gap.

INTRODUCTION

This paper will focus on the business opportunities, benefits and challenges of leveraging geospatial systems to bridge the types of systems used by a utility for operations, maintenance and engineering. As more integration is defined to be built around the enterprise GIS and consuming systems demand more and more levels of data details, the gap between traditional GIS systems -- with their asset contents and operations -- and engineering systems widens. This paper will focus on a typical utility, identifying the synergies and differences between the operational and spatial data requirements for the network models. It will discuss technical solutions for bridging this data gap while retaining the primary design and intent of the enterprise GIS and other systems.

EVOLUTION OF THE ASSET DATA GAP

Historical Perspective of Asset Data in Utilities

Utilities are data intensive businesses by their nature given all of the physical assets that comprise their networks, information needed to operate and maintain the assets, and data needed to drive business decisions and reporting to a variety of agencies. Historically, utilities operated in a departmental or business unit type of structure which set policy, procedures, budgets, asset ownership and personnel alignment. This structure allowed for focus on specific aspects of the utility business, such as electric distribution engineering or pipeline maintenance, in somewhat independent silos. Utilities essentially were businesses within a business and tended to operate

and make decisions independently of each other but served the common good of the overall electric, gas or water utility. Prior to the proliferation of computers and software solutions, these smaller departmental business operations employed specialized people who used data to create information that applied to the business of their department. As computer and software became available and mainstream, the departments adapted these solutions but yet again for their specific business purposes. Over time, common data about utility assets, customers and geography existed in many departments, in many computers and/or tabular systems, but each with unique characteristics or attributes needed to generate departmental business outputs. For example, a single switch in an electric utility existed in the mapping department on a map with an address, pole number and operating number. The same switch existed in the distribution operations department on a wall map with an operating number, an operating position, connected load, circuit and duty rating. Over in the maintenance department the same switch had the manufacturer nameplate data, maintenance history and field history of the asset. Finally, in the distribution engineering department, the switch was in a planning model with connected load, duty rating, operating configuration and current/future seasonal settings.

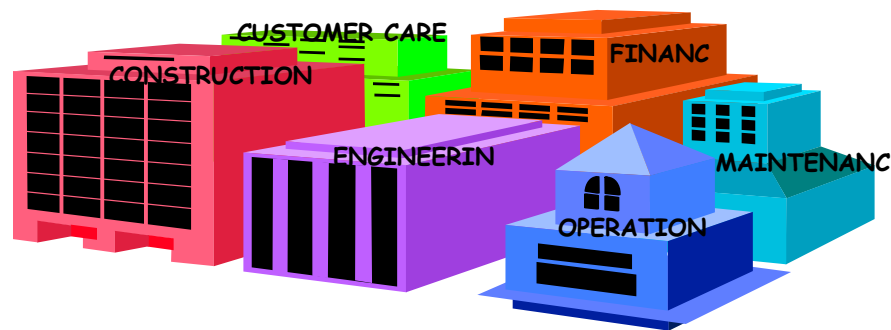


Figure 1 - Independent Departmental Businesses within the Utility

Creation of the Asset Data Gap

From the departmental approach to running the business of the utility came a new focus on optimizing the workforce, organizational “right-sizing,” and leveraging skills across the entire company. In addition new and more comprehensive business systems and Enterprise Resource Planning (ERP) software suites centralized many back office functions of the utility. As GIS came into the mainstream, mapping and CAD converted into the enterprise GIS along with others such as real estate, environmental and land management. However, the engineering, operations and maintenance departments often remained isolated from the enterprise push, primarily due to the nature of their business and the data they needed to function. The result is the asset data gap that now exists between spatial GIS systems and engineering, operations and maintenance systems. Further complications exist with creating and maintaining data separation between as-built and as-operated usage. Specialized engineering data needs, coupled with the need for scenario modeling or viewing history of equipment or locations, are several of the main contributors to the gap, and closing the gap is not solved by a single system.

The following sections will define the asset data gap and discuss an approach to close it.

ASSET DATA REPOSITORIES IN UTILITIES

As stated earlier, utilities are asset-intensive businesses. The evolution to a more centralized business operation while still retaining some departmental control has created numerous asset data sources across the enterprise. In many cases, when dealing with engineering, operations and maintenance groups, the fundamental assets are the same. For instance, the same pipes, pumps, valves, transformers, switches, breakers, fuses and conductor segments may exist in several data repositories, with differences in certain attributes but a lot of redundant information as well. The process of bridging the gap begins with identifying the asset data sources across the business enterprise. It not necessary to determine content validity at this stage, but rather to inventory the data repositories and capture the business purpose of the asset data contained in the system.

The following bullet point lists briefly describe typical types of systems that contain asset data commonly found in utilities with spatial, engineering, operations and maintenance context.

Geographic Information Systems

- System of record for the “as-built” assets in the network/systems
- Supports proposed “as-designed” assets from design applications
- Provides network/system connectivity and relationships between assets
- Contains basic operating and engineering attributes for assets
- Generates labels and annotation based on rules and attributes
- Contains a land base on which assets are placed in geographic context
- Connects customers to the network/systems
- Produces map products, field viewing, navigation and location of assets
- Asset changes driven by construction, permanent operating changes and field updates

Real-time Operations and Outage Management Systems

- System of record for the “as-operated” asset states in the network/systems
- Provides the current network model operating state with abnormal settings
- Support switching operations and restoration steps
- Provides accurate load flow analysis capability
- Source of outage reporting and network/system level reliability and performance
- Analyzes failure points and probable isolation points from outage inputs
- Provides network/system connectivity and schematic views of networks/systems
- Ties in SCADA points to provide real-time pressures, voltages, amperages, etc.
- Asset and state changes driven by network/system operations

Engineering and System Planning Systems

- System of record for “as-operated” and “to-be” assets and states in the network/system
- Provides projected capacity and operating capabilities of the network/system assets
- Ability to support what-if scenario analysis and store short- to long-range system plans
- Models changes driven by forecasted demand, load growth and capacity optimization
- Repository for operational equipment settings and device controller data
- Provides tools to model protection schemes and coordination of protective asset settings
- Asset and state changes driven by engineering inputs based on actual/forecasted events

Field Operations and Maintenance Management Systems

- System of record for “as-built, as-maintained” assets in the network/system
- Incorporates manufacturer nameplate, duty ratings and construction state data
- Tracks history of the assets over their lifecycle, from location to location
- Contains location information in terms of address and hierarchy grouping
- Source of field condition and real world physical behavior data
- Associates costs of maintenance activities to assets
- Supports regulatory compliance and mandated work tracking and reporting
- Source for equipment reliability, asset performance and integrity management data
- Contains asset classifications, maintenance strategies and plans by class or asset usage
- Asset changes driven by construction and maintenance activities

Concept of the Enterprise Asset Data Repository

Given the typical assortment of systems and applications used to manage utility network/system assets, the resulting enterprise view of the assets is fragmented. Multiple data entry points, data manipulation from other sources, loose integration, data redundancy and difficulty ascertaining the source of each record are a few of the resulting problems. Since each system in the mix serves a particular business function, it is not feasible to have one system be the source of record for all others. The design of such a single system, such as the GIS, would incur considerable overhead to keep and manage data not core to the business use of the GIS. The GIS provides an excellent repository for the asset connectivity of the network and can contain many attributes leveraged by other systems. A GIS provides the mechanism to eliminate the need for data redundancy, for geographic references provide the ability to present information in a spatially integrated view (Thomas, 2004). However, the GIS may not be the place to maintain specific engineering characteristics or historical data. Creating an enterprise asset data repository in a logical structure to serve the various consumers, while maintaining single points of ownership, is the fundamental definition of bridging the gap between spatial, engineering, operations and maintenance business systems.

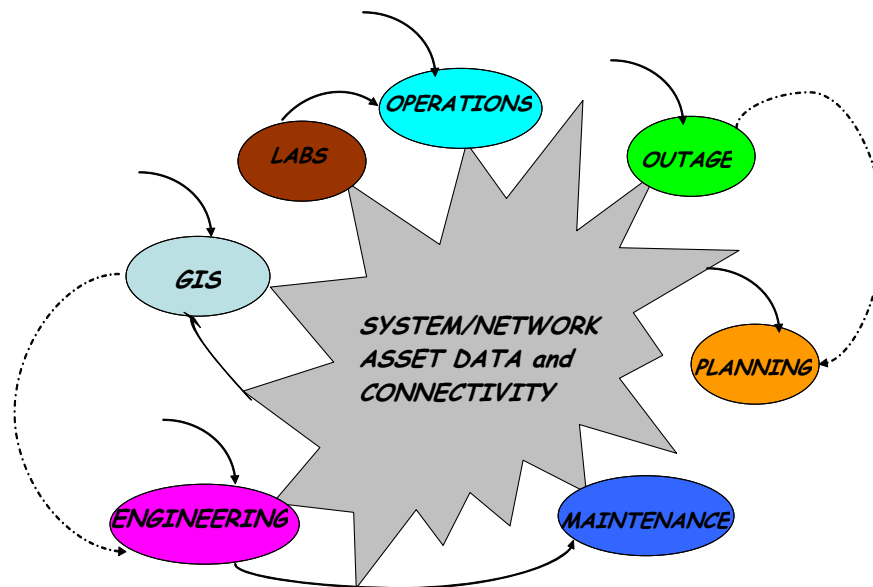


Figure 2 - Asset Data Repositories within the Utility Business

CLOSING THE ASSET DATA GAP

The variety of asset data sources, system functional requirements and departmental needs culminate in a rather complicated enterprise asset view to manage and maintain. There are specific gaps to address in terms of conflicting and redundant data requirements. Some may be at an entity level; others may be at the attribute level. Data content may not necessarily support all of the contexts in which it is to be applied across the various enterprise consumers. To address the gap, specific asset data content, context and functional variations need to be identified.

Reasons for the Asset Data Gap

The types and quantity of asset data sources vary with each utility and the systems used by departments and at the corporate level. However, many sources that comprise the gap seem to exist among utilities in general. A few common reasons for asset data gaps in utilities follow.

- As-built versus as-operated, including device settings and temporary states
- Planned or proposed assets without complete attribution but energized or pressurized
- Historical asset data by asset instance or location
- Functional data requirements in terms of specific attributes used by a system or process
- Connectivity versus hierarchical groupings of assets
- End user-added data for modeling or scenario creation
- Logically correct connectivity rules versus electrically or hydraulically correct rules

Business Value of Closing the Asset Data Gap

Bringing the various asset data requirements into a common repository where ownership can be tracked and redundant entities and attributes can be eliminated creates a strong platform for asset data integration. A complete view of an asset from a data model perspective will be the result of combining unique pieces of data from several sources to build a single asset data definition. Using GIS and other asset systems to build a common repository enables tighter integration of GIS with operations and engineering, leveraging the spatial capability and geographic features such as roads, parcels, addresses and easements. Data redundancy is minimized through creation of a controlled source of asset information. A determined record of source for all asset network/system data entities and attributes is established, whether it is foundational, supplemental or enhanced. A single repository will exist to support departmental and enterprise business processes and support asset data lifecycle management. The data will be available to consuming applications as well as users for query and report creation using metadata. When the spatial, engineering, operations and maintenance asset data gap is closed, a holistic asset network/system data integration solution will be created.

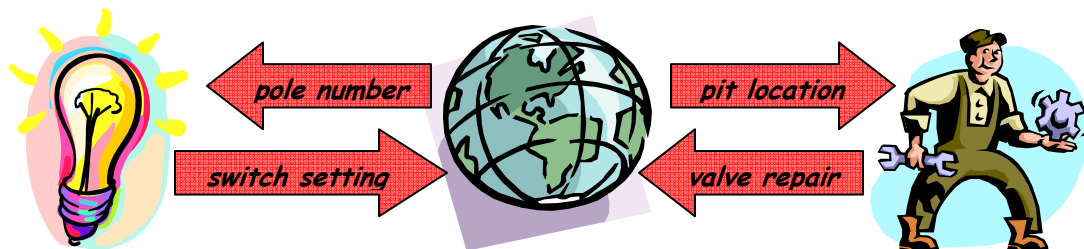


Figure 3 - Closing the Asset Data Gap

KEY CHALLENGES IN CLOSING THE GAP

Designing a Common Data Model from Multiple Systems

Bringing together sources of data across a diverse utility organization will require a project approach and disciplined management to define and make quick, but informed, decisions about data requirements. A sure end to building an enterprise asset data repository will be “analysis paralysis,” where end state decisions can not be reached in a timely manner. Given that utility business has been functioning either centrally or independently for many years, the functions required of each business area should be relatively easy to gather and quantify in terms of general asset data needs. Once the functions are listed, the challenge will be assigning attributes to the functions that use asset data. Attributes do not stand alone but modify or describe an entity. By looking across the functions and primary asset data entities and defining attributes in terms of a list of details the attributes can be categorized and evaluated (*Gause, 1989*). Going through the process of combining and excluding attributes, based on a gap analysis, is an important step in keeping the data model for the asset repository maintainable and not full of useless information. The GIS data model will be a good starting point. The intent is to use the GIS as a source but to not load up the system with information not relevant to the application. Attributes may be determined to be added or removed from the GIS as a result of the asset repository data modeling work; however, that is not the primary intent of the exercise.

Providing Hardware to Support Large Volumes of Data

A shift from local data sources operated on departmental databases or user computers to an enterprise asset data repository requires centralized computing power and data storage. Intermediate databases require good design for building keys and managing indexes for complex searches and joins of tables. The technology on which the asset data repository and its associated physical tables and databases reside must account for data storage, with room for growth that parallels the historical asset growth in the utility. Computing power in terms of processors must take into account the types and numbers of users and methods of integration being used to transact data and manage create, read, update, and delete (CRUD) aspects of the core asset data in the repository. Hardware sizing will be critical in determining performance.

Implementing Organizational Structure for Management and Governance

An often overlooked consideration for moving towards an enterprise approach to managing data is the governance. Bringing together a blend of departmental owners who are used to having control of systems and data into a controlled governance structure can present challenges. The over-arching governance for managing the enterprise asset data repository and databases requires a small committee approach so that all parties have equal input. Decisions to add, change and delete data need to be driven by business need. Cross functional impacts also need to be taken into account. The committee should take into consideration the following when making decisions: what is the source of the data, how will the data be maintained and by whom, what is the business value of the data, and who owns the data along the asset lifecycle? Formal asset data governance across the enterprise crossing organizational boundaries is crucial to keeping the repository content relevant and free from excess data. Inputs from engineering, operations, construction, asset accounting, GIS/mapping records, planning and land management need to be considered when creating and managing an enterprise asset data repository that serves the common good of the utility.

TECHNOLOGY APPROACH FOR THE REPOSITORY

Creating an asset data repository constructed of intermediate databases is an approach that leverages the owning system data without disruptions to the owning application, while also providing an array of data to consuming applications. The asset repository from an end user perspective and technologist's point of view appears seamless. The data is available without being bounded by systems and providing universal data access, but the integrity is maintained by rules and relationships of the owning systems (*Montgomery, 1997*). While intermediate databases in a repository may create copies of asset data, more likely targeted subsets of entities and attributes, they do not create redundancy. A single point ownership still exists within the master system, and the intermediate data is not manipulated but kept as read-only. Data currency requirements will dictate the frequency at which data is made available to the intermediate databases of the asset repository.

Integration Architecture Options

Methods for data integration into and out of the repository need to be based on cost, technology standards and best fit for the volume of data being transported. A few options include:

- Point-to-point and file transfer
- Hub and spoke
- Publish and subscribe and message-based transactions
- Data replication - specific to GIS platform

Repository Technology Enablers

Company IT development platforms and standards generally provide the direction on tools and methods that can be used to create the enterprise data repository and populate intermediate databases. A few common enablers for integration used by IT organizations include:

- Database replication/synchronization
- Data acquisition and enhancement using application specific APIs, custom code or commercial integration productions for an application
- Data access and extraction tool using enterprise standard reporting tools
- EAI/ETL/EII technologies
- Batch file extracts and bulk data loaders

Repository Data Reconfiguration

The intermediate databases and the repository content may require some reconfiguration to make the data open to queries and easier to format for message or file-based integration. Creating tree relationships from spatial references is possible. Several reconfiguration actions may include:

- "Flattening" the spatial system/network model into a de-normalized model
- Adding in customer data relationships by device, segment and location
- Using attributes such as to/from nodes to replicate network traces
- Providing keys in intermediate databases to link to reference source data such as conductor codes, pipe types, regulator flow coefficients and transformer impedances

The asset repository will likely require a combination of technical solutions to create the optimal design and performance. Integration is rarely solved by a "one size fits all" approach.

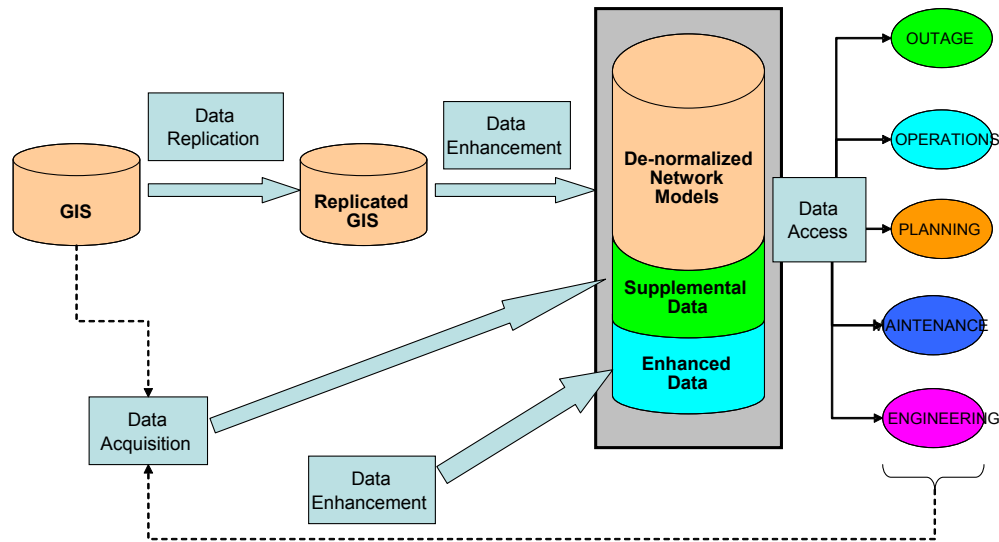


Figure 4 - Asset Data Repository with Intermediate Databases

CONCLUSION

Utilities are data intensive organizations and require large amounts of information about assets that comprise systems and networks. Asset data is fundamental to operating and managing a utility business. Organizational and information system evolution within utilities created multiple consumers and types of asset data needs based on departmental functions or the use of specific computer software systems. The result is many inefficiencies and gaps within a utility enterprise today with regard to the use and sharing of asset data. Technology, together with aligned business governance of data, can greatly improve the quality, usage and value of asset data across all areas of a utility enterprise. The enterprise GIS can serve as a foundational system in the creation of a repository. However, GIS data must be supplemented with additional sources to bring together greater asset data content. Development of an asset data repository comprised of intermediate databases is an approach that will support multiple consumers and types of network data required by utilities of today. By bridging the asset data gap between GIS, operations, engineering and maintenance, the overall utility enterprise will benefit from asset data to make business decisions never before possible with isolated departmental systems.

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