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GIS Enhances Electric Utility Customer Care

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Introduction

This paper examines how a geographic information system (GIS) can dramatically improve a number of customer care processes. The new customer connect process is an example of how integrated information, both within and outside the utility, significantly improves customer service, shortens cycle time, and reduces costs. Other tasks where spatial data can improve processes are meter reading, including rollout of automated meter reading (AMR) systems; credit and collections; customer analytics; billing; and customer communications. An enterprise GIS fully integrated within the mainstream of utility IT infrastructures helps utilities understand customer behavior and their transactions.

Real-World Scenarios

How Things Could Work

BankWorks of Garden Grove decides that it needs a new drive-up automated teller machine (ATM) in the corner of the recently opened Eastgate Mall in a growing area of the city. It does the necessary architectural and engineering work, obtains the rights from the shopping mall owner, and gets approval from the city to build the ATM. BankWorks would like the ATM operational in six weeks. It hires a general contractor to design and build the ATM. As part of the project, the general contractor hires a small local electrical contractor, Jim, to do all the electrical design and construction.

Jim needs an electrical service for the ATM. He applies for an electrical permit from the city's inspection services department. The city permit office reviews the plans and issues the permit, noting that the contractor must contact the local electric utility to install the service and connect it to the grid. The city's electrical permit Web service publishes the newly issued electrical permit. The city's Web service notifies the utility of the new permit.

Jim calls the utility's toll-free number. The utility call center representative, Frank, asks for the city's electrical permit number. The utility's permitting system validates the permit. Frank initiates the electric service work order. The automated work order system captures data about the general contractor, the electrical contractor, and the ultimate owner (BankWorks) from the city's Web service. Jim supplies some basic electrical demand data and location information to Frank. Jim tells Frank that he needs the service in three weeks so that he will have time to complete all the electrical work to meet the general contractor's six-week construction time frame.

Frank pulls up the data on his online GIS. He does a quick load analysis. Since the GIS is integrated with the customer billing and customer relationship management (CRM) module of the company's enterprise resource planning (ERP) system, the data is current up to the last billing cycle. The GIS design module calculates the total demand on the supply transformer. The results of the analysis show that the demand for the ATM will exceed the transformer's capacity. Therefore, the utility will have to install a larger supply transformer. Frank verifies that the service can be completed in three weeks as requested. Frank calculates a service fee for the connection at $250. Jim pays the fee via credit card and gets the work order confirmation number. Frank publishes the work order confirmation number via a Web service to the city's inspection department. The city sets the electrical inspection at 9:00 a.m. the day after the utility completes the service. Frank reminds Jim that in the future he can do all this work online as long as he has a valid city electrical permit. So next time, he can go online anytime, day or night, to have his request completed.

Frank notes that the GIS shows the closest service point is across the federal highway. He publishes a street opening permit request Web service to the federal highway department. The highway department issues an automated permit to the utility electronically. The federal system immediately posts the permit details to its GIS. The utility's trenching detail from the automated design in the utility's GIS is accessible on the highway department's engineering GIS. The GIS is the primary source of data for the highway department's maintenance system including all repaving projects. The department has plans to repave that section of the roadway as part of the overall improvement of road infrastructure that services the new mall, so it allows the utility to use inexpensive cold patch for its pavement repair after completing the trenching.

The utility's automated work management system (WMS) orders all material for the new transformer and service. It generates a markup request using data from the GIS. The WMS schedules a job site delivery the day the electrical connection work is to begin; creates a meter billing cycle; and assigns the crew based on the human resources module of the ERP system, accounting for vacations, vehicle maintenance schedules, and current scheduled work.

Three weeks later, the crew receives the GIS-based construction work order on their mobile device. The crew supervisor notes that the markup contractor indicated the location of the underground utilities below the street. The crew trenches the street and installs the transformer and the service. The crew reports that it had to install a new handle on the pad-mount cabinet and move the service three feet south. This information was captured on the crew's GIS mobile device as a redline to the work order design. Later that day, the data from the mobile device populates the GIS and the maintenance management system. All as-built data for this project becomes part of the GIS from the mobile device. The crew installs the meter, the city completes its inspection, and the ATM goes into service.

The integrated accounting system adds financial value of the work to the utility's asset database. The GIS shows the new service and upgraded transformer. Plant accounting closes the work order. The customer billing system reflects the new load.

The federal highway department repaves the road on schedule.

The technology in place includes an enterprise GIS with mobile devices integrated with the work management, billing, CRM, financial, and supply chain systems (an ERP). It has Web services to and from the city's inspection system and the federal engineering GIS. The city and federal agencies also have complementary Web services with an automated inspection and permitting processing system. The GIS has design capability integrated with electrical system analysis algorithms and standardized design templates.

How Things Probably Work

What is more common is that the city, federal agencies, and utility do not have technology in place to share information. Lacking the technology and good process design, this is how things probably happen:

The utility has a stand-alone automated mapping/facilities management (AM/FM) mapping system (not a real GIS), a stand-alone work management system, and the same ERP as in the above example. It has a text-based mobile work dispatch system.

Jim contacts the utility with the request for the new connection work order on Tuesday of week 1.

Frank, the utility representative, takes down the information about the new service location and the proposed demand of the ATM. He enters the data into the work management system. Jim requests that the utility complete the service in three weeks. Frank warns Jim that three weeks seems like very short notice. He tells Jim there is no way the utility can guarantee the work will be complete. Frank dutifully enters the requested in-service date in the system, but of course, he has no idea whether it's reasonable.

Jim gets worried. He's got three other jobs lined up after the ATM deal, and he can't afford a delay. He asks, "When will I know when you'll complete the work?"

Frank suggests he call back in a week to check. Frank completes the work order entry form for the ATM but doesn't capture any information about BankWorks or about the general contractor. The only contact information for this work is Jim.

On the next day (Wednesday of week 1), Dorrie, the customer service planner, checks her work queue only to discover that she has 20 new work orders just from yesterday. She begins work on the first one on the list. The ATM project is number 16 in her queue. On Monday of week 2, she gets to the ATM project. She checks the AM/FM system for the existing electrical system information and discovers that the shopping mall information doesn't appear on the system. The work order for the new Eastgate Mall is still in the open status, so she knows that no one has posted the as-built electrical drawings and field notes to the AM/FM system. Phyllis was the planner on that job, so she has to find the Eastgate work order file from Phyllis. The problem is that Phyllis is on vacation and won't be back until next Wednesday. She decides that probably the best thing to do is to put this project aside and begin work on the next work order.

Jim calls promptly on Tuesday morning of week 2, exactly one week after he contacted the utility. A different clerk informs him that the work has been assigned to a designer, but the status is "On hold—waiting for more information." The new clerk suggests that Jim call back in a week and maybe they will have more information. Now Jim is downright distraught.

On Monday of week 3, Jim calls back again. Another clerk tells Jim that the work order status hasn't changed since he last called, but he assures Jim that he will put a rush on the work order. The general contractor now is pressuring Jim for electrical service so the bank can begin testing the ATM software in a week.

On Thursday of week 3, Dorrie gets the work order folder for the Eastgate Mall from Phyllis. Dorrie deciphers the old field notes the crew created for the original installation of supply transformer AC725, the transformer that is nearest to the new ATM. She then calls the billing department to order a billing history for the services connected to transformer AC725 so she can calculate the new demand. Billing is backed up and probably can't get to it for a week or so. She makes a note in the work management system: "ATM project on hold—waiting for billing data."

On Friday of week 3, Dorrie notes that the ATM work order has a rush on it. She also notes that the proposed in-service date has already lapsed. She calls the billing department to put a rush on the usage numbers for transformer AC725. On Tuesday of week 4, Dorrie gets a call from a billing department representative who tells her the expected load on transformer AC725. Dorrie now determines that transformer AC725 is at its limit and no further services can be safely added without an upgrade to the next larger transformer size. She then creates an upgrade order for transformer AC725.

Unfortunately, what Dorrie didn't know was that when the Eastgate Mall was being proposed to the city, the federal highway department decided to reroute Highway 44 along the access road to the mall. She also has no idea the ATM is across a federal highway from the transformer that needs to feed it. And of course, she knows nothing about the highway department's repaving project. So Dorrie failed to order a street opening permit from the state.

On Friday of week 5, the federal highway department completes the new paving job on the highway section across from the new, but not functioning, ATM.

On Monday of week 6, a utility crew replaces AC725 with a new transformer called AC750. An alert distribution construction supervisor notes that he has an order to install a service pipe across Highway 44, but he has no permit in the work order file. He calls Dorrie. An embarrassed Dorrie complains that the mapping department should have updated the plans and how did she know that she needed a state street opening permit? She puts a rush on the highway department to get the permit. It grants the permit on Wednesday of week 9. She notes in the work management system: "Service order design complete—released for construction."

On Wednesday of week 10, the utility crew cuts a trench into the newly paved highway. Several days later, the state informs the utility that it must repave the entire section of roadway.

On Friday of week 11, a utility crew energizes the ATM. The crew completes the field notes on a pad of paper, indicating in sketch form the change in location of the service line. It never got a chance to fix the broken handle. It sends the work order paperwork back to Dorrie for reconciliation.

The utility hires ACE Paving to repave a section of the highway at a cost of $1,400.

In a related event at 6:15 p.m. on Saturday of week 22, a failure in a cable feeding AC750 causes a power failure to a portion of the mall. BankWorks calls to complain that the ATM is out of service. The utility has no record of the ATM's existence, except in Dorrie's work order folder. Since it was unclear to the electrical control center exactly how the ATM was fed, it requests the crew perform field testing to see exactly which transformer feeds the ATM. This delays restoration by two and a half hours, adding about $400 to the cost of the restoration. Five stores in the mall shut down early.

On Monday of week 45, one of the utility company's drafting technicians adds the as-built electrical construction details for the original Eastgate Mall to the AM/FM system, comparing the design sketches with handwritten field notes. She sends the work order details to the accounting department including paper plots that show where the crew added the new equipment. However, the paperwork shows the original transformer AC725, not the upgraded transformer AC750. The accounting clerk manually adds the plant data to the ERP system. Eight weeks later (week 53), the drafting technician posts the upgrade work order for transformer AC750 to the mapping system. The accounting department gets the revised work order. The new service to the ATM appears on the books two months later.

By week 60, BankWorks finally gets a bill for the electricity usage of the new ATM installed more than a year ago. Plant accounting completes the asset information by week 65. By week 70, BankWorks finally gets the ATM consumption data included in summary billing.

This may be an exaggerated example; nevertheless, the costs and customer service impacts of these two workflows is worth comparing:

Metrics	How Things Could Work	How Things Probably Work
Elapsed time	3 weeks	70 weeks
In-service date	3 weeks, on time	11 weeks, 8 weeks late
Time to work order closeout and documentation completion	3 weeks	70 weeks
Call center costs—work order group	10 minutes—$5	40 minutes—$20
Engineering review	30 minutes—$20	12 hours—$480
Billing department		2 hours of research—$40
Mapping department	10 minutes—$5	2 hours—$40
Plant accounting processing		2 hours—$40
Billing call center to resolve summary billing issue		20 minutes—$10
Lost revenue from ATM		$5 per week for 8 weeks, or $40
Extra cost of paving		$1,400
Total costs	**$30**	**$2,070**
Customer service impact	**Smooth**	**Painful**

Even though $2,000 doesn't seem like a lot of money for a large electric utility with revenues of millions of dollars a year, this example illustrates the dramatic impact good workflow design can have on a process, particularly when viewed in the context of the annual workload. If the utility processes 10,000 work orders of this type annually, the annual cost would be nearly $3 million compared to $30,000. A million-customer electric utility is apt to process from 5,000 to 15,000 service orders per year, depending on the region's growth. The integrated enterprise GIS plays a key role in this process.

Of course, not all work orders will go this poorly. However, due to poor processes, the potential for error is high. For this particular example, the cost doesn't even include the extra time that the crews had to spend to fix the outage that directly resulted from the poor business process.

GIS and Customer Care

Customer care is a major business process within electric and gas utility companies. As noted in the examples, the key to outstanding customer care is integrated information. Since so much of what matters to customers relates to location, integrated spatial information is critical.

Much of a utility's information technology budget is devoted to customer systems. The customer records represent a major asset of a utility company. Utility customer systems contain information like payment and usage history, location, rate category, metering type, and criticality of supply, among other vital information. What customer systems don't provide is a spatial context for the data.

Effective interaction with customers is essential to the utility's success. Certainly keeping the lights on or the gas flowing is key to customer satisfaction. However, there are a number of other processes in a utility that are involved with customer care.

Metering and Billing

It may seem like a simple thing: read the meter, send the reading to the billing system, calculate the bill, send it out, collect the money. However, customers have different rate schedules, move around, and sometimes don't pay on time. Occasionally, meter readers can't read the meter. All these factors complicate the billing process. When a utility cannot read the meter or when it serves customers in places with no meters, it has to estimate bills. Whenever bill estimation occurs, disputes are not far behind. While most utilities handle the vast majority of bills without a problem, the small minority of billing issues can create an enormous workload for call center and billing employees. So anything that a utility can do to reduce the number of billing issues would pay off handsomely.

GIS can help. GIS can better manage the meter reading process itself. Billing systems tend to be extremely accurate, so given the correct meter reading, bills are almost always correct. However, any problem with billing accuracy is almost always due to an estimated meter read or some special meter read. Estimated reads are made due to the inability of meter readers to access the meter or get to the meter during the scheduled route. Special meter reads occur when customers move or when utilities replace a meter or find the meter to be faulty. It's these special circumstances that create the most work and generate the vast majority of billing inquiries and problems. Utilities use GIS to manage meter reading routes. GIS can be used to dynamically readjust routes for new situations, such as when someone builds a new house in the middle of an existing neighborhood, or to analyze where billing issues most commonly occur. If access is an issue, GIS can determine where to strategically place automated systems in problem areas. GIS can help highlight patterns for meter readers.

Many utilities are moving toward total automation of meter reading. GIS can play a strong role in the planning and rollout of an AMR system. GIS can help dynamically manage meter reading routing during the difficult transition from a manual to an automated system. Once the automated system is in place, GIS can serve as an ideal monitoring tool.

While reliability of supply is probably the most important customer issue, billing is often not far behind. Utilities that strive for high customer satisfaction work just as hard to improve the billing process as they do to keep the gas flowing or the lights on.

Managing Customer Orders

Customers' orders often trigger other processes. Examples include ordering a new service (like in the example above), ordering a private property streetlight, requesting a meter test, seeking a lighting rebate, or ordering an energy survey. While we often think of the work of a utility as installing new pipes, lines, and transformers, utilities need to manage many other customer-related tasks. Since these activities involve a customer or a customer's agent, making accurate appointments, optimizing travel between appointments, and scheduling tasks can be daunting. GIS aids in visualizing the work; seeing patterns in the work; helping route technicians, salespeople, and inspectors; and enabling crews to understand the current status of equipment in the field.

Call Center

The heart of the customer care operation is the utility call center. Here, customer representatives receive billing inquiries, gas smell reports, conservation questions, electric trouble calls, meter malfunction and high bill complaints, shutoff and turn-on requests, streetlight outage reports, and even complaints about loud line trucks working in the area. To the vast majority of customers, the call center *is* the utility.

Some utilities have installed GIS to help the call center better communicate with customers. They populate the GIS database with information about trouble, crew, and emergency locations. They show where technicians are working and fixing broken meters. Projecting this information on large screens throughout the call center provides each customer service representative with ready access to what's going on within the territory. When a customer calls about smelling gas, the call center representative can quickly view the known locations of gas leaks and the locations of gas company field crews working in the area. The representative communicates this information quickly and accurately to the customer.

Customers certainly want their meters fixed, their streetlights turned on, and their power restored. They also want to know what the current status of their issue is. This level of communication, made possible by GIS, goes a long way in really caring for the customer.

Credit and Collections

Nearly every utility sets aside a certain amount of money each year in its operating budget for bad debt. Bad debt is money that the utility has decided it will not or cannot collect from its customers for electric or gas usage; it simply writes the money off. It then sells the receivables to a collection agency, usually for a small percentage of the actual receivable. In the United States, utilities have reported between 0.2 percent to as much as 0.7 percent or more of their revenues as bad debt. For a medium-sized utility that generates a billion U.S. dollars in sales each year, that number could be as high as $7 million each year. If the average arrears is $1,000, that means the average utility writes off 7,000 customers' debt each year. There are a number of reasons why people don't pay their utility bill, but they usually fall into one of four categories: people who forget to pay, cannot pay due to unfortunate employment or medical situations, are chronically delinquent, or are deliberately attempting to defraud the utility.

GIS is a wonderful tool for evaluating demographics. By using simple demographics, utilities can decide the most effective way of collecting from these four kinds of people. Harassing phone calls to the elderly or poor are ineffective. However, personal visits by trained collection personnel knocking on doors in affluent neighborhoods may be very effective. GIS can track chronic delinquents. GIS can help collection agents optimize their time by selecting the right neighborhoods to visit or to call.

The only real weapon a utility has to force a customer to pay is to shut off their service. However, a shutoff involves dispatching a technician to the premises. If at any given time a utility has thousands of people who are so far in arrears that the utility is contemplating writing off their debt, the cost associated with shutting all these customers' services off would be enormous. So if the utility plans to do shutoffs, GIS can help with the logistics to determine which services to shut off and provide optimal routing for the technicians to follow.

By using demographic information together with customer nonpayment information that would properly segment the customers, collection personnel can establish effective programs to collect from nonpayers before those receivables end up in bad debt. If the utility knew, for example, that there was a cluster of nonpayers in an area with a large elderly population, it could send gentle reminders with, perhaps, offers to do energy audits to help lessen the impact of those customers' electric and gas bill.

While utilities in the United States face a bad-debt problem of less than 1 percent of revenues, utilities in less developed lands tend to have much more significant nonpayment problems. GIS can help isolate and identify these chronic nonpayer regions and provide the data needed to attack this serious problem.

Bad debt is a growing problem with utilities. As energy costs increase, the number of people not paying their utility bills will increase. GIS can help utilities optimize their limited resources to make the best effort to increase revenues by reducing bad debt write-off.

Revenue Protection

Some customers steal energy. Like collections, this problem can be extreme in some parts of the world, where widespread theft of energy is common. GIS can help visualize significant mismatches between known usage and actual consumption using GIS advanced network modeling.

Marketing

Marketers increasingly rely on GIS to create business maps to organize, analyze, and visualize customer behavior. In the case of a gas utility, that behavior often is about what kind of fuel customers use. Customer demographics can also be analyzed to understand future uses. For example, the demographics for a proposed new subdivision may indicate that people with small children are most likely to buy homes in the subdivision. However, in 10 years, that subdivision may be populated with families with growing teenagers, who will be large consumers of energy. So marketers use GIS to target neighborhoods for particular products and services. While electric companies have a captive market, gas companies compete with other sources of fuel. Thus, gas companies perform market analysis, trending, and target marketing. Electric companies will often target market segments of the community to conserve or participate in conservation-related programs.

Utilities can use GIS to target locations for advertising. If the gas utility wants to encourage new customers to use gas or switch to gas, it could target key billboard locations where potential buyers are likely to pass. It can target direct marketing campaigns to those areas most likely to be in the segmented group that the utility wants to reach.

Demand Side Management

One way to offset new distribution system expansion is by the use of demand side management (DSM). DSM services reduce the demand on the system by improving energy utilization. Utilities are often required to offer services like relamping with energy-efficient lighting fixtures; replacing old appliances; or offering rebates for energy-efficient heating, ventilation, and air-conditioning (HVAC) systems. Closely related to this activity is the effort to offer peak shaving or interruptible services. These services offer discounts to customers who allow the utility to shut off a portion of their load during energy shortages. Utilities can use GIS to visualize those areas where supply or distribution capacity may be tight, so they can target those areas for conservation programs.

Conclusion

Utilities are using GIS as a common tool to care for their customers. Integration with customer billing and relationship management systems is becoming common. That's because customer location is so key to managing customer connections, collections, meter reading, meter repair, private property streetlighting, trouble location, and many other customer interactions. More and more utilities want to understand customer behavior. They are looking for tools to draw connections between the service they provide and the impact that service has on customers. In responding to customer needs, utilities need to organize their work in the most efficient way to meet increasing customer demands. They need to make and meet customer appointments. They also need to understand how best to leverage their assets in relation to growing customer supply demands.

GIS is not about making maps. It's about empowering the utility to fully care for its customers in the most cost-effective and intelligent way, using GIS integrated with critical customer care IT systems.