Enterprise Applications — Using Spatial Business Intelligence to Improve Utility Outage Management

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Outage Management is a critical to any utility organization. The speed and efficiency in which outages are dealt with impacts not only utility performance in the light of the regulators, but customers' perception of how well a utility is performing. Oftentimes, an outage is the only contact a customer has with the organization, apart from receiving the monthly bill. Ensuring a quick and efficient response to any incident is high on every utility's agenda.

An Outage Management System (OMS) is one of the key ways a utility manages events. It provides a number of key functions within an organization to assist in the timely response to events:

- Receives calls from customers, either through integration with the CIS and call center, or through integration to the Interactive Voice Response (IVR) system
- Uses the location of the customers reporting an outage to predict the location of the outage
- Prioritizes outages based on size, duration, and critical customers (e.g., medical facilities) impacted
- Manages the restoration process, keeping track of crews, restoration times and ultimately when the outage is corrected and the customer once again has power

ROLE OF GIS IN OUTAGE MANAGEMENT

As GIS has developed, it has become a critical system in feeding the OMS the data it uses to understand how customers are physically connected to the network, and how each piece of the network is connected to the other pieces. Being the system of record for asset data, network connectivity, and geographic location of critical customers, the GIS has provided the foundation for the OMS to operate efficiently and correctly. Indeed, OMSs have often driven the quality of GIS data to a much higher level than previously achieved, primarily due to the ultimate need to have the distribution feeder network correctly modeled and connected. If a crew was sent to the wrong location in a storm situation, based on bad network connectivity data, the visibility of that data issue is much higher than say a redline on a paper map that had been sent back for edits.

ADDING SPATIAL BUSINESS INTELLIGENCE

As GIS has emerged from the role of specialist application to become a key part of many utility business processes, there are increased opportunities to utilize spatial data above and beyond what has been the traditional norm. Spatial Business Intelligence can provide insight, knowledge and improvement where it previously did not exist. Spatial Business Intelligence can improve the utility's outage management function, and be used as an example for other functions and organizations.

At its base level, a Spatial Business Intelligence solution can be looked at as combining the functions of an Enterprise GIS with those of a Business Intelligence (BI) application. The GIS drives the user interface, and provides the mapping portion of the view, while the BI portion holds the detailed data that will be used, both spatial and non-spatial. This data is often stored in cube structures, allowing for multi-dimensioned models that can be sliced and diced in multiple ways for a user to get at the data in the most preferable manner. By combining the power of both systems, and providing a way to visualize data results from the cube on the map, it provides a powerful application in a number of ways — in essence, the sum is greater than the parts.

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COMMUNICATING THE OUTAGES

A critical factor in any storm situation is the management of information and communication. For a utility there are two distinct groups of people needing up to date information on an ongoing basis – the customers and the employees. Traditional outage management systems, although having certain reporting capabilities, are generally focused at providing the operators the critical information they need to do their job. While this may be acceptable for a minor outage when a distribution transformer blows up, having a significant percentage of customers without power during a major storm is a different matter.

Given that the outage data exists in a spatial manner (by feeder, by operating headquarter, by critical customer address etc), utilizing the web interface of an Enterprise GIS for outage reporting is a logical choice. This approach can provide both customers and employees with a high level view of (for example) the number of customers out per zip code. Since most customers are primarily interested in when their power will be restored, a simple user interface to query the predicted restoration time for their address or zip code could be added.

For employees, more detailed information is often useful. By combining the GIS functions with a BI cube database structure to pull in outage data, users can both see summary level information and also drill down, either by area, outage type, or customer type. Employees are typically only interested in their assigned areas, and can therefore set their view of data at that level, minimizing confusion and lack of focus. Screens can be designed to answer questions, such as:

- Are all of the incidents where a wire is down properly manned?
- Do I have any estimated restoration times in the system that are about to expire?
- How many critical customers are without power, and what are their expected restoration times?
- Do I have crews in the right areas based on the severity of the outages in those areas?

By combining ease of use with the right data at the right time, communication during a critical situation can be drastically improved by Spatial Business Intelligence.

PLANNING FOR OUTAGES

One of the most difficult aspects of outages for a utility is how to plan to deal with them. When a storm blows through the service territory, or ice freezes overhead lines bringing them crashing to the ground, there's no time to take pause and study which plan of action would ultimately lead to the fastest and most cost effective solution. Incidents involving wires on the ground for example are serious safety issues, and the protection of the public and workers are of primary importance. In addition, with such a fast paced environment it's difficult to get new staff members up to speed and operating in a manner that doesn't impact the end results. However, given the importance put on responding to outage events, utilizing the best solution and having adequate staff training are critical to a utility.

One of the advantages of the cube structures used in BI solutions (and therefore also the Spatial Business Intelligence solutions) is the ability to handle the extra dimension — in this case time. All data that has been processed in near real-time to support the outage reporting previously discussed is now stored in the cube, and available for re-use as needed. Whether this is just to confirm outage statistics after the heat of battle, or something more substantial is up to the utility.

One opportunity for using the data is to "replay" an outage as if it was happening live. With all the data from past events being stored, a simple time series view of the data, utilizing dates of a past outage as the query parameters, can provide this view for a utility. Now it's possible to review critical data and decisions —

the number of crews in a particular area, the accuracy of restore times, the peak number of calls in any hour – in a controlled environment. This provides the opportunity for analysis of the performance of the existing systems, processes and decision making in the cold light of day. It's a lot easier to make improvements in this kind of environment than in the middle of a storm.

Training can also be positively impacted by using this approach. Not only can operators get familiar with the data and systems they will be using, but they can "re-live" the 100 year storm that passed through the territory three years ago as a final training exercise, providing confidence in both the employee and employer that they're ready for the real thing if and when it arrives.

MINIMIZING THE OUTAGES

The final area to look at is in the minimizing of outages in the first place. The flexibility of Spatial Business Intelligence allows multiple datasets to be pulled into one environment and then used to make better decisions. An example of this is in the area of capacity planning. Historical outage data is often used to drive capacity planning studies of particular feeders. These capacity planning studies are done typically with a separate application, pulling load and network data in, wire types and sizes etc (fed by the GIS, just as OMS is), and then running complex mathematical and electrical engineering equations on the network to indicate areas which are currently, or could become, overloaded. By pulling this data back into the GIS environment, the load can be visualized on a feeder by feeder basis, or even down to a more granular level.

However, this isn't really unique — this could be done in the core application. What could be much more useful is to combine the load data with external demographic data. If a circuit looks like it might become overloaded in the next year or two, what's critical in the decision making process is whether or not the load on that particular circuit is actually going to increase in the next year or two. Pulling in coverages of projected population growth (or manufacturing growth) and overlaying that with circuits close to maximum capacity would provide an additional level of clarity not currently available.

Another impact could be any Demand Response (DR) programs the utility has in place. These are programs that allow a customer's load to be reduced a certain number of times per year during periods of peak load. An example of this is allowing a utility to raise a customer's target AC temperature by a degree or two during a heat wave. It's probably not enough for the customer to notice the difference, especially for the hour or so it might last, but if the utility gets enough customers to sign up to such a program, it can make the difference between an overloaded circuit and subsequent outages, and a fully functional circuit. Studies have shown that certain demographics respond to these DR programs, so by combining all the previous information and overlaying the additional customer demographic data over the top, further refinements of target circuits can be made. In some instances, capital expenditures could be postponed, providing significant savings for the utility, and ultimately their customers.

IN SUMMARY

Spatial Business Intelligence provides a new paradigm to look at existing business systems and processes, both in the utility industry and beyond. By combining operational, historical, external, spatial and non-spatial datasets, more complete answers to ongoing business questions can be answered with more rigor and confidence, and further process improvements can be made.

Figure 1 shows an example dashboard from Enspiria Solutions' ESIntial tool, displaying an outage summary page, filtered by circuit, charting current customers out, wires down, line techs and broken poles on a circuit basis. The map view shows the circuits thematically mapped, colored by the number of customers out on that circuit.

FIGURE 1. SECURE SMART GRID IMPLEMENTATIONS SAMPLE OUTAGE DASHBOARD WITH THEMATIC CHARTING BY CIRCUIT

Figure 2 shows an example dashboard from Enspiria Solutions' ESIntial tool, showing the customer load by circuit for a particular area. The map view is displaying circuit loads based on a Demand Response event with a 5% participation rate, overlaid with a heat map of customers with Home Area Network (HAN) devices deployed.

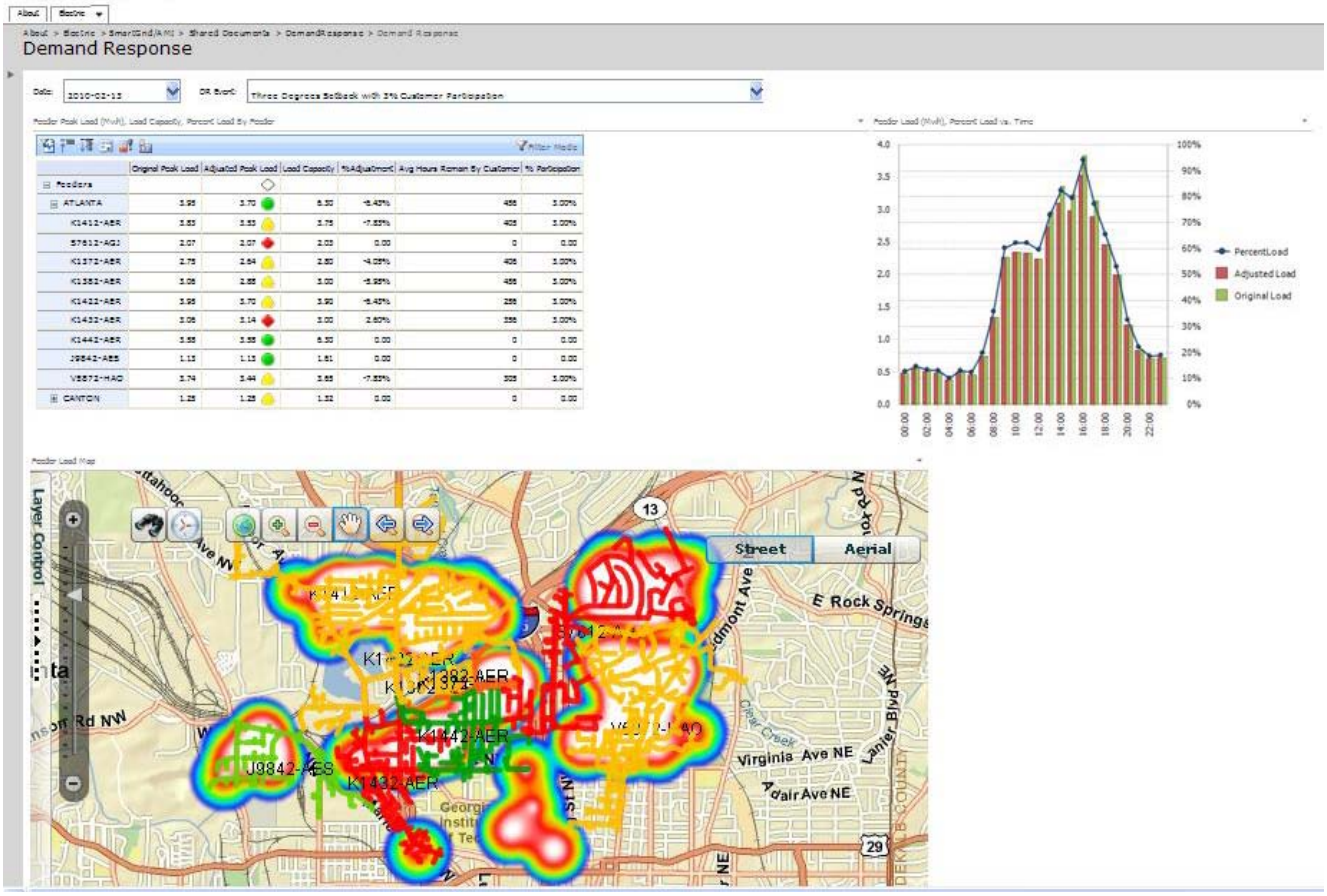

FIGURE 2. SAMPLE DEMAND RESPONSE IMPACT ON CIRCUIT LOAD PAGE

About the author

Aaron Patterson has been involved in architecting, designing, developing and delivering large-scale systems for utility companies around the world for over 15 years. As General Manager of Engineering, he is responsible for managing Enspiria's technical organization and is a member of the executive leadership team of Enspiria. He also provides consulting, systems integration and program management expertise to maximize utility clients' return on investment. Mr. Patterson holds a BS degree in Business Information Technology from the University of Northumbria, United Kingdom.