BIOGRAPHICAL INFORMATION

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Specific Responsibilities

Mr. Weiss joined KEMA inc. in February 2000. For the past few years, he has either led or participated in efforts to help utilities evaluate their processes, consider technical alternatives and determine strategic direction. Responsibilities include project planning, conducting work sessions, capturing/developing current and future processes and business case development.

Past Experience

Early assignments at KEMA inc. focused on project management, primarily associated with Geographic Information System and Outage Management System efforts. Prior to joining KEMA inc., Mr. Weiss spent 28 years with Atlantic Electric and then Conectiv. He has experience in many areas of the electric utility business including: metering, substation standards, distribution design, business planning and reengineering. He has also led a number of IT efforts including mobile data capture, work management implementation and GIS.

Education Information

- MS in Computer Science – (Object Oriented focus), New Jersey Institute of Technology, 1999
- Licensed Professional Engineer – 1988
- BS Electrical Engineering - Power Option; Drexel University, 1985

MANAGING OUTAGES – WHAT ARE MY OPTIONS?

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ABSTRACT

In today's environment, it is increasingly difficult for utilities to manage outages using dated business processes and tools. An aging work force, downsizing and regulatory pressures drive companies to consider new approaches to support this necessary function. However, budgetary constraints often present difficult challenges and spawn innovative solutions to meet business objectives. Some of these alternatives are discussed in this paper. These include manual, low-tech and high-tech approaches. Implementations discussed include leveraging mainframe tools, using low-tech telemetry, leveraging AMR, building on an existing GIS, leveraging Mobile Workforce Management and full integration of a commercial Outage Management System with legacy systems. An approach for developing future state processes is also presented. While all utilities are interested in employing best practices, it is realized that what works best for one utility, may not fit the needs of the next. The ultimate approach will depend on a number of factors. These factors include: what technology is already in place, what are the business/ cultural constraints, what are the financial constraints and what are the driving needs. A methodology is presented for evaluating one's current business practices, reviewing alternatives and determining a "best" solution.

OVERVIEW

As described in the abstract, this paper presents a variety of approaches for satisfying the needs of outage analysis and restoration. There are varied tools and techniques that can be applied and each utility has its own particular variation of process and technology mix. One approach to this topic would be to move from the least technical to the most technical. However, the potential permutations could become unwieldy. This paper approaches the subject of outage restoration by its basic components:

> INFORMATION GATHERING – various means of being notified of outages
> ANALYSIS – evaluating the information available to determine problem locations
> DEPLOYMENT AND RESTORATION – getting the right resources to the problem locations and making immediate repairs
> RESTORATION CONFIRMATION – verifying that the customers have been restored
> COMPLETION - The capture of outage specifics to allow tracking of statistics
> FOLLOW ON WORK – The passing information for construction to make permanent repairs.

There is a section in this paper for each of the above tasks. The last section of the paper discusses a methodology that may be used to evaluate a utilities current processes and systems, to develop a strategic plan based on a sound business case.

INFORMATION GATHERING

The outage restoration process begins with the utility receiving notification that an interruption of service has occurred. This notification can occur in a variety of different ways.

Phone call

The typical means for receiving outage information is via customer phone call. A customer service representative records the time of the call, the customer's location and any helpful information such as "I saw a flash" or "I heard a loud bang". This type of call is sometimes called the "smoking gun" call.

For utilities that have not automated, this information may be recorded on slips of paper. Many utilities have some computer-based system for recording this information. Some of these represent extension of their existing Customer Service Systems (CSS). There is a natural fit for capturing information in the CSS since it already houses the customer specific information and because the Customer Service Representative (CSR) is already familiar with the use of that system. Another place to capture this information is in an Outage Management System.

Outage Management Systems typically have a call capture screen as part of their offering. These provide the utility with a front end to the Outage Management System for recording outage particulars. The use of these screens simplifies and speeds the implementation of an Outage Management System by eliminating the creation of a CSS interface. However, many utilities prefer to build the CSS to OMS interface. This approach keeps the CSR in a system that has a familiar look and feel, plus this reduces redundant storage and maintenance of customer information.

VRU

Frequently, utilities will integrate an automated Voice Response Unit (VRU) with their Customer Service System. These systems will capture the customer call information and pass the particulars to the Customer Service System for inclusion in the outage record. By incorporating Automatic Number Identification (ANI), the customer database and existing outage information, the calling customer can be informed that the utility is already aware of the outage and can be presented with an estimate on how long the outage is expected to last. Providing this level of information to the customer goes a long way to reducing the workload of the Customer Service Representatives.

Dial Up Home Monitor

There are a number of products on the market that allow a customer to plug a monitor in their homes. These devices track house temperature, power availability under-voltage, over-voltage and other parameters of interest. The units are used to dial a number and report when a problem occurs. These can be used by utilities as a loss of service notification (As a side benefit, they can also provide improved information on momentary interruptions). By strategically locating these behind a sectionalizing device, the devices can serve as a simple form of telemetry. To avoid nuisance notifications ("the vacuum cleaner hit the plug"), more than one installation may be installed at an adjacent site.

AMR

Some companies have implemented Automated Meter Reading to eliminate the need for physically reading meters. These companies are beginning to leverage this investment to gather outage information. Some meters can be set up to send information when an outage occurs. This approach has the risk of "swamping" the AMR system with large volumes of data during major outage events. Another way to use AMR is to poll the meter, rather than have it initiate the data transfer. This would be useful if one wanted to confirm an outage prediction to confirm outage restoration. The latter would be helpful in discovering "nested" outages.

Cell Based Recloser Telemetry

There are devices on the market that can be installed at various line devices such as reclosers, sectionalizers and capacitor banks. These devices use the cell phone system for telemetry reporting. Rather than use CDPD, these devices are similar to the home monitors, they dial a phone number and report exception information. There are different models available that provide for feeder fault monitoring (momentary and permanent), capacitor or sectionalizing switch control and status or end of feeder voltage monitoring. These devices are powered from the distribution line via a step down transformer. Battery backup and solar powered versions are either available or under development.

Distribution Management Systems

The term Distribution Management Systems represents a suite of products including Substation Automation, Feeder Automation, Distribution SCADA, Switch Order Creation, Short Term Load Forecasting, Feeder Load Flow Analysis and Load Shedding. These systems are designed to work in real time to monitor and manage the distribution.

As in a Transmission System EMS, communication is established between a control room and devices on the feeder. The system provides monitoring and control of sectionalizing devices such as reclosers, sectionalizers and automated switches. These systems can detect outage situations, analyze adjacent sources as sources for restoration alternatives and reconfigure the system to restore as many customers as possible.

ANALYSIS

Paper Maps

We have previously discussed that many utilities still utilize paper-based processes for performing restoration. In this environment, stacks of call slips are manually sorted, typically according to municipality. These are then referenced to feeder drawings to determine the location of outages. For larger outage situations, some companies will employ a map board and plot outage locations and crew locations, as an aid in visualizing the situation. For companies that desire to centralize operations, paper based systems become problematic. A company normally decentralizes after a large number of outages occur, such as during a storm. Moving to storm mode requires ramp up, time part of which is to translate outage information to a map board. One problem is that the map board information cannot be shared with other areas of the company, limiting flexibility

GIS/ Manual Grouping

Some companies have built applications on top of their GIS to display customer calls. This approach enables visualizing clusters of calls, indicating probable outage locations. Additional tools allow users to manually draw a boundary line in the GIS, enclosing one or more calls. This groups the calls together, associating them in the system to an outage. Typically, new calls that appear within an existing boundary automatically become related to the existing outage. The quasi-manual approach requires a large number of skilled resources to do the grouping and to keep the system updated, especially during major outage events.

Outage Management System

An Outage Management System (OMS) is a software product designed to manage outages and facilitate restoration. Early on, OMS software was developed internally by utility programming staff. Some of these were pretty advanced and are still in use today. More powerful OMS software is availably from a number of vendors in the market place.

The foundation of the OMS is a model of the electrical network. This model represents the distribution electrical topography needed for outage analysis and restoration: sectionalizing devices, switches and other isolation locations. At some OMS installations, feeders are represented from the breaker through to the loads served while others also include busses and devices internal to the substations. Conductor impedances are not used and voltage-conditioning devices (capacitors and regulators) are normally not included other than to represent the isolation point. This model is typically radial and the OMS maintains the hierarchical relationship between down stream devices and the upstream devices that provide protection.

A critical piece of information for the OMS is the customer to system relationship. Normally, utilities maintain distribution transformer information on a customer record. The source for the customer to transformer relationship may either be the Customer Service System or the GIS. During Outage analysis, customer calls can be related to the serving transformer and then analyzed with other calls to find the upstream protective device that most probably operated. As was mentioned, some utilities have interfaced their OMS with external telemetry, most commonly the EMS while some are considering AMR. In these instances, the telemetry will feed into the analysis, aiding in determining the problem location.

Outage Management System Data

An OMS depends on having a solid set of data upon which to perform analysis. If there are gaps in the model, erroneous results will occur. These errors become magnified during major outage events, precisely when the OMS is needed the most. Processes must be in place to keep the data current and updated in the OMS. Ideally, the update process should be incorporated as a central part of the construction/ work management process. Timely posting of in-service facilities to maps and records and ultimately the OMS is necessary for it to perform its function, let alone the safety issues associated with out of date records.

Note that an OMS typically provides tools by which one can maintain the circuit model and/ or the customer to transformer relationship. Early implementations of OMS were stand-alone and this was the only way to maintain the model. Most OMS implementations today rely on a GIS interface to maintain the circuit model and the customer to transformer relationship.

Energy Management System Based Systems

In addition to the third part integration between EMS and OMS mentioned above, a number of Energy Management System (EMS) vendors also have Outage Management System offerings. The integration between these is tighter than is normally possible between systems from differing vendors. In some cases, they share the same database. In others, the user can move between the EMS and the Outage Management System using the same GUI.

DEPLOYMENT AND RESTORATION

Once the location of the outage has been identified, the utility must get the correct crew to the highest priority location as quickly as possible. For utilities lacking automation, piles of tickets, representing outage locations are often organized by area. A roster of available crews is referenced and the restoration of the outage is assigned to the crew, typically via radio communication. The crew records the outage information and analyzes the outage by searching for the open point. They will then make temporary repairs, if possible. When restoration is complete, the crew will radio in the completion and await the next assignment.

OMS Crew Management

In the OMS world, the system keeps track of the crews on duty, their current assignments and the outages that exist. Using established criteria, the system indicates the next highest priority outage location. The dispatcher can communicate the outage information, including the most probable operated device to the crewmember. The crewmember records this information and responds back to the dispatcher when service is restored.

During a major storm, the Central Dispatch can get beyond their ability to manage all of the resources working. Allowing local crew locations to manage their resources has a couple of advantages. First, it reduces the workload for the dispatchers. Secondly, it provides for close interaction between the crews and those managing them. Some OMS products have a Web based component to allow for decentralization during a storm. Since storm mode is an infrequent occurrence, there are concerns with part-time maintaining efficiency. The web based front end can be simplified to help with this problem.

Mobile Workforce Management

Mobile Workforce Management is a term used to describe a system that allows one to send and receive information from mobile crews using a radio link. The ability to electronically send outage information to the truck provides a tremendous boost to outage management efficiency by reducing verbal dispatcher-crew communication. This offloads the dispatcher and eliminates the bottleneck of a crew trying to call in. Some utilities have chosen to have the OMS automatically assign jobs to crews without dispatcher intervention, provided the jobs match certain criteria. Others prefer to have a dispatcher review all work before sending it to a truck.

There is a mix of mobile vendor options/approaches that have been taken to manage outages such as offerings from MWM vendors, OMS vendors and Work Management System vendors.

MWM Vendors - Some utilities have implemented Mobile Workforce Management (MWM) systems, justified primarily for non-outage/ short-cycle work. Leveraging that investment, many of these systems have been integrated with OMS's to automate sending and receiving outage information from the trucks in the field.

Work Management System – Work Management System are typically focused on redesigned, long cycle, multi-day kinds of work. Some of these vendors also have strong short cycle work modules along with MWM functionality, offering similar integration and savings opportunities as the MWM vendors.

OMS Vendors - Some OMS vendors also provide MWM software already integrated into their system. The advantage here is the tight integration and avoided cost of developing/maintaining the interface. Conversely, there are MWM vendors that offer OMS modules as part of their suite of products, with the same advantages as above.

The strengths and weaknesses of each approach need to be evaluated against the individual utilities needs. Some utilities prefer choosing best of bred which may (but not necessarily) point to building an integrated solution. Others may prefer to avoid the responsibility of maintaining an interface, which may point to a bundled solution option.

Work Management System Integration

Some utilities have worked on integrating the resource modules of OMS and WMS. The goal here is to provide a single view of the utilities entire pool of resources. The advantage to this approach is the ability identifies the crew closest to an outage and to shuffle resources as necessary.

RESTORATION CONFIRMATION

After service has been restored, the crew reports the status back to the dispatch center. Typically, a sampling of customers is then contacted to confirm that restoration is complete. This occurs in a number of ways.

Phone Call

Some utilities track the individual calls within the Customer Information System (CIS). When restored, samples of these calls are manually returned. The utility resources available limit the number of customers that can be manually contacted.

VRU

Utilities that have implemented VRU's typically relegate the call back task to those tools. Part of the information gathered during the initial outage call, is if the customer wants a callback when service is restored. After restoration, only customers that indicated a desire to be contacted are called and only during reasonable hours.

AMR

The other automated way to confirm restoration is to leverage AMR. After restoration, the meters on the section of circuit that has been restored can be polled. This approach will provide a more complete sampling and provide the ability to uncover "nested" outages (outages within an outage).

COMPLETION

Utilities are required to capture outage statistics for a number of reasons, including performance measures. Information that must be captured includes the cause of the problem, the confirmed location of the outage and the time of restoration.

Manual Capture

For utilities that have not automated, the crew that performed the restoration records this information on forms. After the event, the information on the forms must be entered into a database for reporting purposes. During major outage events, it is possible for this information to be lost or need to be recreated after the event is over. This is a labor-intensive task and leads to inaccuracies in data. OMS technology can help increase accuracy and reduce the risk of lost information.

OMS

Utilities that use OMS commonly have the crew communicate the restoration information to the dispatcher. This allows the capture of information while it is still fresh, reducing the opportunity for error. To improve the efficiency of this process, some utilities have reduced the completion information to a series of codes that the crew can quickly communicate. The dispatcher then populates the codes into the system.

MWM

Capturing the information at the source is always the best approach to improving accuracy. Utilities that have Mobile Work Management systems allow the crew to enter the completion information directly. This reduces the dispatcher's workload and avoids the possibility of miscommunication.

FOLLOW ON WORK

Sometimes an emergency crew performs temporary repairs sufficient to restore service, but leaves a situation that is still in need of permanent repair. The need for this follow on work and a description of the work needed must be captured and passed on to the design/construction process. For the paper-based utility, the needed repairs may be captured on notes or a specific portion of the outage completion form. The information can then be entered into the work management system for design and scheduling.

Some utilities have built an interface between their OMS and their Work Management System. This allows the dispatcher to enter basic information in the OMS and create a job in the Work Management System for the follow on work. As with other completion information, integration with a Mobile Work Management system allows the crew to enter some basic job requirement information to be passed to the Work Management System without the need for intervention by the dispatcher.

BUSINESS CASE DEVELOPMENT

When building a business case for change and deciding which alternatives best meet the needs of the utility, a number of factors must be considered. These include legacy applications that the utility has in place, organizational considerations, budgetary constraints, technical preferences and cultural characteristics of the company. When evaluating the various alternatives and deciding which options best fit the needs of a utility, we have found a process-based approach to work well.

Capture Current State

The effort begins by mapping out related processes with Subject Matter Experts from the company. It is important that the Subject Matter Experts involved have a strong background in the areas that they represent, can consider new ways of doing things and are respected by their piers as trusted representatives. It is often difficult to get managers to release resources of such caliber to participate in work sessions, but there is great benefit to the company to get the right people involved in shaping its future.

The mapping out of Current State Processes provides value in a couple of ways. First it documents these processes as a baseline for later comparison. It also provides a forum for the Subject Matter Experts to discuss issues that they regularly face. These issues often point to opportunities for improvements in the processes, so it is important that they are captured in such a way as to provide later retrieval and analysis. Along with steps in the process, it is important to capture who is involved in those steps and what technologies they use. The term technology here is used loosely and could represent any tool from PC to hand-written notes.

Develop Future State

The lessons learned in the capture of the Current State Processes are leveraged in the next step, development of the Future State Processes. The same Subject Matter Experts are pulled together for another set of work sessions. The effort builds on the Current State diagrams, modifying them to address deficiencies that had been discovered in the first pass. During this step it is valuable to have assistance by resources that are familiar with what options have been used successfully at other companies and know what future direction technology is taking. As in the Current State works session, issues and opportunities are documented, roles captured and technology to be used noted.

Perform Gap Analysis

The Gap Analysis provides a view of the differences between where the utility is (Current State) and where they wish to go (Future State). At a minimum, the Gap Analysis should capture where process steps have been eliminated, where roles changes have been identified and where technology changes are needed to provide improvement. The product may take a number of forms including a Word ™ document or as spreadsheets.   These comparisons can be manually created by visual inspection, which is a tedious exercise. Alternatively, the comparison may be made programmatically with certain software tools available on the market. The later approach reduces effort and assures accuracy.

Determine Benefits

During the Work sessions, a large amount of information is gleaned. Depending on the opportunities uncovered, different means for capturing metrics and calculating benefits will be employed. If the anticipated savings are to be derived from improved staff efficiencies, spreadsheets are built to capture the amount of time currently expended in parts of the process, the cost of resources and the change in level of effort between the Current State and Future State processes. Again, there are tools available to use the information captured in the session and generate base tables for comparison. Otherwise, the sheets may be created manually. In either case, skill and experience need to be applied in determining the productivity improvements that can reasonably be expected.

One area of opportunity may come from efficient crew management. When managing outages, especially during major events, it is a constant challenge to track all of the crews on duty, know the current assignment statuses and providing new assignments to the correct crew in a timely fashion. A contributor to the problem is the bottleneck of having to verbally communicate via radio. These factors can result in crews remaining idle when they could have been contributing to the restoration effort (particularly frustrating for the crew). Mobile Workforce Management solutions mentioned above can help in a couple of ways.

First, the OMS can prioritize work and identify the closest available crew for restoration. One has a couple of options, staging the work for when the crew becomes available or doing assignments as the crew becomes available. The work staged in the OMS becomes visible in the crews truck, eliminating the need for most verbal communication. Some utilities allow the crew to enter completion information directly, further improving efficiency.

There are other tangible sources of benefits to be considered. An example is the ramp up effort associated with the transition between normal storm operations to a situation associated with a major event. This can represent a considerable time when manual processes are employed. Technology can shorten the transition time, allowing faster restoration.

Many utilities are looking for opportunities for consolidation. This is driven by various factors, including the need to reduce workforce for cost savings and the need to work smarter as skilled resources retire. Consolidation allows resource load balancing, but the trade often is that the intimate territorial knowledge of local dispatchers can be lost. Technology can fill that gap by providing tools for the dispatcher to manage the entire area.

There are many other areas of potential savings that will vary by the utilities' situation. These may include the reduction of information post-processing effort, reducing the amount of space needed to house dispatchers risk associated with legacy applications and others.

Build Strategic Road Map

The Strategic Road Map is a set of documents that represents the culmination of a study. The documents included depend on the initial goals of the study.
The Strategic Road Map typically includes an executive level summary of the findings, alternatives considered, the business case including cost benefits analysis, risk assessment and a recommended course of action. The documents created during the study are included such as the Current State and Future State process maps, the Gap Analysis and the data supporting the analysis.

It has been found useful during a study to interview executives that have a stake in the restoration process. One should include those from the operations side of the company and the technology side. The executives can provide insight into upper management's perspective on the project, constraints and expectations and a vision for where the corporation is headed. This information provides valuable insight into how bold a recommendation one can reasonably expect to be accepted.

As was mentioned, all utilities are interested in employing best practices. The ultimate approach will depend on a number of factors that are unique to a given organization. These factors include: what technology is already in place, what are the business/ cultural constraints, what are the financial constraints and what are the driving needs. By evaluating one's current business practices, reviewing alternatives and considering existing business drivers, your "best" solution may be determined.