Integration of GIS with Asset Management: Creating a Road Map for Success

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Paper Abstract

Great River Energy, a generation and transmission cooperative based in Elk River, Minnesota, is committed to maintaining their transmission assets in an integrated system utilizing asset management with GIS. A well-defined roadmap for any organization is essential when embarking on a major project like integrating two systems containing data in two unlike data models and expanding it interdepartmentally and into the field. This integrated system is an essential tool for daily operations and business in many areas. Many benefits attained from the project are described including a checks and balances for accurate accounting and maintence, streamlined on-demand data retrieval, minimizing data redundancy, system modeling, enforcing departments to work efficiently with each other, and other future integration. Many successes and pitfalls from the project will be discussed like management support and utilizing existing staff in order to help you create a roadmap for success in your organization.

The Company:

Great River Energy, located in Elk River, Minnesota, is the second largest electric utility in state, based on generating capacity, and the fourth largest generation and transmission (G&T) cooperative in the U.S. in terms of assets. We provide wholesale electric service to 28 distribution cooperatives in Minnesota and Wisconsin. Those member cooperatives distribute electricity to approximately 560,000 homes, businesses, and farms and serve roughly 1.5 million people.

United Services Group (USG) is an engineering consulting department of Great River Energy whose primary clients are electric distribution cooperatives and municipal utilities. USG, founded in 1988, currently serves thirty-two cooperatives and municipals in Minnesota and Wisconsin.

Paper:

United Services Group was tasked with the analysis of Great River Energy's transmission division processes from the perspective of asset information in the summer of 2004 to come up with a plan on how to better manage the asset information. When we look at asset data requirements, the question is, does the Transmission Division have the proper asset information to run its business, how should the information be collected, how should the information be stored, how should the information be retrieved, and how should the information be maintained. A company's assets can create a competitive advantage in earnings. If you are not getting the maximum from its asset base, you are losing a major opportunity. The immediate goal of the asset information project is to begin the development of a corporate roadmap to follow for managing the asset data that used within the Transmission Division. This asset data consists of values such as transmission line electrical characteristics, transmission line structure information, and transmission substation equipment information. This asset data is used to plan, engineer, construct, operate, and maintain the transmission system. Our primary goal in the project is to incorporate the many different views, uses, and needs of asset information and facilitate sharing. The major outcome of the project is process improvement throughout the departments in creating a geographic information system (GIS) centric database for the management of transmission assets and incorporating a unique ID per asset that contains real world coordinate information to ensure the usability across the division. This is used to promote and initiate the sharing of key asset data between departments. Every electric company has assets that can be effectively tracked utilizing GIS. Utilizing this technology can be a key tool to help create a return on investment by facilitating data interaction vs. data creation. In this paper, an outline of a roadmap that can help in setting the groundwork for a corporate asset management project focusing on GIS as the key driver.

When looking at any major project the first road that we traveled is to determine the project problem. Our initial problem was each division in our company had a different definition of what an asset is as well as what the data needs are for that asset. Data was isolated, duplicated, and seldom shared. We held preliminary focus groups with key individuals of each area to investigate and document their views, definition, and use of asset information. There was a wide variation of definitions on what an asset was. Key concerns revolved around how data is used, maintained, historical data tracked, how to share information, and what systems interact with this data. A recurring comment is that everyone is so busy doing their own parts of the process, that they loose sight of sharing data throughout the organization. If they do not see a need in their area for accuracy of data, it is not viewed as a priority.

We found that there is much redundant and conflicting asset information throughout the division. This information is stored in various databases, spreadsheets, paper files, and human memory. Multiple people often keep separate databases and spread sheets because of mistrust and no true central data. The increasing volume of data, the complexity of the transmission system, and the future reporting requirements make this practice very inefficient. Often these areas or silos of disconnected specialized information are not being shared throughout the division often resulting in our departments working and spending many resources to update information that may already be maintained by other areas. Asset data is usually acquired through an export and converted for its need to be utilized by different applications or tools. This often then created a new data silo that met its purpose then modified with no restraint. These silos potentially were shared with other areas with no restraint. Soon the data potentially would come back to the original source for update and have to be entered manually due to no constraints then a new export was requested starting the process over again. We found that the flow of data between areas is as important as the data itself. There was as much bad data as bad processes. The potential savings and return on investment from good data and sharing efficiently are enormous, and have potential of keeping the overall transmission rates down.

In other sharing instances an over expressed need heard throughout all divisions was the need for a unique standard naming convention for the assets. Because of no unique ID, data sharing and data relating was very cumbersome and often avoided. Many times data acquired through

an export and converted for its need had to be manually updated or modified for its data to be used with the desired system. Mainly each area modified the asset name to meet its purpose based on the application used to do their work or personal preference. These changes were usually cosmetic preferences like uppercase, proper, or lowercase character designations. Other changes had to do with space requirements, sorting needs, or data type. Each area relied heavily on its own way of naming an asset and customized tools to follow those designations. The naming convention mainly had to do with its purpose or how the tool or system was designed that stores the data. Typically names of assets transverses throughout the division by varying communications with the value of a meaningful name to represent what the asset is. An example of adding value to an asset name is our transmission line names. The line name was designated from the "from" location to its "to" location by taking the first letter of each facility at the start/end point of the line and prefixing it with the cooperative it runs in. A line that runs from Arbor Lake substation to Elm Creek substation that runs through the Wright Hennepin Cooperative Electric association named the WH-AE line. Soon the way to uniquely identify the line names soon ran out due to upgrades of the lines or facilities and taps that were added between. Other times the name would have to be changed due to some of the member cooperatives merging and forming a new cooperative named differently. These resulting new names were not always consistent, conformal, communicated to, or adopted by all divisions.

Other concerns were areas of missing, inadequate, or incorrect data. A major reason for the data being in an unreliable state is due to the merging of two companies in 1999, and the transition of information and processes. The two companies that merged to form Great River Energy had two different approaches in business processes. United Power Association (UPA) perceived as data rich did most of the work in house and accurately tracked their assets using various tools and storing them electronically in several corporate databases. Corporate Power Association (CPA) perceived as data poor contracted much work out and relied on other to track their asset information. Information retained was in files of paper records. These records updated infrequently and often misfiled or lost. When Great River Energy formed, there was much effort to get all the information stored digitally in one system. This would be the starting place of tracking and maintaining asset information. The initial goal was to find areas of missing data with the attempt to go back and collect as needed. Many different names assets and attributes based on using consultants names for the asset type or are of an outdated non-standard design. Areas struggled with how you attribute the current information, do you use its old non-standard name or use a standard asset replacement name. The current systems, deemed not accurate or reliable due to the information entered, was often very outdated. Questions also arose on how field verification should be completed and how it would affect current field employee's workload. The need to display, find, and gather the areas of missing information for system verification helped to push the need for a GIS display.

In addition to looking at our current ways of tracking asset information research and interviews were conducted with other utilities about asset management in their organizations, including methodologies, tools, and lessons they had learned. We also met with several vendors who gave us varying options centric to the tool they are selling with the promise that they can integrate with any current systems. What we ultimately learned was that there were as many ways to approach asset information as companies we called.

In conclusion, of holding the focus groups, basic recommendations and process were outlined. First for any project to be successful there needs to one person within the Transmission division who is charged with the responsibility and authority to implement the overall business strategy of asset information, leading to asset management. A centralized Information model needs to be adopted and adhered to for the projects success. Change the processes that hinder the flow of data between departments and establish new processes to efficiently streamline the data without need for conversion. Improve the process for collecting and archival of data. Finally evaluate the staffing levels required for the gathering and maintaining of the asset information

From these meetings to continue on the project route we first needed to identify the project teams that would be needed to accomplish project. The first project team needed was a senior transmission management team. The members would be vital in giving or supporting key decisions throughout the project, grant monies and resources, assign responsibility to carry out the project and ultimately make the tough yes/no dissensions. These senior departmental managers help to ensure that the project has priority and gives the authority of work. Next, the work groups in the various departments picked by the senior managers to carry out the project. These stakeholders need to be knowledgeable of the problem area, enthusiastic in fixing the problem, and have the power to adapt and implement new procedures to facilitate the project. The roles of these people were clearly documented on what was expected, timelines, and effort needed. The various departments with a key stake in the project and unique uses of information were:

Planning - Future system needs and load growth modeling
Land Rights – Acquire and maintain Land Information
Engineering – System Design and surveying
Construction and Maintence – Construct and Repair Transmission Facilities
Field Services – Data acquisition and system monitoring
System Operations – System Control

Once the work/management teams were assembled, further detailed analysis had to be completed to come up with an overall best-fit doable solution. In meeting with key individuals, the overall consciences seemed to center on all asset information used by most contain a real-world location. These areas were called geophysical locations to help members focus on this information. These assets were further defined as being a real-world transmission device owned/operated/maintained/utilized by Great River Energy to serve its customers. It was determined that a GIS system would be a natural application to center asset information around. All other assets were deemed to be attributed or related through a hierarchy data scheme. These attributes or related tables could be maintained outside the application if in a relational database or converted to utilize existing applications due to the specifics of how this information is used as well as the users comfort level of using the current applications to perform their day-to-day work. It is not a desired result to take away any tools currently in place only to facilitate sharing of common data between. To effectively share the asset data and integrate systems, the next stop on the road map is analyzing current systems and modeling the interaction with a central GIS system.

When representing an assets in the GIS it was determined that each asset should conform to standard feature geometry done with points, lines, and polygons. We determined that points should represent all transmission structures and devices that represent a small insignificant area. Lines should represent our transmission routes and communications. We choose to calibrate our transmission lines to easily incorporate route events based on engineering calculations to easily identify points the line transverses like road/lake crossings, PI's and potential future integration of easement locations. Also by calibrating the transmission lines, we have also been able to easily represent conductor types and construction type throughout the line. We use polygons to represent any area of land ownership for our transmission facilities, generation sites, office/maintence facilities, and transmission line corridor right of ways. A network was established to help in feature hierarchy and allow for searching for assets up and down stream. Relationships between assets helped in determining and implementing rules in the network to insure proper construction of the transmission system from generation to consumer meter and all points between. This also helped us in defining reliance between parent and child features.

Once the geometry model was determined, we determined the necessary attribute information per asset. We determined that all data deemed an asset must have a Geo-Physical Unique ID for the GIS. Attribute data that is stored and maintained by the GIS is of use to most areas, descriptive to that asset, change infrequently, and has a true geo-physical unique ID. All other applications whose data relates to the GIS data must utilize the unique ID. This unique ID must not have any smart number characteristic and must be assigned to that asset for the life of the

asset and potentially maintained for historical purposes. The unique ID was defined as a random numeric number that would never be duplicated or changed to a potentially meaningful of sort able value. Because of the ease to remember the smart numbering system and the reliance of these names physically located on equipment, user fields were included to help ease in searching and recognition. The use for information stored in the GIS data are primarily used for finding basic information on the asset, search/locating feature, locating based on proximity, and tracking changes through history. Output from the GIS helps users in the field get the necessary information by utilizing detail paper map books, PDF map books, ArcReader, with eventual ArcIMS and ArcPad applications.

To ensure transitions of current data, diagramming of all asset data was performed on the unique databases, spreadsheets, and lists that needed to be incorporated. Relationships between data that was to be stored and tracked in the central GIS and the data maintained form various other systems had to be determined to ensure its workability and use. These relationships and cardinality rules to the central database were designed and documented. Test data sets were created based on exports from these other systems to ensure data relationships and to construct the overall GIS data model. Departmental reliance on data and the overall flow of data between and the processes needed to share was also documented. Various existing disconnects between departments were discovered and many new solutions proposed.

From the working group the overall roadmap was designed and documented. This roadmap consists of an overall business practice of a continual circle of planning, engineering, construction, operating, and maintaining. All functions feed information back to planning and loop through all departments. It is essential to share data throughout the circle easily, timely, and efficiently. Departments will continue to use the tools they have in place to do their day-to-day work. The head of transmission will enforce the adhering to the constraints of the data model and hold the areas responsible to only maintain the data they are required to with emphasis on accuracy and completeness. By spatially enabling data in a central relational database all business functions can easily view and adapt the restraints of the designed new unique ID. All areas in one way or another use the core geo-physical locator as a base for their applications to effectively share data by its utilization. Focused departmental utilization of their roles and responsibilities in relation to asset information was also discussed in detail focusing on efficiencies, cooperation, and trust. Following this paper highlights the department's use of the central GIS centric database as well as its utilization of GIS tools and outputs.

The Planning department previously utilized data in spreadsheets to help in modeling their system and proposing new facilities. Data would typically come from a combination of engineering and field services to populate their modeling software. Their biggest disconnect was the lack of communicating that new facilities or lines being energized. By utilizing the central GIS, they can efficiently link to the data thy need and more efficiently populate their planning software to have current data. The planning department utilizes ArcGIS and through cooperation with nearby electric transmission companies, incorporates their major transmission lines and facilities to get and overall complete transmission system map. With a complete system map, loading data, and future growth data, planning can design system additions and improvements, as well as get public/government approval for projects.

The Land Rights department utilizes planed system enhancements to determine and acquire land and easements. GIS helps in specific route determinations based on environmental constraints and existing infrastructure. Maps produced and representative asset photos help educate affected landowners to what is being constructed. Due to the need to know easement information, permits, and restrictions before entering or building on land, land information will be assessable by searching in the GIS to get the required easements.

The Engineering department determines the overall system design and specific asset type per location. They survey/GPS new and modified facility locations for incorporation into their design

modeling system software and updates GIS with the true asset location and parent child relationship. In facility and line creation, they produce the staking inventories and design for construction. Data collected is updated in GIS for all geo-physical locations and essential attribute information and is entered at the time of energization. Attribute information about these locations are housed in the asset management system and related to the GIS.

The Construction and Maintence department works closely with the engineering department and provides the final as-built information for the assets and GPS locations of any changes. Provide system asset changes due to emergencies where the system changes. They utilize the map books produced to do there day-to-day activities which include line patrol and in field system verification.

The Field Services are responsible for maintaining asset information related to the geo-physical location of all facilities and equipment. They perform the major field verification of facilities and line patrol utilizing produced map books, Arc Reader and ArcPad. In addition, they acquire metering, SCADA, and operational data for the assets and are key into entering the data into the asset management system.

The System Operations department utilizes and continues to initiate the main user field for naming assets and describing their location and use for easy interoperation in the field. They utilize the GIS system for dispatching and locating crews, and general system control. They plan to utilize ArcSchematics in the near future to create new seamless ties to replace their existing schematic system drawings maintained by cad systems with no intelligent data. They see the benefit of seeing both views simultaneously to help them more efficiently see the state of the system as well as get the useful attribute information. They also want to get away from updating the various drawings they use. They also utilize the analysis capabilities of ArcGIS with weather data to help in system control, forecasting, and system enhancements do to lightning strike analysis.

Project implementation has started in the beginning of 2005 and is continuing today. Tools and procedures are beginning to be implemented and adopted as personal begins to be trained on the effectiveness and the need for the solution and sharing of asset information throughout the division. The central GIS database has been transformed and remodeled to accept and maintain the unique ID. Procedures to maintain the core central geodatabase are in place in getting new and updated information quickly entered at the time of facility energization. Some of the major gaps in communication and data migration have been solved and areas are more effectively sharing and working together.

Major perceived project benefits include keeping many existing tools that areas rely on only changing some data structure. GIS has a solid need for data maintence and helps to add the power of analysis to non-GIS savvy departments to ensure an accurate system. Tools and applications used by each area can efficiently be used and related through common relational data maintained in GIS. GIS gives a good easy to interoperate graphical representation of the asset and the relationship to the system. A central database helps to reducing data redundancy and helps insure that all assets and key attributes are correct. It allows each area to build relational data to the central database with little to no impact on existing data. It also becomes a central place to verify data through checks and balances with various departments running query's against the GIS data compared to the data that they are responsible for maintaining. Other benefits include the Increase sharing of common data vs. creating new or duplicating. It helps to focus data collection on essential key data vs. trying to capture all data. Finally, it increased the awareness to refocus practices from working as a department to a business.

Pitfalls to the project include that not all departments buy in to the perceived benefit. They feel they are overworked and only have time to focus on the immediate needs of their job. Each area is busy doing their work that they can easily lose focus of the circle. Other times there is a low level of trust and communication barriers between areas. Other times highly accurate information

is not needed for their area they are less likely to contribute to the process even though other areas may be very dependent on this information. Data returned from the field not always accurate or complete. Modifications to the system due to emergencies are not always communicated for update. Another pitfall is the use of many outside contractors for construction and maintence in which data is not properly tracked or entered.

In conclusion, asset information is vital data used throughout the company. There is many applications and areas that utilize this data on a daily bases where sharing is essential to ensure our transmission system is reliable now and into the future. By looking at how Geography and GIS can be a central common asset manager helps facilitate information sharing throughout the department. A common intuitive language can be easily understood in its graphical representation by all skill levels throughout the department. By utilizing GIS, all areas can get a better sense of how our system looks, operates, performs, and relates to each other and other foreign assets. GIS helps facilitate the sharing circle of asset information throughout Great River Energy's transmission departments as the central keeper of all geo-physical information. In utilizing GIS and documenting processes and procedures and how each department interact and rely on each other can help you to create a roadmap of success.

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