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Smart Grid Solutions

AMI Rollouts: Ensuring Success by Avoiding the Pitfalls

Utility Lessons Learned from Using New Mobile Workflow Optimization Solutions

One Solution **Ahead**

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Executive Summary

Problems associated with poor installations of advanced meters have done tremendous damage to public perceptions about the utility industry. To those familiar with the challenges associated with Advanced Metering Infrastructure (AMI) deployments, it comes as no surprise that significant quality and process issues, such as hot meter sockets and other safety and reliability problems, have come to the fore.

AMI customer-facing issues, including customer billing errors from improperly registered meters and poor handling of utility customers by an inexperienced, hybrid workforce, are areas of concern. Utility project costs have been impacted negatively because of lost meters and poor inventory tracking, schedule overruns, and inefficiencies in a range of processes. Utility executives are demanding new processes, tools and strategies to confront these risks. To avoid media and regulatory scrutiny, AMI rollouts in particular demand fail-safe programs and processes that ensure automated process compliance and tracking. Utility executives know that when it comes to batch errors, hot sockets, and billing mix ups that *"one such incident can stall the whole project."*[1]

The reasons utilities face higher perceived risks can be traced to the increasing politicization of energy policy along with well-documented findings related to the psychology of risk.[2] In an environment where every public mistake is magnified, utilities will be increasingly drawn to the use of workflow optimization systems that ensure adherence to standards and structures providing documentable audit trails.

The advent of new Mobile Workflow Optimization solutions: Recently some utilities have been able to use new Mobile Workflow Optimization solutions to successfully deploy and track the full range of processes to successfully complete AMI roll-outs. Mobile Workflow Optimization has enabled the uniform training, deployment, and management of large groups of relatively inexperienced workers.

Utilities using these new Mobile Workflow Optimization solutions have not only met the challenges, risks and costs associated with large-scale AMI deployments, but they have also used challenging AMI deployments as a successful proving ground for new workflow design principles that will be needed to support smart grid and distributed energy resource projects in the future.

For utilities that have implemented new Mobile Workflow Optimization solutions, the AMI deployment stumbling blocks described above have either been designed out entirely or avoided through strong processes. Utility executives have used Mobile Workforce

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1 Several utility executives who have deployed Mobile Workforce Optimization solutions in AMI rollouts at both investor-owned and cooperative utilities were interviewed during the development of this white paper. Their quotes are denoted throughout the paper through the use of italics.

2 Psychological studies regarding risk indicate an inverse relationship between perceived risks vs. rewards of an activity, and whether the activity is voluntary and enjoyable, versus involuntary and unenjoyable. The public outrage associated with advanced metering issues and other customer-facing utility activities is heightened precisely because safe, reliable electric service is typically taken for granted (involuntary and unenjoyable). In contrast, consider the risks associated with driving a sports car at high speed. The fact that driving a sports car is perceived as a voluntary and enjoyable activity enables people to easily accept risk levels many thousands of times higher than those they think are acceptable when it comes to things such as new meter installations. Even if the risks are quite small, in recent media coverage, utilities face perception and brand risks that defy engineering reality, and executives must act accordingly.

Optimization to minimize risk while creating a solid foundation to address the challenges that will be posed by the distributed energy future.

AMI Deployment Risks & Challenges

System-wide Advanced Metering Infrastructure (AMI) deployments represent an unusually substantial resource commitment for a utility.

AMI rollouts are often carried out by a highly varied workforce that includes relatively inexperienced field personnel. Problem areas generally relate to installation processes and personnel, rather than being specific to a particular meter manufacturer.

AMI deployment problems include:

1. Hot meter sockets and associated fire hazards
2. Meter registration, batching, and pairing installation errors
3. Meter inventory errors (lost meters and/or inefficient tracking)
4. Inefficient processes (for workers, managers and/or administrators)
5. Safety, reliability, or customer-facing process deficiencies
6. Liabilities arising from a lack of audit/photo trail of standards-based activities

Mobile Workflow Optimization solutions are designed around workflows that were built to address the needs and challenges of AMI deployments. Utility managers accustomed to evaluating software solutions on features and functionality will need to look at workflow optimization solutions differently. To fully appreciate their value, utility managers must evaluate Mobile Workflow Optimization solutions in a holistic, process-centric way rather than in a fragmented "module centric" fashion. Doing so will reveal the powerful common business process management principles as the source of dramatic improvements across different workflow scenarios.

Managing AMI Rollout Productivity

What gets measured gets improved. Mobile Workflow Optimization solution providers looked to other industries, such as emerging mobile technologies, to find strategies to achieve measurable improvements to AMI deployments. They found that integrating time-stamped GPS data and site condition survey photographs create an audit trail to:

- Track worker progress and improve worker productivity and accuracy.
- Enable rapid identification and resolution of problems with legacy meters (insect infestations, burnt lugs, illegal wiring/power theft).
- Provide any nearby O&M information of value (e.g. joint asset inventory or problems with secondary service lines, etc.).

Humans are fallible. Therefore, attempting to automate a process without designing for considerations associated with human interaction can easily backfire as indicated by the

simple experience one has when "automating" an alarm by setting a reminder to ring on a cell phone, but having the alarm "fail" because the speaker on the phone was muted.

When highly efficient process throughput and high quality outputs from a process really matter, it is best to have specialized tool kits for specific situations. Utilities have used Mobile Workflow Optimization solutions to secure productivity gains by:

- Ensuring proper work assignments are given and that new team members are assigned work based on their skill set as soon as they are badged.
- Allowing the rapid update of assignable tasks after completion of new training.
- Managing the life-cycle of a project's inventory.
- Integrating bar-coding and GPS data into process steps (e.g. tracking meter movements from a pallet being opened, to boxes being moved, to individual meters being installed, with workers scanning their badges so status and location of each meter is traced).
- Guiding workers through each step in various workflows, using interactive questions or prompts, from the moment the meter is removed from the box.
- Providing a single system rather than multi-system integration for time sheet and payroll system data tracking.

Contrast these results with legacy enterprise software solutions that often lack native ability to process photographic records, perform job assignment changes based on new certifications, or integrate time sheet and payroll system data. The productivity gains and advantages from a Mobile Workflow Optimization approach, incorporating a business process management framework, provides far superior productivity gains when compared to legacy solutions originally designed for other uses.

A key element of the process-related benefits is the user interface itself. An interviewee at a large IOU contrasted the Mobile Workflow Optimization solution they are using for their AMI roll-out and the company's previous PC-based mobile work management system:

> "With the Mobile Workflow Optimization solution, workers take the handheld unit right to the job site with them. Everything is scanned using the system--it scans the meter barcode and brings in GPS coordinates, and takes site photos, which our legacy system could not do. We avoid a lot of errors…errors introduced simply because our guys did not take laptops to the job site. Instead, they took notes on a piece of scrap paper and wrote down the information, brought it back, and then entered it in manually."

Optimized workflows achieve lasting productivity gains because they avoid systemic inefficiencies, process "bottlenecks," and common errors. Fundamentally, the interaction with the user interface is different because workflows involve more interaction in a specific, verifiable order. As another IOU interviewee stated:

> "With our new Mobile Workflow Optimization solution, field technicians are driven from one screen to the next in a strict sequence of steps to answer the questions and capture the required data and photos. In contrast, our legacy work order

management system is basically a single screen where workers have to fill in certain information."

Applying BPM to Mobile Workflow Optimization Design

Mobile Workflow Optimization has taken long-standing principles of business process management (BPM) out of factory and IT-centric environments and applied them in new ways for utility-related fieldwork. A great deal of care is taken to collaborate with the utility in designing an optimized workflow for each step in the installation process. An IOU executive noted:

> "The upfront planning we did with the vendor is really paying dividends. The solution is a real-time system. I can look at the system right now and I can tell you how many meters are currently installed and I have a report that can tell you how many have been installed today."

STATISTICAL SAMPLING

In the case of traditional business process management, the focus was on reducing errors through measurable quantities, like defect rate, productivity, and cycle time. Typically, the output of machines in a factory would be randomly sampled to determine error rates. In contrast, with Mobile Workflow Optimization, utilities can identify "error-prone" situations and single those out for analysis. For example, because newly trained workers, or workers thrown into unfamiliar situations, are among the most error-prone, the sampling process can focus on them. This creates an inherent bias, but in doing so it combines the two highest points of risk—new employees and error-prone situations—allowing for the greatest possibility for process improvement.

Using these biased samples has become a key component to process quality assurance (QA) improvement for all Mobile Workflow Optimization solutions. While the overall average worker sampling would normally be 7% or lower, the sampling level for a new worker involved in meter replacements is set, in the first 3 to 5 days, at 100%.

Sampling the new work is not an after-the-fact audit but rather a real-time shadowing that involves recording observations on a tablet PC dedicated to the task. As the worker gains experience, the sampling tails off until it reaches the average for all employees.

FORCED MARCH WORKFLOWS

Workflow design is grounded in the concept that the best process design does not over or under-automate a workflow, but instead finds the perfect balance of interaction between human being and automated system. Part of the optimization process can include mechanisms that create a series of "forced march" steps in a workflow so as to help design out errors.

Forced march workflow design ensures good processes are being automated. By rigorous identification of common errors in specific workflows, tasks are redesigned to create optimal workflows that guide the user through the new process step by step.

As an example, a water utility had a problem with the work process of using a clip to connect a radio to a meter. Installation technicians found it difficult to determine whether or not the clip was fully inserted.

The "forced march" workflow design improvement: The connector clip has two holes in it which fully protrude only when the clip is firmly inserted and the radio is connected correctly. To ensure proper connection, a step was added to the workflow requiring the installer to insert toothpicks into the two holes, and then photograph them. The photograph not only provides evidentiary proof that the clip was installed correctly, but also serves as a verification record that gets stored for quality assurance record keeping. Steps in many of the other workflow processes similarly force the correct process to be accomplished and documented, thereby forming key elements of the forced march, which help to eliminate failures.

FAULT-RESISTANT WORKFLOWS

In addition to forced march workflows, Mobile Workflow Optimization also involves fault-resistant workflow designs that prevent workers from engaging in error-prone work processes. This is accomplished by analyzing the "fault trees" of a process and designing *against* them.

As an example, an endemic problem in mass meter deployments, commonly referred to as "batching," was described by a utility interviewee:

> "Instead of removing and replacing one meter at a time, installers may remove multiple meters at once, and then when they go to put in the new meters it becomes impossible to associate the correct old meter with the correct new meter. Consequently, bills go to the wrong customers, creating a serious public relations issue. One such incident can stall the whole project."

This utility observed that its Mobile Workflow Optimization solution, "*has designed out the possibility of batching errors*." The risk of batching errors was eliminated by requiring the technician to follow this 3-step process:

1. Take a photo of each meter prior to removal and installation.
2. Log the legacy meter number into the system.
3. Scan the new meter serial barcode.

Because this workflow mandated that these three steps were performed in strict sequence, it forced the technician to install each meter one at a time, eliminating any possibility of a mix-up.

CUSTOMER-FACING FIELD ACTIVITIES

In addition to reducing failure rates and improving productivity, utilities also report that their Mobile Workflow Optimization solution helped them improve key customer-facing activities during AMI deployment. As reported by an investor-owned utility manager after using their new Mobile Workflow Optimization solution: "*The solution is very process*

oriented. It is a series of built-in checks. Did you knock on the door? Did you leave a door hanger? So before you can go on to the next process, you have to complete the previous process, do the steps, and answer the questions. The technician cannot change the order of operations or skip steps."

Documenting QA with Photography & Barcoding

In legacy systems it was not uncommon for a person to have to go back out in the field to validate a previously reported meter-related condition. However, Mobile Workflow Optimization solutions incorporate photographs at key steps in the meter replacement process. This reduces, if not eliminates, the need to revisit installations because forensics can typically be done in the office through inspection of the photographic record.

Photographs and insertion of real-time GPS data into workflows is part of the "trust but verify" principle within the quality assurance process. Photos taken by less costly employees extend the eyes of more experienced employees out into the field. Interpretation of a photo of an old meter base or a new meter installation by an experienced person in the back office can save a great deal of time, especially during large deployments. Installation photographs also provide valuable opportunities to document customer equipment issues and proactively engage customers for corrective steps while warning them of any hazardous conditions. One rural electric cooperative leader who completed a full AMI deployment without any ARRA related funding noted:

> "The contract workers involved in the meter replacements were trained to recognize obvious problems like burnt meter lugs. Our personnel, who had a great deal of experience, could identify more subtle problems using photographs the contract workers took. By extending their eyes into the field, our experienced personnel were able to look inside meter bases we have not seen since we plugged in the old meters 30 to 40 years ago. And along the way we see things like carefully concealed illegal wiring, which was of great value for us to then schedule work to correct these situations at customer locations."

In addition, barcode-centric steps in workflows also comply with the "trust but verify" philosophy. A utility program manager reported this about their Mobile Workflow Optimization solution:

> "Barcoding is a key part of the new Mobile Workflow Optimization solutions. Each change in custody—from the warehouse manager to the installer and vice-versa, or between installers in the field—the barcodes of the meters being exchanged as well as the badges of both parties are scanned into the system. I can look at the system right now and tell you precisely who has custody of which meter. Such tightly controlled asset management ensures that no meter can be lost."

BARCODING & CASCADING INVENTORY

To deal with utility AMI rollout supply chain challenges associated with lost meters, meter theft, and warranty tracking, Mobile Workflow Optimization solutions provide tailored capabilities to manage cascading inventory business processes.

While a pallet of meters is intact, only pallet labels need to be scanned and the exact contents of the pallet, including the boxes and individual meters, are derived from the shipment manifest provided by the meter supplier. Once the first meter in a box is scanned, Mobile Workflow Optimization solutions recognize that the box has been opened and require individual meters to be scanned thereafter. In addition, the physical movement of all meters is tracked and each transfer requires a scan of all inventory. Each meter transfer requires cascading inventory scans of the pallet, the box or the meter as appropriate, as well as the badges of the personnel issuing and receiving the meters. Unless the field installer has taken formal custody of a meter in this manner, Mobile Workflow Optimization solutions will not permit a meter to be installed.

The benefits of this tailored approach for AMI inventory management include lower rates of lost or stolen meters; physical tracking of all meters in the deployment cycle; and the ability for utility personnel to quickly locate, separate and, in the rare instances when required, return meters recalled by manufacturers that are not yet installed.

Confronting Misperceptions & Reducing Legal Liabilities

Utilities deploying AMI today must confront a range of misperceptions and consumer fears around fires, RF exposure, high bills, and more. Mobile Workflow Optimization solutions address these stakeholder concerns through carefully documented deployment records, workflows and photographic audit trails that greatly reduce the risks associated with the rare occurrence of "hot sockets." For example, one utility reported using its Mobile Workflow Optimization solution to take photographic thermal readings of empty meter sockets during installation to ensure a site-specific audit trail of socket conditions. Through a variety of methods, Mobile Workflow Optimization solutions reduce utility liability risks and the risks posed by potentially negative public relations exposure during AMI rollouts.

As reported by an investor-owned utility:

> "Photographs on-site of customer premises are very helpful. You always have some customer claims resulting from a big project like an AMI rollout. Having photos showing on-site conditions before you started to work, and after you finish the work, goes a long way to protect the company from legal liabilities."

Another utility executive noted:

> "We have had some situations where the meter reading may be entered incorrectly. Our contractor performed a "blind validation" of every meter reading captured in the field, using the photo of the legacy meter face, zooming in to read the digital display or the analog dials. This gave us 100% accurate meter readings and the photo evidence to back them up. So, if a customer contested their billing, we could verify the accuracy of the reading in our system right in the office, instead of going to the expense of another truck roll to actually look at the meter again."

Conclusion

Utilities have employed Mobile Workflow Optimization solutions to complete successful AMI rollouts and avoid many of the most widely reported deployment pitfalls. In the process, these utilities have lowered risk, increased field productivity, and enhanced consumer engagement. Mobile Workflow Optimization solutions are ideally suited for other utility applications including rollouts of load management, home area networks, distributed generation, T&D inspections, and more.

Forward looking utility executives who have applied Mobile Workflow Optimization solutions to AMI rollouts have laid a strong foundation to confront unknown challenges and exploit coming opportunities in the distributed energy future.

ABOUT APEX SMART GRID SOLUTIONS

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Apex Smart Grid Solutions is working on Smart Grid projects around the world, featuring **ProField**®, Apex's industry-leading mobile work force management platform. Our Smart Grid service offerings include Technology Licensing, Consulting, Installation Services, System Acceptance Testing, and Network Design/ Implementation.

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