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page 23

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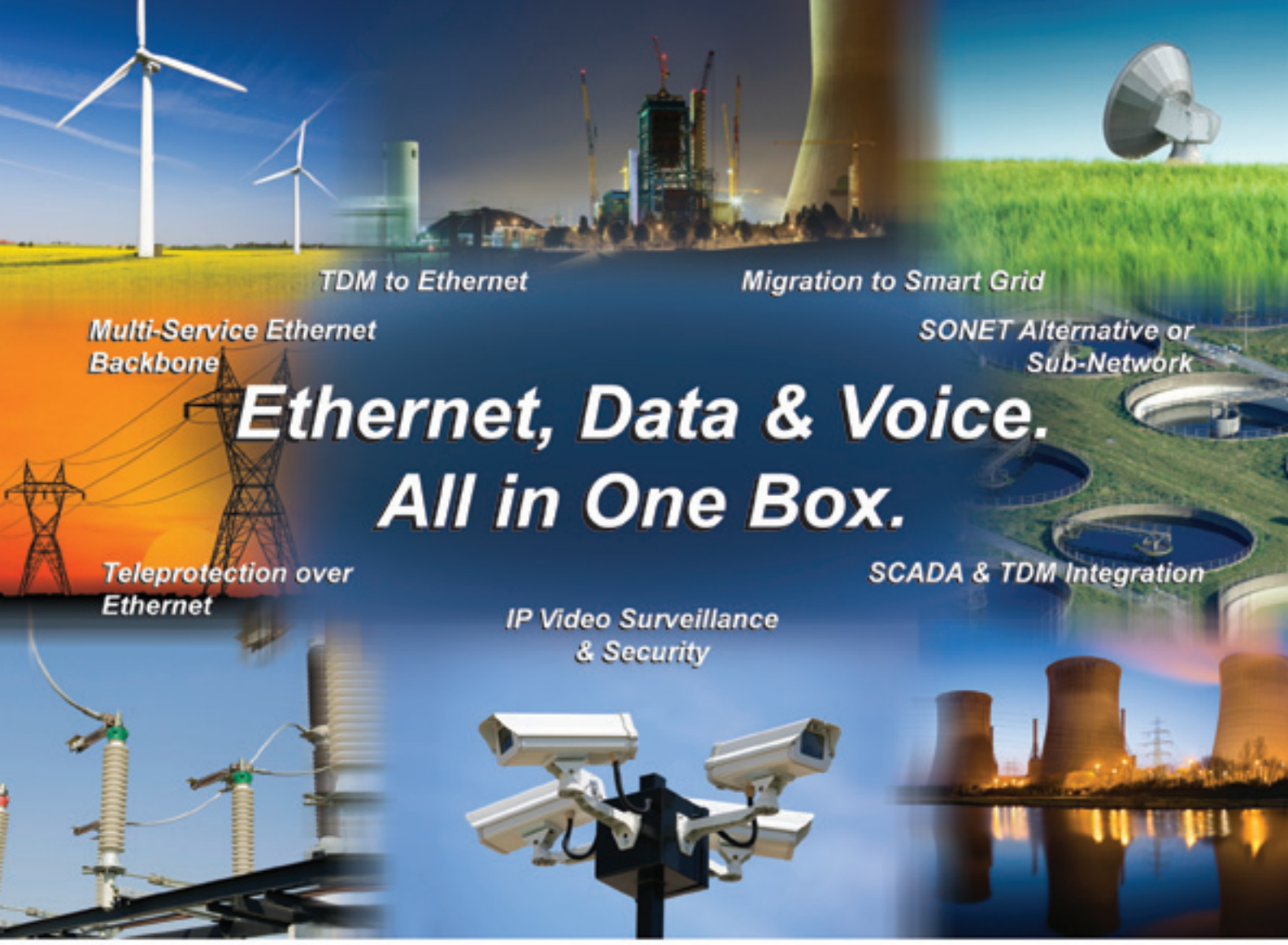

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GridLines

Michael A. Marullo,
Editor in chief

You say you want a revolution...

Well you know. We all want to change the world;
You tell me that it's evolution;
Well you know, we all want to change the world...

(Excerpt from the lyrics to 'Revolution' by The Beatles; 1968)

As regular readers will recall, we published a Guest Editorial at the beginning of last year in our January-February 2010 issue, authored by Jon Brock, President of Desert Sky Consulting Group, in which he pondered the stage of Smart Grid development. At the time, Brock was asking the not-so-rhetorical question: "Is the Smart Grid over-hyped?" He went on to quote the high-profile market research and consulting firm, Gartner Group, as saying that Smart Grid technologies serving the utility industry were nearing the peak of their "Hype Cycle" at that time.

In case you need a refresher, the Hype Cycle is a process that Gartner says every technology goes through. It consists of five stages: 1) On the Rise; 2) At the Peak; 3) Sliding into the Trough; 4) Climbing the Slope; and 5) Entering the Plateau. Brock's contention at the time was that the 'hype' period was ending and Smart Grid was teetering at the edge of Stage 3: "Sliding Into the Trough." But whether or not you agree or disagree with that assessment, interestingly enough, the hype has continued.

For some reason there seems to be a general feeling that Smart Grid needs some kind of a punch line – something really big and bold – before it can be fully legitimized or validated. However, I think those expectations may be misplaced, especially if we consider where we really are and where we think we need to be now that we have all of this hype under our belts.

First of all, I think you have to look at all of this from an *evolutionary*, rather than *revolutionary*, perspective. When it comes to automation – now that we're about 50 years into it – we've clearly come a long way, and of course, we still have a long way to go. But within the past five decades we've seen mainframe computers give way to minicomputers; then microcomputers, followed by micro-controllers, IEDs, smart phones, and most recently, ultra low-cost, ultra low-power sensors and endpoints. And so far, technology advancement is showing no signs of a slow down. During that *evolution*, however, there has been a lot of *revolution* with each passing stage. I won't say that we're past the potential for revolutionary developments — that's always just around the corner — but for energy and utility markets, I think we can say with some alacrity that we're ready to capitalize on the evolution that has already taken place. Simply stated, it's time for things to crystalize to provide that tangible ROI along with all of the other promised benefits.

Think of it this way: 25-30 years ago, almost nothing was off-the-shelf, standardized, or interoperable from one generation to the next — there was LOTS of room for REvolution! But today, that has all changed; standardization (electrical, mechanical, etc.), compatibility and interoperability abound. Among other things, that means we don't really need a lot of revolution at this point. What we do need is application-centric (i.e., real-world problem-solving) value – and that only rarely, if ever, comes in the revolution phase.

Now, before you get all excited and accuse me of being 'anti-innovation' (hardly!), let me clarify that I'm talking about traditional products, systems, platforms and markets — the ones we all know so well like GIS, CIS, SCADA, etc. These are mature markets for which the initial investment costs are dwarfed by the life-cycle costs. Sure, there's still plenty of room for revolutionary developments – and they will happen – but these mature markets are now stable enough to wring tangible value out of those massive investments made over the passing decades.

So rather than clamoring for a Smart Grid revolution, let's put our efforts toward capitalizing on the fruits of the evolution that has already taken place – and in doing so, help to prepare ourselves for whatever 'revolution' comes next. – ***Ed***.

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INDUSTRY NEWS

Toshiba Acquires Landis+Gyr
To accelerate development of global Smart Community business

Tokyo, Japan - Toshiba Corporation (TOKYO:6502), a world leader in electronics and social infrastructure systems, announced on May 19 that it has entered into a definitive agreement to acquire the entire equity of Landis+Gyr AG, a company incorporated in Switzerland and a global leader in energy management solutions for utilities, from the company's shareholders and warrant owners. The acquisition, valued at US$2.3 billion (approximately 186.3 billion yen) including net debt, will substantially enhance the scope of Toshiba's Smart Grid and Smart Community businesses and position the company as a global competitor with world-class capabilities.

The acquisition is subject to regulatory approvals and other customary closing conditions.

Benefits of the Acquisition

Projects to establish Smart Grids are being promoted by countries and regions around the world, toward achieving the modern and more environmentally friendly infrastructure essential for a low carbon society and sustained economic growth. Forecasts indicate that the next decade will see the Smart Grid market grow to 5.8 trillion yen, six times today's level.

While the original Smart Grid business mainly covers power system network management, the latest trend is a shift to a higher level concept, 'Smart Community'. This supports diverse infrastructure systems, including energy, water, transportation and ICT, delivers comprehensive solutions to consumers, and secures the integrated modernization of the overall infrastructure supporting entire towns and cities.

Toshiba Group, an innovator in environmentally conscious businesses that support realization of a low carbon society, positions the Smart Community business as a new focus area and is determined to maximize its presence and capabilities in the business.

Established in 1896, and now with over 8,000 utility customers globally, Landis+Gyr has pioneered the development of leading-edge smart metering, networking and service products to meet the needs of the utilities industry. Its business operations now extend to 30 countries and regions across five continents.

Landis+Gyr provides a wide range of smart meter solutions, from advanced interactive communication technologies to various applications and services based on data collected from the meters.

The combination of Landis+Gyr's advanced smart metering technologies and services, plus its extensive customer base, with Toshiba's comprehensive expertise in energy management for utility companies and the corporate (buildings) and consumer (homes) sectors, will allow Toshiba to provide customers with sophisticated one-stop solutions that offer communities optimum power monitoring and management, plus effective applications and services based on cloud computing technologies.

By drawing on the diverse capabilities of each company and maximizing synergies, Toshiba will enter new business domains encompassed by the Smart Community concept, centering on integrated energy management systems.

Upon completion of the acquisition, Toshiba will promote operational and technological synergies and further growth in its Smart Grid and Smart Community businesses, toward achieving net sales of 700 billion yen in fiscal year 2015, against current annual sales of 300 billion yen.

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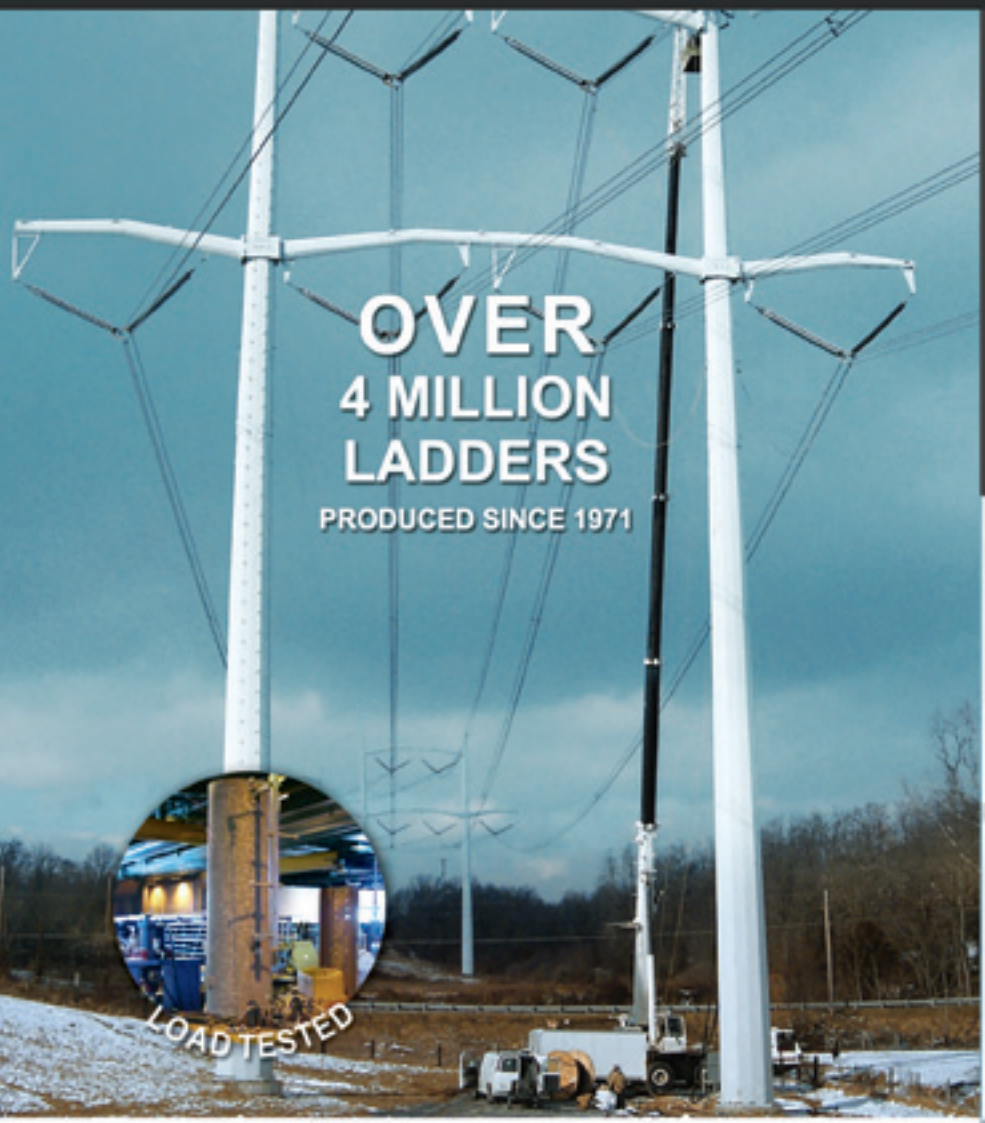

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About Toshiba's Smart Community business

Toshiba established a dedicated Smart Community Division to promote its Smart Community business in October 2010. The division reports directly to the president & CEO.

On April 1, 2011, Toshiba established a new in-house company, the Social Infrastructure Systems Company, which reinforces Toshiba's ability to offer integrated solutions across power transmission and distribution, a broad range of social infrastructure, including railway systems, automotive systems and rechargeable batteries, and to support the Smart Community business.

As a pioneer in the Smart Community business, Toshiba is already involved in a number of Smart Grid and Smart Community demonstration projects in Japan and overseas, including the U.S., France and India, that will ensure customers can access promising solutions and well-proven technology.

Business operation after the stock acquisition

Toshiba and Landis+Gyr will together develop total energy solutions that meet diverse hardware and software standards and deliver Smart Grid and Smart Community products and services worldwide.

Landis+Gyr, as a standalone growth platform within Toshiba, will continue to hold its properties, equipment, employees and trade mark rights, and will expand and reinforce business by making use of complementary relations with Toshiba. The company will aim to expand orders received in Europe and the United States, and in China, India and Brazil, which are promoting rapid modernization of social infrastructure.

Landis+Gyr is expected to exploit synergies with Toshiba's energy management business to create new business opportunities. Beyond this, Toshiba and Landis+Gyr will cooperate closely in developing and executing business strategies and promoting operations.

As its works to maximize synergies with Landis+Gyr, Toshiba will continue to promote alliances with leading-edge companies around the world, centering on cloud computing and solutions services, aiming to expand its global operations and to grow the Smart Community business.

Outlook for the current fiscal year

The possible impact of this acquisition on Toshiba's FY2011 business performance has yet to be determined.

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Majority of Consumers Ready to Consider Buying Plug-in Electric Vehicles, But Challenge Utilities with their Car Charging Demands, Accenture Study Finds

London - The majority of consumers would consider buying a plug-in electric vehicle (PEV) for their next car purchase, according to a global study by Accenture (NYSE:ACN). But an accompanying report concludes that consumer preferences for charging PEVs could increase the cost and complexity of managing the electricity grid and charging infrastructure.

'Plug-in electric vehicles: changing perceptions, hedging bets', a study of over 7000 people in 13 countries, found that 60 percent of consumers would consider buying a PEV for their next car purchase. 68 percent would probably or certainly do so within the next three years (23 percent certainly, 45 percent probably). Respondents in China are by far the most enthusiastic, 96 percent of them probably or certainly considering a purchase in the next three years.

Consumers' preferences for charging PEVs, however, could challenge utilities and charging service providers by increasing grid congestion and peak time electricity demand.

- Two thirds (67 percent) of consumers are not willing to let charge point operators limit when they can charge their PEV. A further 20 percent would only accept limits if they fell within time periods they had chosen. This would reduce the scope to manage electricity demand and avoid grid congestion.

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- 62 percent would reject battery swapping, where empty batteries are quickly replaced at service stations for fully charged ones, preferring to plug in their car to recharge the battery. This could limit the opportunity for charging off peak, when battery swapping companies would most likely refuel batteries.
- 55 percent would only plug in their PEV when they need to charge up, rather than whenever they park. This behavior could result in less predictable charging patterns and could reduce the demand for public charging infrastructure.

Consumers would also need more supportive charging infrastructure in order to adopt fully electric PEVs. Only 29 percent of car drivers would buy fully electric PEVs. 71 percent would prefer plug-in hybrid EVs (PHEVs), which run on gasoline / diesel once the battery runs low. 85 percent say fully electric PEVs have insufficient battery range to cover their daily driving needs. But 83 percent cite the insufficient availability of charging points and 70 percent think charging times for full plug-in EVs are too long.

"As drivers get behind the wheel, they may become more open to fully electric vehicles and battery swapping services. But denser charging networks and fast charging units will be required if utilities want to drive up demand for all plug-in electric vehicles," said Matias Alonso, global managing director, Utilities, Accenture. "The uncertain demand for plug-in electric vehicles and their impact on the grid means that energy providers must choose between running the risk of network overload and the need for large infrastructure investment, or early deployment of smart technologies that proactively manage local electricity demand and supply."

Cost not the only factor of adoption

The fuel source of electricity is important to car drivers. 80 percent would want to know the source of the electricity used to charge their car. 45 percent say that the fuel source would have an impact on their decision to buy a PEV. Of these, 85 percent would be encouraged to buy a PEV if the fuel source was renewable. Nuclear and fossil fuel generated electricity would discourage 48 and 51 percent respectively from buying a PEV.

The cost of PEVs is not currently the only key factor of adoption. 51 percent of consumers would be motivated to buy a PEV for their next purchase if the total running cost was lower than for a conventional vehicle. More important, however, would be the availability of charging points (63 percent) and the battery range being equal to a full tank of a conventional car (53 percent).

When asked what incentives would encourage them to switch to a PEV, 65 percent of respondents cite free parking, 44 percent point to toll discounts and 43 percent to the availability of priority lanes as potential incentives.

"The cost of buying and running plug-in electric vehicles will be a major factor determining take up, but city authorities and energy providers will have to motivate drivers in non-financial ways if they are to push up adoption," said Matias Alonso. "Stimulating demand for plug-in electric vehicles at the lowest possible cost to investors and taxpayers will require the public and private sectors to segment the market and offer a range of non financial incentives. For instance, young urban drivers may be attracted by the availability of parking concessions and the guarantee of renewable fuel sources."

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Competition for charging services

Utilities may face strong competition in the charging services market. When asked who they would prefer to buy charging services from, 79 percent put utilities in their top three choices. 71 percent listed gas/ diesel service stations in their top three. Retailers and local governments fare less well on 51 and 48 percent respectively. The vast majority of car drivers would want to pay as they charge, as they do for fuel today, requiring utilities to consider changes to their revenue and billing systems if they are to service the market.

Recommendations for energy utilities

1) Reach consumers through commercial alliances with automotive distributors: this will help monitor local demand for PEVs and their impact on infrastructure. It will also give them advantaged access to new customers as they purchase PEVs.

2) Optimize infrastructure through collaboration with distribution network operators (DNOs): This includes investing in smart charging to automate charging at times and speeds optimal to the grid and generation capacity. Utilities should also use analytics to exploit consumer usage to better determine patterns of demand and supply.

3) Engage consumers through market segmentation: Target customer groups with different offers to increase margins as adoption rises. Utilities should also ensure the focus of PEV pilots covers the customer experience as well as technology issues.

For more information, visit: *http://www.accenture.com/us-en/Pages/insight-plug-in-electric-vehicles-changing-perceptions-summary.aspx*

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2011 GreenWays Series

Leadership for a Clean Energy Future

Opower

Arlington, VA USA

By Daniel Yates, CEO/Founder and Alex Laskey, President/Founder

I guess you could say that Opower is a different kind of company – a really different kind of company. While at first it seems that they're just another "Smart Grid' company. But after reading this interview, you will probably find – just as I did – that they take a very different approach to energy efficiency and demand response than most other suppliers in that realm. I recently had the opportunity to talk with the co-founders of Opower about the genesis of their company and its admirable accomplishments in the barely four years since its founding in 2007, as well as some interesting insights regarding how human behavior figures into achieving realistic, tangible goals for energy efficiency. – ***Ed***.

EET&D: When I first heard about Opower, I didn't immediately grasp the idea that it wasn't going to easily fit into a conventional supplier category or classification. There are so many new CleanTech startups vying for a piece of the burgeoning Smart Grid market that are essentially variations, combinations and permutations of existing technologies, that it was quite a surprise to find something that was truly different. But let's begin by explaining a bit about "that thing you do" for our readers.

Yates: Well, I suppose we really are different from a lot of other companies that are focused on the Smart Grid space. Our company was founded on the premise that it's time to engage the 300 million Americans who are in the dark about their energy use. Alex and I combined our talents to actualize our belief in the power of information to improve people's lives. Together, we envisioned a product focused on providing energy information to all, and created a company that would empower people to make smart decisions about conserving resources, reducing their energy consumption and helping to preserve our planet.

EET&D: One of the first things I noticed is that unlike a lot of the companies in the Smart Grid space, you really aren't pushing a particular set of equipment or system architecture, and there is really nothing that requires new standards or standardization; that has implicitly dangerous cyber vulnerabilities; or that requires huge capital investments, is there?

Yates: No, there really isn't. The Opower platform simply enables utilities to connect with their customers using existing communications channels: email, mail, SMS, phone and web. We can achieve a lot by making full use of what we already have.

EET&D: Eight of the ten largest utilities in the United States currently use your products to improve the effectiveness of their energy efficiency portfolios. How did you manage to accomplish that in such a short period of time?

Yates: We've been very fortunate in many ways, but like other enterprises that have successful products, it started with being focused and not trying to do too many things at once. We decided early on that sending information, not installing devices, was what we wanted to do, and we developed one communication channel at a time; we started with mail. As a consequence, we were able to build a highly effective customer engagement platform that today scales with ease across nearly 10 million households. We also took the time to consult our Chief Scientist, Robert Cialdini, and apply behavioral science research to our product design.

EET&D: Actually, I've reviewed a few of the reports on this topic and noticed that they identify some really interesting aspects of human behavior, especially as regards to what I'd call the inherently competitive spirit of most people. Can you elaborate on that a bit?

Laskey: Yes, that competitive spirit you refer to really is an important dimension of what drives people to do what they do, whether it's energy efficiency or something else in their lives. As you have pointed out, it's important to consider that the intent of these programs is to influence human behavior, much of which – when it comes to energy use – is as much a matter of habit as anything. There's a passage from the 2009 Franklin Energy Report outlining behavioral change in residential energy use that I think sums things up rather well regarding the scientific foundation for this approach…

"Many of the ways in which consumers use energy at home are the result of behaviors like how and when we turn on and off lights and televisions in the rooms we use, how we set and adjust our thermostats, our practices in doing laundry and running our dishwasher, the frequency with which we replace furnace filters, even the length of the showers we take and whether we unplug our cell phone chargers when they are not in use. Impacting these habits is difficult for a number of reasons.

First it is important to recognize that electricity is an enabling product – consumers don't turn on the television or the lamp to use energy, they want to be entertained and they want to see. Electricity is an intangible necessity that, as BC Hydro identifies, like toilet paper is a dissatisfier we take for granted until it is missing (BC Hydro 2008). This is the first challenge [of] any behavior change program; they must get people to notice and care about their energy use.

Secondly, behavior programs are largely focused on changing old habits. The benefit of habits, as Corinna Fischer [from The Federation of German Consumer Organizations in Germany] relates, is that habitual behavior is functional because it allows us to avoid expending the time and effort making decisions on issues that re-occur frequently and for which we have developed a means of addressing. The challenge is to break this cycle and protocol in order to get individuals to adopt more energy efficient habits." (Franklin Energy Report; 2009)

And another report on human behavior prepared by Cialdini in 2004 (see excerpt following) helped to establish our belief that we could use behavioral science to accomplish what a lot of other companies have tried and failed to do with various combinations of technology and financial incentives. That report showed that we all make our decisions in significant part based on what others are doing. If you think about it, when you hear that a lot of other people are doing something, there's an immediate curiosity in almost all of us that drives us to at least find out more. Tapping into this instinct is one of the keys to driving behavior change.

"The results from these studies clearly show the power and applicability of normative messages. Across our three-year set of studies, we have consistently found: a) that normative beliefs are correlated with behavior, and b) that normative messages can cause a change in behavior. The results from these studies are currently being written up for peer review and possible publication. In future research, we intend to continue our studies of normative social influence. One question that emerged from these studies concerns the process of social influence. Consistently across our studies, participants rate normative messages as the least effective and believe that they are not influenced by their perceptions of others. But our data show otherwise." ("Understanding and Motivating Energy Conservation Via Social Norms"; 2004)

EET&D: How does your solution fit into the bigger picture for utilities investing heavily in Advanced Metering Infrastructure?

Laskey: The Smart Grid is great, and it makes our platform stronger. For example, with more timely data coming from smart meters, we can deploy features like giving folks email or SMS alerts telling them they're headed for a high bill that month. People appreciate this information and feel more empowered as a result. By helping utilities roll out such services we help their customers clearly see the value of the smart meters.

EET&D: What do you think the success you've had with this concept say about the prospect of getting consumers to adopt energy efficiency as a lifestyle change?

Laskey: We estimate that around 85% of people utilities communicate with through our platform not only pay attention but take some kind of action. That's quite an astounding figure, and it proves that the vast majority of the people don't want to waste energy and are quite willing to make changes when given the right information. So large-scale behavior change is possible and it all starts with increased transparency and education.

EET&D: What about the tangible incentives associated with these programs; are they at all quantifiable?

Laskey: Yes, absolutely. These programs deliver an average of 1.5% to 3.5% in energy savings across the entire participant population. That may not sound like a big number, but it's important to remember that we're talking about the aggregate here – it includes people who may not open their mail or read the email. To put it in context, if everyone in the United States had access to better information about their energy, we could help people start saving enough energy to power more than three million homes, each year – that's about as much as the amount of energy produced by the entire wind power industry. Several reputable scientists have looked at our data and verified that this is quite achievable.

EET&D: Can you put that into more specific terms relative to how much energy is actually being saved once the product is put into place at a given utility?

Yates: Depending on location, this means 150 to 300kWh in annual electricity savings per targeted household, or 10 to 15 Therms for gas customers. These are real savings for utility clients, and real dollars for consumers.

EET&D: Dan, would you like to take a shot at summing all of this up for our readers?

Yates: Sure. Opower is working with utilities around the world to help them transform the way they interact with their customers and in the process really make a huge leap forward in energy efficiency. We are a rapidly growing team of software engineers, product specialists, behavioral scientists, and efficiency advocates and are already engaging nearly 10 million households across the US. Helping ordinary people find easy ways to save on their energy bills is our passion; making an unprecedented impact on the health of our planet is our goal. And we hope that every one of your readers will join us in that quest!

Smart Grid as a Service: An Alternative Approach to Tackling Smart Grid Challenges

By Tom Damon and Josh Wepman, Science Applications International Corporation (SAIC)

Building a smarter grid is difficult. It is never an easy undertaking when a utility, large or small, is faced with making major investment decisions, especially when they can represent a similar order of magnitude as would be required for building a new power plant or transmission line. The process of selecting and implementing smart grid technology solutions can be quite a risky venture. This is especially true because technology is expected to impact all facets of a utility's business for the next 15 to 20 years.

The burning platform – A catalyst for change

Deciding on a course of action, given an organization's specific set of financial circumstances, current technology investments, and strategic business requirements, can only make the process more complex. Are we moving too fast? Are we moving too slowly? Is the market mature? Will it ever be mature? How can we invest today in something that is constantly changing and evolving? How can I manage the risk to my operations and enterprise?

Smart grid is hard because it blends so many disparate parts of an organization together and forces utilities to excel in each of these areas. Many utility leaders have boldly invested in these changes, and a wealth of experience and lessons are available from their investments, actions, trials, and tribulations. Based on these experiences, different approaches are being considered to the traditional version of asset ownership and deployment.

Challenges to success – Where it gets difficult

Smart grid is often described as a set of new technologies deployed over transmission and distribution systems. While any smart grid deployment likely includes new assets and technologies, challenges often arise for smart grid when those new technologies need to be integrated into the business, supported by IT and operations, and operated efficiently enough to deliver the benefits promised. With limited budgets, challenging business cases, and a need to focus on existing operations, integrating new technologies into operations often takes a backseat to asset deployment, thus limiting the value programs are able to deliver. Utilities end up with infrastructure but lack the ability to develop the benefits to be derived from integrating that infrastructure into the business.

Those who are implementing smart grid successfully – with or without DOE funds and moving beyond simply introducing new assets and technologies – are able to address a set of key challenges within their operations. Without tackling these areas, smart grid fails to move from technology to business transformation. A number of the key challenges are explored below.

Security: Utilities need to apply world-class security capabilities across the technical, operational, and management security domains. While there is no smart grid security "standard," there are industry guidelines and best practices that need to be intelligently applied. Since security excellence and extensive risk management often have a particularly poor business case, utilities need to make sure they are maximizing their ability to efficiently manage risk in the investments they make. Critically, utilities need to know how much security is "enough" in a world of evolving and expanding security risk, impact, and probability. Security design is one dimension, but integrating smart grid into security operations and lifecycle risk management is ultimately a critical dimension successful utilities need to be able to address. In addition, security must be executed in concert with North American Electric Reliability Corporation Critical Infrastructure Protection (NERC-CIP) and other potential regulatory and compliance mandates.

Operational Excellence: Utilities need to operate investments as an example of operational maturity and excellence across the people, processes (well documented and demonstrable), tools, and technologies involved. Otherwise, it is a constant challenge to derive the value and benefits out of the solution. Many utilities focus too heavily on the capital assets and installation, instead of the operational tools or, critically, the people required to operate effectively, securely, and efficiently. Successful utilities understand the need to "plan for excellence" in operating new services and in enabling technologies.

Obsolescence Avoidance: Most utilities need to make their investments count. Today, the lifespan of new assets needs to be long enough to recoup the costs and deliver the benefits, without breaking the bank. More importantly, they need to know that they can enter the "smart grid" universe at a comfortable and accessible entry point and grow into their future once they understand the value better. Successful utilities have confidence that their up-front investments will deliver business benefits as well as lead to the next logical step down the evolutionary road.

Modular Functionality: Utilities should enable the functionality that supports their business case; not everything the manufacturer offers. They need to be able to select the functions that have a meaningful impact to them and grow as their needs grow, rather than buying everything up front. That's where budgets get eroded. Successful utilities are able to avoid the trap of buying everything today, at too high a cost, and having nothing left to integrate smart grid into their business operations.

Investment Clarity: Utilities need a full understanding of solution and capability costs as well as the risks; not just another set of unknowns. Utilities need to be able to represent the full lifecycle costs of the people, processes, and tools involved with smart grid so they can develop a complete cost perspective. Successful utilities maintain a clear understanding of cost and benefits and are able to reduce their need for ongoing pilots and test systems.

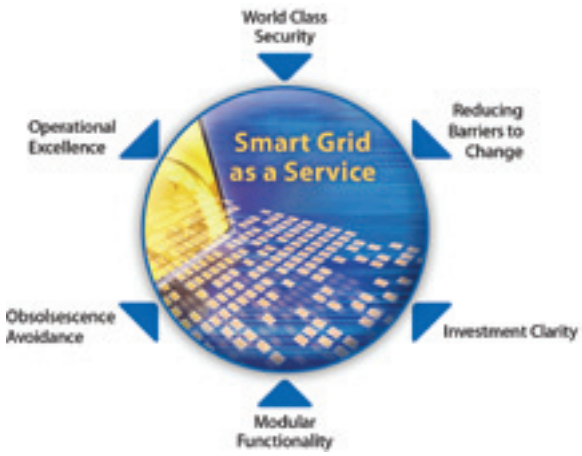
Reducing Barriers to Change: Utilities also need to focus on their core mission and not on a continuous set of enabling infrastructure distractions. Successful utilities are more likely to focus on leveraging actionable intelligence and information as opposed to exhausting their energy on designing and building the assets and communications that supply data.

In the end, the utilities that succeed in smart grid are those that focus on their core missions and augment their operations through smart grid value. Those who have invested, but failed to derive the perceived value in smart grid thus far have frequently gotten overwhelmed with the distractions and externalities that the enabling assets and technologies create.

How Smart Grid as a Service is helping

Successful utilities deploying smart grid should be able to address these challenges, but few are able to do so on their own. An increasing number of utilities are looking at procuring services instead of building out custom capital assets. More and more utilities are finding a better business case and investment justification through externalizing some dimensions of the "net new" infrastructure. Smart Grid as a Service, a key focus and offering of SAIC, can provide more certainty, clarity, and value through addressing some of these significant core challenges.

Figure : Smart Grid as a Service Value



Security. Smart Grid as a Service provides real, responsible, and defensible security, applied throughout deployed assets and their ongoing operations. Many utilities get pressed on business cases and agree to too much risk in order to make the numbers work. Smart Grid as a Service can make strong and lasting security investments and distribute the costs across clients. Meaningful security is an intimate process of identifying, measuring, and managing risk. Smart Grid as a Service can also accelerate organizations' abilities to identify and manage risk in a meaningful way, without having to reinvent the wheel.

Operational excellence. Many utilities operate their technology investments on an ad-hoc basis. One of the most challenging aspects of smart grid can be investing in and maturing IT systems often seen as a cost center, not a core business area. Smart Grid as a Service can bring out-of-the-box operational maturity and excellence that allow utilities to start realizing benefits immediately. No more roadmaps to maturing IT in order to start smart grid; Smart Grid as a Service allows utilities to take big steps forward in maturing their business right out of the gate.

Obsolescence avoidance. Most utilities can't afford constant new capital investments. They need to select the right ones and make them count. In an emerging landscape of constant change like smart grid, selecting the right technologies and platforms for today and tomorrow can be a challenge. Smart Grid as a Service providers aren't tied to individual vendors, technologies, or solutions. They have the ability to take a best-of-breed approach and are constantly motivated to do so in order to bring leading-edge capabilities to utility businesses. As a result, Smart Grid as a Service helps externalize the obsolescence risk.

Modular functionality. Most advanced metering infrastructure and smart grid solutions are "all in." You get all the functionality of a platform, at all the price. Smart Grid as a Service allows utilities to buy only what they need – no more, no less. This approach allows utilities to start wherever they are, wherever makes sense and to grow incrementally as their needs and business cases allow. Utilities can take this approach and have faith that their investment will meet service level agreements (SLAs) throughout the operational lifecycle.

Investment clarity. How much is it going to cost ultimately? What does a fully burdened operational lifecycle cost? Most utilities get stuck in continuous pilots working to discover benefits, and more importantly, a real idea of costs. Smart Grid as a Service can abbreviate or remove the pilot phase by providing clear functionality, service levels, and costs throughout the service's lifespan. Smart Grid as a Service can provide clear benefits, clear costs, and often times, clear catalysts for change, without the uncertainty of people, processes, and tools that go along with it.

Reducing the barriers to change. Even in the best climates, absorbing significant operational and technological change can be a real risk to daily operations and focus. Most utilities have a need for operationally actionable intelligence and enterprise functionality, but the risks of transforming themselves into an IT company prevent them from achieving that functionality. Smart Grid as a Service is allowing utilities to externalize the technological distractions and focus on improving core operations through dependable mission critical smart grid intelligence.

Smart grid as a Service reduces the utility's challenges associated with IT, but does not confuse IT with energy operations. Smart Grid as a Service providers need to be much more than IT operators or telecoms organizations. They need to bring experienced system operations and planning: an ability to bridge IT and operational technologies and an ability to translate technology into value and value into services. Smart Grid as a Service addresses IT challenges in a mature and focused manner, but needs to address much more than just IT in order to truly help utilities transform and mature.

Smart Grid as a Service versus do-it-yourself smart grid

In a world where "fit for purpose" solutions such as Smart Grid as a Service exist, the traditional smart grid project can be considered a "do-it-yourself" project. Smart Grid as a Service resembles do-it-yourself projects in many ways, but maintains important differences by primarily shifting the focus from assets and enabling technology to business value and operational investments. The goal of Smart Grid as a Service is fundamentally to provide defined functionality at consistent SLAs and metrics. With this goal in mind, Smart Grid as a Service allows utilities to worry less about specific technologies, for example the subtle differences in radio transmitters, and more about consistently providing the business justified value. Smart Grid as a Service concentrates on delivering benefits to organizations, period.

Smart Grid as a Service has many of the same components and functions as do-it-yourself solutions. For example, in advanced metering infrastructure approaches it includes meters, in-home assets, ZigBee, wireless systems, head-end control platforms, enterprise services buses, meter data management systems, analytics platforms, etc. Additionally, in advanced distribution operation systems, Smart Grid as a Service includes sensors and communication systems for collecting feeder data, state estimation tools for validating data, and analysis platforms for developing and distributing actionable information about system optimizations to reduce costs and improve service. The material difference between Smart Grid as a Service and do-it-yourself is in who designs, builds, operates, and owns the infrastructures, services, and performance requirements. Do-it-yourself investments leave all of that on the operator. Smart Grid as a Service investments make practical choices about where investment and ownership should reside.

Figure 2: Overcoming the Six Fundamental Challenges to Smart Grid

What Smart Grid as a Service is NOT is an endless distraction of technology choices. Smart Grid as a Service operators pick the technologies that can deliver benefits, achieve operational excellence, demonstrate exceptional security, and deliver functionality at or above defined service levels. Smart Grid as a Service is pre-integrated across technologies and operations, leaving organizations able to focus on matching function and value to each utility's mission, culture, scope, and business case.

Moreover, Smart Grid as a Service customers don't have to choose a service-oriented architecture and enterprise service bus solution, if indeed they need the latter. They don't have to perform vendor test implementations and test-beds, or spend years evaluating competing technologies. Smart Grid as a Service customers buy solutions that are designed and delivered to perform to expectations around quality, security, efficiency, and efficacy.

Smart Grid as a Service begins in the design phase where business and benefits cases are defined and understood. Requirements are developed and specifics around territory, geography, consumer breakdown, financials, and business process are all mapped in order to determine "what success looks like" at that particular utility. Once requirements are understood, the relevant components from a Smart Grid as a Service portfolio are matched in order to deliver the scope of functionality at the service levels required. In the build phase, meters will need to be deployed, communications systems deployed and optimized, and business process transformed.

In do-it-yourself projects, hosting and datacenters need to be transformed or created; disaster recovery and business continuity plans need to be extended; investments in power and cabling need to be made; and talent needs to manage the deployment in perpetuity. Smart Grid as a Service projects on the other hand have the back-office transformation completed in the cloud without the need for the people, the processes, and the breadth of tools to monitor, measure, and report on each component or the services built on top of them. Do-it-yourself investments need to build the tools required to monitor and maintain security, 24/7. Smart Grid as a Service can leverage existing and mature solutions already deployed across the breadth of energy and utility security control catalogs and best practices.

In the operations phase, the two approaches diverge significantly again. Do-it-yourself programs now need to transform their organizations into mature, aggressive, and leading edge IT shops. Focus needs to move from utility core missions to IT lifecycles and operational maturity. Staffs must be identified, trained, and then retained in a booming labor market. Conversely, Smart Grid as a Service clients manage their vendors and monitor that their "net new" infrastructure performs. It also allows the utility to continue to deliver their core mission: reliable and safe energy to consumers. Critically, Smart Grid as a Service clients are now able to focus on their core missions with the aid of smart grid capabilities, but can do so without the distraction of an IT and security shop growing beyond expectations, desires, and identified budgets.

Conclusion

Smart Grid as a Service certainly isn't for everyone. Some utilities are already too far down the path to take a different approach. Some have already made the difficult internal investments required to transform themselves into nimble, effective, and mature IT and security operations that get the most out of their investments. However, for those who seek to maintain focus on core functions and staff, and are looking for a more rapid, fit-for-purpose, and cost-effective smart grid transformation, Smart Grid as a Service has begun to catch the attention of cost-conscious and focused utilities. Instead of utilities becoming large IT organizations, some utilities are choosing to focus on their core mission, and engaging partners whose core mission is operational excellence in smart grid critical infrastructure operations and security. ■

ABOUT THE AUTHORS

Tom Damon is vice president of SAIC's Smart Grid Solutions. He has spent more than 27 years assisting utilities with developing strategies and tactical requirements pertaining to workforce automation technology selections; process change management; and systems integration options and their impact on people, data, and technology management in solving business process issues for electric, gas, and water utilities. He has experience at all phases of the technology solution delivery cycle, including business case development, business and technology use case requirements, cost/benefit and gap/feasibility analysis, executive briefings, and project management from conception to fully functional deployment. Mr. Damon also has experience with systems integration for creating the smart grid, including advanced metering infrastructure, advanced distribution and transmission operations, demand response, direct load control, home area networks, meter data management, outage management, geospatial information, distribution automation, and business intelligence implementations for the utility industry.

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LightsOn

Smart Grid Service Management Helps Utilities Avoid the Innovation Death Spiral

By Ian Mitton, Worldwide Director-HP Enterprise Business for the Utilities Industry and Roy J. Pratt, CTO-HP Enterprise Services, Energy Industry (Utilities) Hewlett-Packard Company

The utility industry is at a crossroads and the introduction of smart grid technology introduces disruptive effects. Governments are mandating more open and competitive markets, requiring new smart meter technology to conserve energy, and demanding more reliable security of supply. There is an increased pressure to reduce the massive energy carbon footprint and provide more renewable sources for energy. Technology modernization is opening the door for intelligent grids backed by new world information systems that demand more information exchange than ever before. An increasing move to de-regulated competitive markets, and the introduction of new players, is placing new demands on established utilities companies.

The Challenge of Connected Intelligence

To gain competitive service advantage in the face of new customer and constituent patterns requires that technology be at the very forefront of enterprise innovation and growth. Tomorrow's leaders will be organizations that embed technology in everything they do. For utilities, this means smart grid service management, service oriented architecture (SOA) and 'connected intelligence'. This will enable them to capitalize-on, rather than simply adapt-to, customer expectations.

The Power of the Smart Grid

The promise of the smart grid is in the data and power it holds to transform the relationship between consumers and utilities. Vast amounts of granular consumption data have been made available. This explosion of information requires a solid plan for its management, maintenance and usage.

Properly handled, data analysis can open the door to new markets, new services and new lines of business. In a smart grid, the end-point network devices don't just gather data. They communicate vital information to provide a deeper understanding about supply and demand. Providing consumers with detailed information on appliance performance and energy management services can help consumers conserve and save, as well as funnel important usage information back to the enterprise.

From the outset of any smart grid program, utilities should plan on enhancing the analytics environment or building a strong information optimization strategy that harnesses data and delivers it in the right context for the business.

Customer-Centric Focus

To succeed in this environment, utilities need to become more customer-centric, offering new services that bring value.

Utility companies must serve customers, employees, partners and citizens with whatever they want and need, instantly, at any point in time and through any channel. They must use technology to integrate and automate the value chain. It adapts easily and innovates rapidly; it manages risk and environmental responsibilities.

Home Area Networks (HANs) will evolve to integrate the customer experience in the home with components that send and receive real-time information from utility and third-party providers. Additionally, Internet access will provide a secure utility portal to monitor and compare detailed energy consumption. And, as smart grid technology moves from concept to implementation, the utility-customer relationship will fundamentally change. Customers will have newfound tools and information to help utilities drastically reduce demand spikes and drive energy conservation. Monthly paper bills and outage calls will be things of the past. The customer of tomorrow will demand daily, if not hourly, interaction with their utility provider.

Lessons Learned from the Telecommunications Industry

The utilities industry's transition to smart grid will be as dramatic as the shift from landlines to mobile phones was for the telecommunications industry. There are several lessons that can be applied from one industry to the other.

This shift requires changing the current approach to provisioning energy (and other resource) infrastructure, to one that concentrates on empowered consumers. This is not an easy task, but utilities have the opportunity to learn from the telecommunications industry. Over the past two decades, telcos have moved to a customer-centric business model, having navigated similar challenges to those now facing the utility industry. Key lessons and best practices in service management, connected intelligence and service oriented architecture apply.

Grid Service Management

One of the key issues facing utilities is the service management of the grid. Today's distribution networks have little to no form of network supervision or management. As smart meters are rolled out, the suppliers are focused on data output and management from the meters. However, the smart meter will also provide an important sensor point at the end of the network.

By applying advanced networking tools and business analytics, events and alarms emanating from the intelligent networks are correlated and provide key information that will positively influence security of supply and customer satisfaction. Today's smart meters deliver advanced capabilities to monitor multiple types of energy usage in defined time periods. In addition, smart meters come equipped with a multitude of communications technologies, allowing them to share data and receive command and control signals from the utility company. LAN and WAN communications enable smart grids to cover diverse geographical areas.

However, as smart meters, low cost sensors, and other devices that communicate over the network become pervasive on grids, utilities will have the added challenge of managing tens or even hundreds of millions of devices just as the telecommunications industry has implemented provisioned solutions to manage the real-time networks of millions of mobile phones.

Smart Grid Maturity

Most utilities' major systems environments were designed 20 or 30 years ago when the primary objective was reliability and simplicity. These legacy systems require significant modification to handle the granularity, volume and timeliness of new data when integrated with new smart grid-specific systems. Therefore, it is critical to identify the primary objective of a smart grid project upfront to achieve the appropriate level of smart grid maturity. Simply securing cost savings through automated meter readings is very different from implementing AMI to enhance customer relations and conservation capabilities. Smart grid vision and maturity evolves in stages that build upon one another.

Smart Grid Phases, Attributes and Capabilities

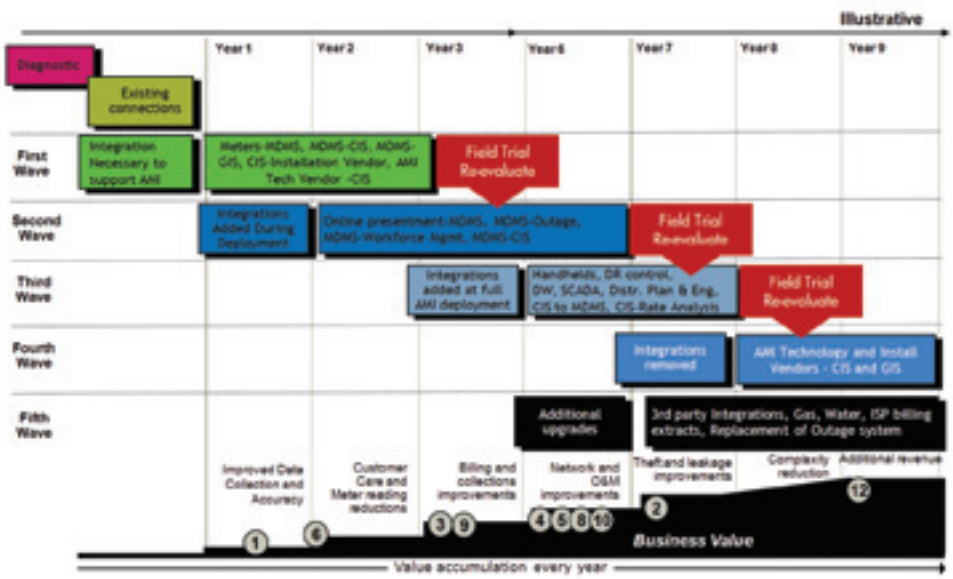
Key Attribute	Solution Goal	Smart Grid Capabilities
Proactive Control	Event Avoidance	• Increased use of sensors for Grid condition and Predictive Response • Correlation of Events • Remote management action • Artificial Intelligence modeling
Real Time Sense & Respond	Automation to react to grid alarms/alerts (Distributed generation safely accommodated)	• Improved Asset Management • Meter used as a sensor • Transformer load management • Grid event detection & location • Automated Crew dispatching • Remote security monitoring • Theft detection (grid) • Power quality management
Two way Monitoring and communications	Automated meter interaction via AMI	• Communications infrastructure to the edges of your delivery system + data repository for billing and operations • Remote disconnect • Prepayment • Theft detection (local)

The key attributes to smart grid maturity include: proactive control, real-time sense and respond, and 2-way monitoring and communications.

The first phase of smart grid maturity introduces communications into metering. Digital application and implementation kick off as prices drop and performance improves. In time, automated reading systems are able to gather time-based electric consumption information and deliver granular information to the utility without reading meters on-site.

In the next phase, AMI improves communications considerably, giving more information to the utility and sending it from the utility back to the meter on an individual basis to control the meter.

A Phased Approach to Implementation



Smart grid implementation occurs in 5 waves and can take up to 9 years.

The third phase of smart grid maturity includes bi-directional device communication applied to customers and devices in electric grids, including wires, transformers and switching stations. All network devices deliver consumption information and how the network is responding. This empowers utilities to adjust network operations and optimize power delivery.

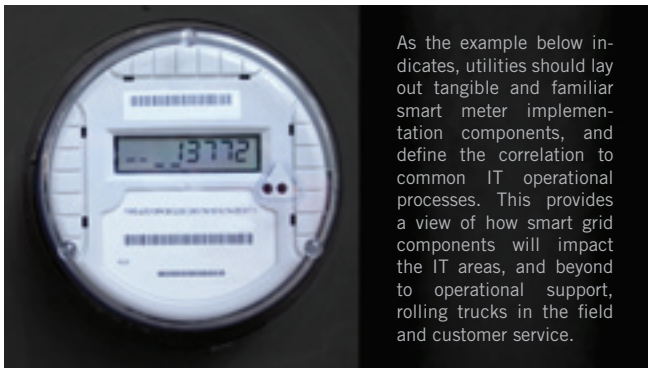
Service Oriented Architecture

Service oriented architectures (SOAs) are ideal for smart grid service management because they allow complex components to be integrated, as well as solutions to be built and implemented on a timeframe that suits the business. SOAs are modular and scalable, allowing an incremental approach to smart grid deployment that supports the reliability utilities require.

Architecture must drive interoperability between solutions and related consistency in operations because it defines how components will interrelate and integrate. As smart grid solutions continue to evolve and change, SOAs enable utilities to regularly re-validate components throughout proposal, build and deployment stages. As such, the architecture-based approach provides critical future-proofing and investment protection.

The SOA approach is logical and simple and gives flexibility to enhance the solution without deep-routed changes.

Utilities must avoid a too-large, big bang implementation, as unmanageability could risk a disruption in service. Because they represent a truly fundamental change, smart grid implementations are too large and complex to be handled all at once. Smaller packages of change will minimize risks and empower the utility to start reaping rewards incrementally.



As the example below indicates, utilities should lay out tangible and familiar smart meter implementation components, and define the correlation to common IT operational processes. This provides a view of how smart grid components will impact the IT areas, and beyond to operational support, rolling trucks in the field and customer service.

For example, many utilities realize the benefits of automated meter reading relatively early in the process while more complex functionality (e.g., pre-payment, load limiting or distributed generation) will yield the most benefit when applied to larger domains. Opting for a phased approach minimizes project risk and maximizes time value of benefits through an interconnected series of changes.

Connected Intelligence

Capacity planning is a core service management area where utilities can avoid missteps on their journey to smart grid. Having built network-based data storage systems independently of the business model and the operational and customer information, telecoms are now struggling to break out from this curtailing structure. Utilities must embrace this need for long-term planning. By building enterprise data warehouses, they will be able to plan for the increasing demand by providing "connected intelligence" across the whole supply chain.

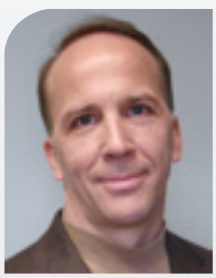
Managing the grid according to anticipated demand will be instrumental. The prevalence of digital technologies being applied to the grid and other disruptive influences such as electric vehicles (EV) and micro-generation are bound to change the dynamics of the grid. EV drivers will want to recharge their cars at a time that is convenient for them. Unless this is carefully managed, peak loads might be exacerbated.

As EV users are also likely to want to recharge at various locations there will be a requirement for utilities to reconcile these 'roaming charges' to consumers' home electricity bills. Once again, utilities can look to the telecommunications industry for a successful model in roaming and the consolidation of billing of customers' charges to their personal telecom bills.

Looking Ahead

Only a collaborative and open approach between utilities, vendors, partners, industry groups, regulatory bodies and the government will prove overall successful. Utilities should not take an introspective approach. Utilities should actively involve themselves with these groups to glean best practices on technology solutions, business models, regulatory approaches, financial justifications and customer marketing as well as communications. Grid service management can provide a common-sense approach which will ensure they are on the right track in developing a clear vision of future business requirements, which will help them avoid unnecessary pitfalls and investments on their path to success.

Ian Mitton is the HP Enterprise Business worldwide director for the Utilities Industry. His role includes developing HP Enterprise Business's global strategy and overseeing the creation of industry specific solutions that incorporate the company's broad portfolio of services and software. Mitton has been involved with the energy industry since 1999 and his responsibilities over that time have included seven years as a global client business manager for Shell, building relationships at the most senior levels and assisting Shell to align IT with their business strategy. More recently, Mitton was the business development manager for HP Enterprise Business's Energy and Distribution Industries vertical in Europe, the Middle East and Africa.



Roy Pratt is the chief technology officer for the Energy Industry Utilities practice in HP's Enterprise Services division. Pratt leads utilities portfolio integration, innovation, technical solutions, delivery oversight and Smart Grid consulting activities. He provides executive level analysis, recommendations, and hands-on guidance for major infrastructure and application technology implementations throughout the energy industry. As CTO, Pratt has provided enterprise integration strategies, AMI and Smart Grid architectures, and implementation solutions for numerous utility companies. Pratt has over 25 years of experience in the manufacturing, engineering, process control, SCADA, communications, oil and gas, and utilities industries. He actively develops industry alliances with strategic partners and participates in industry associations.

The Next Big Thing: Prepackaged Customer & Billing Analytics

By Guerry Waters, Vice President of Industry Strategy
Oracle Utilities

To maximize the benefits from smart grid programs like demand response and net metering, utilities will need to know a lot more about their customers than they do today. That means not just collecting their data but also analyzing it. How much do you really know about YOUR customers?

If your utility is like most, the answer is: not much. You know which customers are residential. You know their location, their energy consumption history, and their bill/payment records. You may know that they have used an efficiency rebate or automatic debit.

You know a lot more, of course, about your large commercial and industrial customers. Key account managers may work with many of these customers on a daily basis, helping them manage their energy consumption. When those customers agree to participate in load reduction programs, grid operators analyze their usage to ensure that, in emergencies, they can decrease load in the exact spots needed to prevent brownouts and blackouts.

Until now, that has been enough. But compared to companies that must pro-actively attract and retain customers, utility customer information seems a drop in the bucket. Manufacturers, wholesalers, and retailers constantly search for more details about their customers so that they can offer products designed to please them at the optimal price point.

Historically, utilities and regulators have rejected data-gathering techniques such as tracking individual consumer movements from one Web page to the next or purchasing demographic information by zip code. Customers' incomes, ages, or home values are unrelated to utility service provision. Why gather or analyze data you do not need?

A New Era

All of that is about to change. The premise behind the smart grid is that information, analyzed and used appropriately, can reduce power waste and thus lower the amount of generation needed to supply a utility's territory. Less generation means not merely an economic cost savings but also a reduction in the toll that generation exacts on the environment. Those are social benefits worth pursuing.

Much of the smart grid's efficiency enhancement will occur at the grid level, where sensors and meters will measure power flow in small increments, and where software will use that data to optimize grid performance. There is, however, a more significant benefit for utilities to gain by more carefully analyzing customer data.

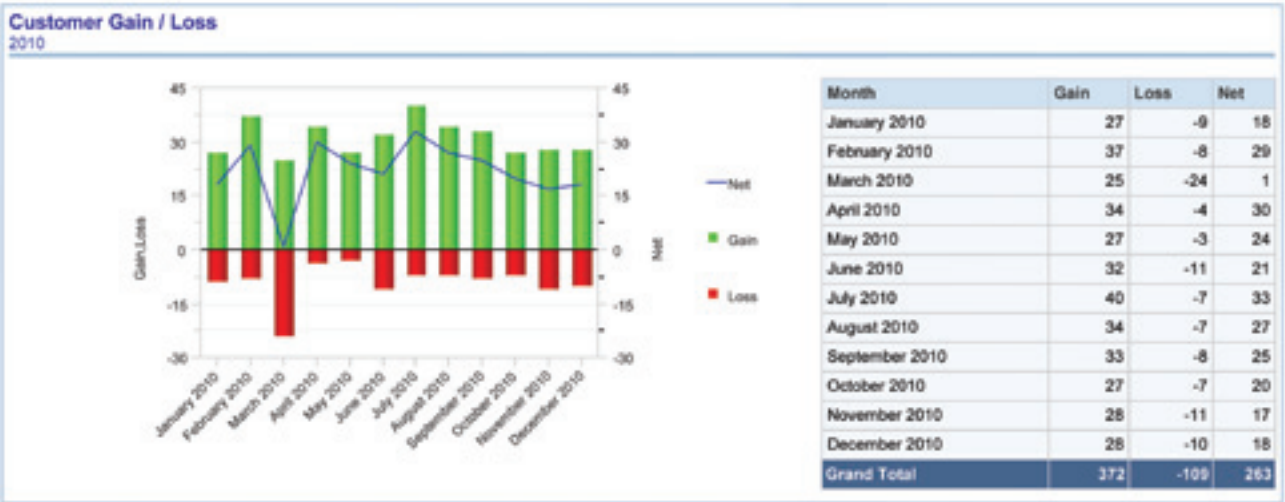
Eliminating the "Spare Refrigerator" Problem

Let's take a simple example: measuring the effectiveness of rebates that encourage consumers to purchase highly efficient refrigerators.

In the past, utilities commonly evaluated rebate programs by totaling the number of rebates given to their customers. Some utilities went a step further and asked participating merchants to compare the number and efficiency ratings of refrigerators sold prior to the rebate program with those sold during the rebate period.

Neither of these measurements, unfortunately, addressed the actual program goal: to reduce the amount of electricity households use to refrigerate their groceries.

Analyzing consumption data from smart meters, however, can clarify program success. The first step might be to compare a weekly total before and after the rebate. There is such a dramatic difference in the electricity use of a new, efficient refrigerator vs. a 10-year-old standard refrigerator. That failure to see a significant consumption drop is the first clue that the rebate may not have accomplished its goal.



Month	Gain	Loss	Net
January 2010	27	-9	18
February 2010	37	-8	29
March 2010	25	-24	1
April 2010	34	-4	30
May 2010	27	-3	24
June 2010	32	-11	21
July 2010	40	-7	33
August 2010	34	-7	27
September 2010	33	-8	25
October 2010	27	-7	20
November 2010	28	-11	17
December 2010	28	-10	18
Grand Total	372	-109	263

For retailers and for conservation program managers, following the numbers of customers gained and lost each month can give significant insights into the effectiveness of various marketing campaigns.

Of course, the consumer's trip to the appliance store might have resulted in the purchase of not only a new refrigerator but also a new big-screen TV. Here is where utilities need to move to a second level of analysis using intervals of an hour or 15 minutes rather than a day. The consumption pattern of a refrigerator, with its regular on/off cycles, is markedly different from that of a television – at least, in the vast majority of households. Graphing typical refrigerator consumption against the actual interval consumption as reported by the customer's meter should readily show if the customer has replaced the old refrigerator with the new one or has simply moved the old one to the basement and is now cooling more food.

Might utilities address the "spare refrigerator" issue in a different way? Of course; but running an analysis on customer consumption is far easier, more energy efficient, and likely far more cost effective than collecting, transporting, and disposing of all those used refrigerators.

Marketing Efficiency

The need for customer analytics becomes even more acute when utilities try to increase participation in demand response or other energy conservation programs.

Without detailed customer information and the ability to analyze it, most utilities have no choice but to offer "one-size-fits-all" programs. Every customer gets the same offer via the same bill-stuffer. What happens if a program is undersubscribed? Utilities are likely more than willing to change it. But without the ability to compare the customers who accepted with those who did not, they scarcely know where to begin.

Feeding demographic data into the customer database can change this picture. Data on house size, age of inhabitants, and features like central air conditioning may be available from the assessor's office. Highly sophisticated demographic data is generally available by zip code from companies in the business of assembling and providing it. Increasingly, utilities are seeking information from customers themselves about their household's use of technologies and motivations for participating in various utility programs. All this provides the means to distinguish the characteristics of program participants from non-participants and to experiment with alternatives that can increase the success rate.

Spatial Analytics: The Next Frontier

While charts and graphs are helpful, they pale in comparison to spatial analytics, especially for staff members who are not full-time analysts.

Spatial analytics applications take digital data and turn it into maps; that's nothing new. Utilities were among the first adopters of Geographic Information Systems (GIS) and have long used them to pinpoint outages, manage assets, and map construction and repair projects. What IS new is the pre-packaged spatial mash-up…

Utilities can gain new perspectives on customers when they take a set of data and display it using several different analytic tools, like maps, pie charts, and graphs.

Spatial mash-ups typically combine data from two or more sources and display the result as a map. Utilities might, for instance, map the addresses of unhappy customers with a map of frequent outage locations to see if there is a correlation.

Simple mash-ups like this may be moderately useful. But they become far more valuable when users can query the data – a sort of spatial regression analysis. Starting with the complaint/outage map above, utilities can sort customers who complained about outages from those who complained about high bills. They can compare those who complained about high bills with those who signed up for a new Demand Response (DR) program. Utilities can also compare those who signed up for DR with those who started service in the past 12 months or those with at least two late payments or those whose consumptions patterns indicate very low usage during the workday.

Typically, utilities just beginning the use of spatial mash-ups will find "correlations" that make little sense, at least initially. They might discover, for instance, that customers with the longest outage durations also sign up for more refrigerator rebates and have the best bill-paying records. Check that data against similar data from different years, different service territories, or other utilities in your trade association. You may discover that the outage/bill-paying association is a fluke but that many utilities show a correlation between outages and new refrigerators. Might that be because consumers have discovered that, in the event of an outage, food stays colder for a longer period of time in a new, more efficient refrigerator? And if that is the case, shouldn't you be using that to entice more consumers to join your refrigerator rebate program?

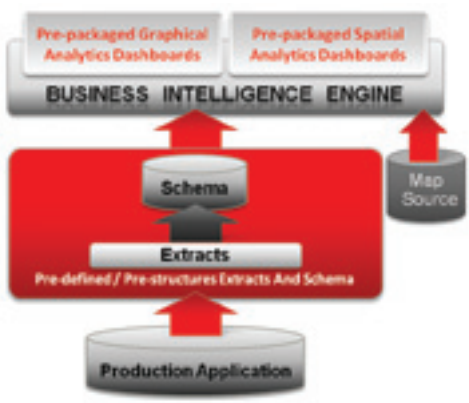
Pre-packaged analytics applications are not necessarily restrictive. Some permit utility-defined fields and even utility-defined dimensions.

Getting There From Here

If your utility is using the same legacy customer information system (CIS) it cobbled together in 1985, if your chief financial officer (CFO) turns green when she contemplates those enterprise-wide business intelligence (BI) projects of the past – the ones that required three bus-loads of newly-minted Masters of Business Administration to implement – talk of major new analytic initiatives may seem like little more than talk.

Take heart. Software vendors understand that to be effective, analytics must be less costly and easier to use. They are coming out with BI applications that sit on top of production applications and are designed to work right out of the box. They prepackage the extracts and schema that go into the data warehouse and place them within a star-schema-based data warehouse. They provide standard sets of analytic tasks pre-programmed into dashboards. Then they make multiple BI applications available from the same dashboard so that you can ask questions that involve more than one source of data.

These vendor-provided, pre-packaged BI products are an easy way to get started down the analytics path. Moreover, you do not have to undertake an entire enterprise-wide BI project all at once. And, you need not hire expensive consultants or new analytics staff. The dashboards are intuitive enough for staff and managers to use right out of the box. These new, structured BI tools can answer many current questions quickly and easily. Longer term, however, vendors will have to provide more.



Pre-packaged, application-specific analytics applications that are provided by the vendor of the underlying production application can provide utility staff with fast and easy ways to understand customer dynamics.

The "Unknown Unknowns"

The smart grid has launched utilities toward the unknown.

We know that in the very near future, we will have enormous amounts of data to work with. The smart meters now taking over the utility landscape will provide staggering amounts of data about each customer. Six channels of data recorded every hour or every fifteen minutes – or perhaps even every five minutes. By the time we are adding data from home devices to our data store, a Tier-1 (typically a large investor-owned) utility will be organizing, storing, and using more than 800 terabytes of data, according to a recent estimate. And that's before you add in data related to electric vehicle recharging.

The history of technology assures us that the availability of large amounts of new data will help us improve our business processes, find new efficiencies, and provide new services. But traditional BI tools, with their highly structured star schemas, may not be adequate for this task. To mine these immense data volumes for new options, new proactive business processes, and new ways to predict business outcomes, utilities may require less structured query tools. Those tools will have to function without disrupting ongoing operations. They will have to return answers in near real time.

So what might that look like? Tomorrow's answers may well emerge from a huge data dump manipulated rapidly and easily from a reporting engine that fosters unstructured drill downs.

At this point, no one knows precisely what such data manipulations will tell us. Former U.S. Secretary of Defense Donald Rumsfeld might well have been speaking about the smart grid when he opined, "*There are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.*"[1]

Starting with today's application- and suite-specific BI tools is an excellent first step. Operational and business staff must become self-sufficient in basic data analysis so that they can emerge with the insights to serve customers better in the near term. Longer term, however, we will reap the greatest efficiencies and the greatest benefits by fully exploring smart grid data's unknown unknowns.

[1] At a Washington, DC, press briefing, February 12, 2002.

ABOUT THE AUTHOR

Guerry Waters is Vice President of Industry Strategy, Oracle Utilities. He joined Oracle Utilities in 2006 when Oracle acquired SPL WorldGroup, a company he joined in 2000. Previous positions include Vice President of Energy Information Strategy at META Group (now Gartner) and CTO and Director of Technology Strategy and Engineering at Southern Company. He focuses on IT strategies that help utilities meet their goals amidst changing customer demands, regulations, and market structures.

Benefits Realization for Smart Grid Investments

By Jeff Evans, Executive Consultant
Enspiria Solutions, Inc. — A Black & Veatch Company

Utilities across North America are implementing Smart Grid projects – many in the US doing so with matching funding from the DOE and with expectations of regulatory recovery of expenditures. To achieve regulatory recovery, utilities must ensure that the projects are based upon prudent expenditures and actual achievement of promised benefits. Utilities typically hone in on cost effectiveness because it is most easily tracked, but equal attention should focus on the realization of anticipated benefits. Without a target on benefits, actualization is difficult to achieve and subsequent recovery of expenditures may not occur. A rigorous program of benefits realization will ensure that committed benefits occur in the valuation expected.

Regulatory Drivers for Benefits Achievement

Recent regulatory orders have linked benefits achievement to the potential for recovery of Smart Grid project expenditures. In its order 83532, the Public Service Commission of Maryland (PSCM) ordered Pepco Holdings, Inc., to develop metrics for tracking customer benefits and report periodically against those metrics. The PSCM stated:

"These periodic reviews will monitor the Company's progress, and the results may well inform our analyses of prudence and cost effectiveness in the rate cases to follow, and thus may influence our future cost-recovery decisions. The reviews will focus primarily on whether the project is being deployed properly and on schedule, whether and how it functions, whether and to what extent customers are receiving benefits, and how the costs compare to the Company's budget."

Similarly, the Public Utilities Commission of Nevada (PUCN) is tying benefits achievement to Smart Grid cost recovery for NV Energy's Smart Grid project implementation (PUCN dockets 10-02009, 10-03022, 10-03023):

"…the Companies must produce evidence of the progress in achieving the benefits that were used as the basis to support this application, including verifiable savings related to meter reading, field services, revenue protection, distribution planning, billing, credit collections, and load research. The Companies are responsible for the execution of this project to ensure that the potential benefits are realized and that these benefits flow to the Companies' customers in a manner that is equitable and commensurate with the risks involved in this endeavor. Failure to demonstrate that the benefits of this program are reasonably realized could result in a rate base adjustment and or expense adjustment in future general rate cases."

Benefits Realization Process

(The key steps of the Benefits Realization Process discussed in the following paragraphs are enumerated in the sidebar on this page.)

Steps in the Benefits Realization Process

Benefits Realization should incorporate the following key steps:

- Identify and document the benefits to be considered
- Gain business unit buy-in for each benefit
- Cash flow the benefits over time – full valuation of a benefit does not occur until the system is fully deployed
- Gather data and quantify the actual benefit achieved – where will you get the data? How often? From what systems?
- Certify the benefit – utilize a defined process to ensure acceptance of that benefit and that the project gets credit
- Understand that external forces may change benefits valuation
- Identify and take credit for new benefits
- Consider qualitative, strategic benefits

The Benefits Model

All Smart Grid projects should be based upon a business case that includes a benefits model. Benefits modeling should start with identifying the business units that will be impacted by the implementation of a Smart Grid project. Business units are being called upon to commit to benefits – commitments that will reduce resources and budgets and require changes in processes and procedures. Documentation of commitment to a benefit must occur and should including sponsors, assumptions, methods of quantification, key inputs to quantification, expected outputs, and the systems needed to produce the data that will quantify a benefit.

Some benefits are easy to quantify but politically sensitive to realize. Eliminating meter reader positions as a result of AMI is easily quantified based on known budgets. But the act of eliminating personnel can result in potentially significant economic, labor relations, and public relations issues. In addition, significant time elapses between the approval of a business case and the deployment of a Smart Grid project. For example, up to five years can pass between the time a utility approves an AMI project and the last meter is deployed. During this time, personnel change and support for projects evolves. Ideally, a signed commitment from business units ensures cooperation of future leaders when the time comes for budgets to be reduced to reflect benefits achieved.

Cash-Flow of Benefits over Time

Once quantified, the cash flow from benefit streams should be modeled over time. Benefits models typically quantify benefits based on a fully-deployed solution. Deployment of an AMI solution, for example, can occur over many years. An increasing portion of benefits can be realized monthly, quarterly, and annually over the term of deployment. But the full, annualized amount won't be realized until the system has been fully deployed and is operational for a year.

Cash flow from benefits is based on many factors, including number of meters deployed and the various systems and integrations needed to affect business process change and replace eliminated FTEs (Full-time Equivalents). For example, as more remote-disconnect enabled meters are deployed, more premises become eligible for remote disconnect for non-payment or change of party activity. Integrations among the AMI, MDM, and billing systems, often referred to as business releases, must be operational regardless of the number of meters deployed before any disconnect activity can occur.

Meter deployment plans and business releases are fluid and subject to continual modification. Original assumptions for cash flows should be clearly documented, and drivers for changing cash flows must be clearly understood. Significant variations in benefits realization may require special communications to, and approvals from, regulatory bodies to ensure the continued feasibility of recovering costs or receiving grants/reimbursements.

Quantification – Where do you get the data?

Once the assumptions for quantifying benefits and modeling cash flow over time are documented and agreed to, the data to quantify the benefits must be gathered. Some data inputs are easily gathered; others may be more difficult. While a meter reading budget may be clearly documented and easily sourced, the data needed to quantify a benefit from billing customers earlier in the meter reading window with AMI may be harder to gather.

Key steps include identifying the data required to quantify the benefit; identifying the sources of the data, including systems and owners; and identifying the queries and reports that will be required to provide the necessary data. For example, implementing an AMI solution obviates the need for a meter reader. As meter reader routes for a full bill cycle are saturated, those routes can be cut over to billing via AMI reads. When routes cut over, meter reader FTEs are eliminated. Human resources documents the reduction in FTEs, and the actual versus budgeted meter reading spend is calculated to quantify the dollars saved.

Once you've identified the sources of data needed to quantify the benefits, start acquiring the data and executing the calculations. Recognizing salvage value of removed legacy meters is usually simple: the disposition of meters is tracked in the meter asset management system. A value is assigned to each salvaged meter, then that value is given a project number in an accounting system, and monthly queries of that project number report value achieved to date. Other benefits are more difficult. The availability of interval data allows for the better understanding of the transformer's under- or over-utilization. Utilizing the interval data requires complex modeling and analysis algorithms to ascertain the true operation of an asset. New models must be compared with old models. Dollars saved due to improved asset utilization may require trending and longer term analysis to validate savings realized.

Getting Credit for Benefits

Utilities often implement multiple strategic projects simultaneously. Each project has a stand-alone business case that articulates the expected benefits. In some cases, these projects may compete for similar benefits. For example, utilities that implement both a remote disconnect technology and a mobile workforce management system seek to achieve labor efficiencies and savings. Labor savings due to mobile efficiencies are distinct from labor savings that result from avoided disconnect field trips.

A certification process should be established to ensure appropriate assignment of benefits as they actually occur. Certification should be conducted by independent organizations within the utility – typically a Financial Planning and Analysis or Internal Audit group. Corroboration by such "third parties" lends credibility to certification. It can also arbitrate budget changes, since these organizations typically set and enforce those budgets.

Certification should follow an established, defined process. On a periodic basis, typically quarterly, the project team identifies the quantified benefits for that period. Formal documentation of the achieved benefits, including the quantification process, assumptions, inputs, and outputs, is gathered and presented to the impacted business unit. Often the "benefitting" business unit is negatively impacted when labor savings are realized and/or process efficiency improvements occur. The business unit must support the benefit, or a compelling case for overriding business unit objections should be presented.

Once signed off, the benefit is presented to the "third party" for validation and acceptance. Accepted benefits are presented to the project steering team and executive sponsors, and approval is secured. Upon approval, benefits and the decision to accept them should be documented, and supporting information archived. Once certified, business unit budgets are permanently impacted. The budgeting organization reflects savings as reductions in capital or labor budgeted and actual costs.

Benefit Uncertainty

The value of benefits originally determined in the benefits model may be reduced due to external forces. The implementation of a remote disconnect allows utilities to better manage the collections process and reduce past due and charged off balances. Utilities can disconnect customers as soon as and every time they meet collections criteria – something not always achieved due to labor limitations. Utility regulators protect customers' rights during the collection process via a Consumer Bill of Rights (CBOR). Disconnect practices have been challenged and CBORs have been strengthened, causing some utilities to reduce realizable benefits.

Other external factors may also negatively impact benefits valuation. Slumps in the economy can reduce utility customer growth rates. The value of benefits that depend on growth rates (e.g., avoided new meter sets) declines when new home construction decelerates. Negotiations with bargaining units can result in increased severance or job placement costs. Politics and relationships with regulatory bodies can inhibit support for the inclusion of new benefits (e.g., the value of demand response). In order to keep the business case strong and deserving of cost recovery, it is critical to ensure that existing benefits are managed and new benefits are identified.

Benefit uncertainty is not limited to external forces. Internal politics and the simultaneous implementation of capital intensive projects can lead to a clamoring for benefits. As discussed earlier, multiple projects can potentially claim the same benefit. These claims can result in eroded confidence in, and support for, project valuation.

New Benefits

Business cases and their supporting benefits are typically conservative and often do not reflect the full potential of a Smart Grid project. Technologies are nascent and deployments not wide-spread, so the extent of a quantifiable benefit is sometimes underestimated or not included at all.

For example, estimates of energy theft and diversion vary greatly across the utility industry. Some believe that no incremental theft recovery will be realized; at the same time, some utilities believe the occurrence of theft (and corresponding recovery) can be as high as 5% of revenue. Because of this disparity, and due to the need to meet regulatory benefits commitments, some utilities have estimated theft recovery low. During deployment, the real value of theft is determined, and the project should get full credit for the actual benefit realized.

As project deployment continues, the occurrence of new benefits should be monitored. Similar to the process above, utilities should implement periodic assessments, develop a process to quantify benefits, collect data, and implement the quantification. New benefits should ultimately be certified with the rest of the benefits model.

Strategic Benefits

Should qualitative, non-quantifiable ("strategic") benefits be included in a business case? This depends on the nature of the benefit and the regulatory climate in which the utility operates. Too often, utilities are willing to consider strategic benefits only as icing on the cake; these are examined only when the business case is very favorable. Still, a benefits realization process should track these benefits, too. Reduced call center volume may be an indicator of increased customer satisfaction with a utility, but assigning a dollar value to satisfaction has not been accepted throughout the industry. An understanding that customer satisfaction has improved may positively influence the outcome of a future general rate case.

Conclusion

Many utilities are implementing complex, enterprise-wide Smart Grid solutions. All utilities have modeled business cases with large values of quantified benefits justifying significant capital expenditures. Although most utilities concentrate on implementing these solutions, only a few focus on the process of realizing the benefits required to obtain cost recovery. A rigorous process of benefits realization should be implemented early during project implementation to ensure that utilities deliver on the promised benefits. Without such a process, utilities may not achieve cost recovery if actual benefits realized are less than those previously promised.

ABOUT THE AUTHOR

Jeff Evans is an Executive Consultant with over 19 years of experience in the utility field. He has particular expertise in Smart Grid and AMI solutions and related technologies. His areas of expertise include strategy development, requirements analysis, business case development, solution benefits identification and qualification, vendor evaluation, contract negotiations, solution implementation and project management. He holds a BS in Mechanical Engineering and an MBA.

Text Alerts: A Key Development Driving ePayments in the Utilities Market

By Daryl Williamson, Vice President of Customer Support;
Pulaski Electric Systems and Randy Phelps, COO; BillingTree

As customers become more willing to receive alerts from utility companies and pay their bills through their cell phones, utilities need to follow the lead of electric companies such as Pulaski in integrating innovative ways of applying the Internet and mobile phones in order to provide customers with more convenient, flexible and timely information.

Billing for utilities is still mainly carried out on paper. A huge 63 percent for electricity providers, 64 percent for gas and 73 percent for water (according to a recent PayItGreen Survey) are all significantly lagging behind their counterparts across the cell phone, financial services and Internet provision markets, which are already benefiting from engaging with their customers through new channels such as text and Internet.

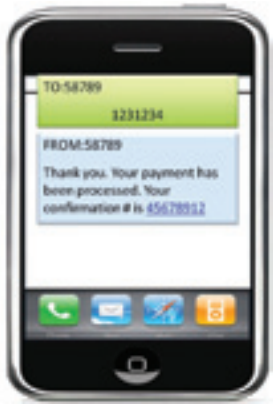
But the predicted growth of mobile payments is set to reach 377 percent over the next three years (AITE Group), and utilities for the first time in 2010 recorded on average more than 10 percent of customers receiving and paying their bills electronically, according to a recent report from industry research firm, Chartwell. So the move towards electronic bill presentment and payment (EBPP) has clearly started, and 2011 will see a sharp increase in adoption, extensively driven by the deployment of smart meters and by new payment methods, including SMS messaging.

Other industries using electronic payments have already shown that through the use of these new technologies, Days Sales Outstanding (DSOs) have been significantly reduced. Whereas the average DSO for a customer receiving a paper bill is approximately 45 days, eBilling and payment solutions can reduce this timeframe by up to 70 percent. And recent NACHA (now the Electronic Payments Association) research found that the cost of issuing such paper bills can currently amount to as much as $.66, a figure that could be reduced or shifted to the customer by introducing more direct channels such as paying via SMS/text.

Most importantly, eBilling – and in particular using SMS/text – can dramatically improve overall customer satisfaction by providing customers with timely information about changes in their services and offering them more flexible payment options.

Mobile payments a key driver

Integrating text into customer communications is going to prove a key driver for enabling utilities to embrace this rapidly emerging payment channel. SMS/text can be used in a variety of ways, such as for sending timely payment reminders to encourage customers to pay on time; sending immediate confirmations to let customers know that their payments have been received; to get instant traction with delinquent customers by sending shut-off avoidance messages to inform customers when their payments are critically overdue; and to receive payment authorization messages in order to process a bill payment.



One way SMS can be used is for sending immediate payment confirmations.

The use of SMS/text also transfers these benefits directly on to the customer, allowing them to pay bills faster, more conveniently, and at a time that best suits them.

Potential for utilities

Despite the fact that many utilities haven't fully optimized paperless billing into their collection processes, NACHA predicts a 35 percent year-on-year growth rate in eBilling. 2011 will be a huge year for utility companies looking to improve their collection rates – with the benefits of using mobile payments being a substantial portion of those improvements.

One company already reaping these benefits is Tennessee-based Pulaski Electric System (PES), which has integrated the BillingTree mobile payments suite into its existing collections processes. The energy company services 15,000 electric customers in Giles County in the State of Tennessee, and has always been at the forefront of energy supply. It launched its state-of-the-art 100 percent fiber-optic network in early 2007, and continues to offer its "triple-play" of video, voice and data services to a growing number of residents and businesses across the county.

> *"Initially, I expected the 20-30 age group to sign up for the mobile program, but we had customers well into their 50s and 60s signing up as well. It has been very well received by our customers. We publicized it through the radio and of our walk-ins the day of the launch, 30 percent of customers signed up. At Pulaski, we provide every avenue possible for the customer to take care of business, with 15 percent of customers accepting bill notifications via the web and 10 percent of them paying online. We anticipate similar results through the text program."* ***– Daryl Williamson, Vice President of Customer Support at Pulaski Electric Systems.***

By integrating SMS/text technology into existing infrastructure, utilities can reap multiple benefits across other communication channels. The use of SMS/text helps to alleviate pressure on inbound call queues and consequently reduces waiting times for customers, which in turn, enhances the customer's experience and maximizes efficiency.

Added benefits of SMS/Text

Utilities can go one step further in using SMS/text to gain full advantage. By using it to communicate with customers about any upcoming issues that they need to be aware of, customers can receive helpful information on planned brownouts or possible power outages due to maintenance work, easily and conveniently. Such information would be happily received by most customers, who will appreciate being able to plan their activities and energy usage accordingly.

The European experience

The use of SMS/text has already been extremely effective in utility companies across Europe, with many already using SMS/text to their advantage. Companies including E.ON – the world's largest investor-owned power and gas company – have already leveraged the benefits of automated SMS/text notifications in order to effectively communicate meaningful information to their end user customers. Judging by the levels of success in Europe, this new channel has huge potential to be similarly successful in the U.S.

Smart Meters driving change

Add to this the fact that over the next ten years, half of all American households will have a Smart Meter installed in their homes (according to statistics from the Edison Foundation), and it is clear that utilities need to start preparing themselves to be able to deal with these new technologies in ways that enable them to quickly and cost effectively distribute data and information. Through the deployment of Smart Meters, consumers are able to see precise detail around the time(s) of day, week(s) and year(s) when they use the most energy.

This increased detail in information is putting more and more pressure on utilities to be able to deal with higher volumes of consumer information and is, in turn, driving the requirement for a new approach to engaging with their customer base. Utilities are realizing that by implementing new payment channels such as SMS/text, customers have more flexibility in managing their personal payment processes and feel more in control of their usage payments.

Allowing customers to pay by text allows more flexibility in managing their personal payment processes.

Going Green for the Gen Ys

Eliminating the paper cycle through the introduction of eBilling and epayments and exploiting mobile and SMS/text applications also matches the expectations of the tech-savvy 'Generation Y' group of home-owners, who are already used to eBilling and ePayments for Internet and cell phone use. And most Gen Y customers are happy to pay for power and water in the same way. By using these new payment channels for the 'Gen Ys', utility companies can increase the likelihood of timely payment by offering more convenient payment options.

Pre-paying for Services Enhances Customer Service and Drives Loyalty

This development in mobile payments is a huge breakthrough for utilities, as Pulaski is finding. The other major driver in 2011 will be the rise in the use of pre-funded accounts, which offer another option for making payments easier, and reduce the element of risk for utilities.

In the past year, electronic payment facilities that utilities can offer customers have dramatically expanded, not just with optimized web-payment forms for use on smart phones but with new services such as pre-funded accounts.

Pre-payment for services has gained significant acceptance in the US led by the cell phone industry, where a report from IDC indicated 65 per cent of new customers in Q4 of 2009 opted for pre-pay service plans. The same economic factors driving the shift in cell phone plans have impacted pre-payment demand for other services that traditionally rely on short-term credit or deposits. Utilities can consequently reduce the risk of an unpaid bill by introducing pre-funded accounts for particular customers who they have identified as being unlikely to be able to pay on the spot.

Customers can draw down funds allocated for a specific service, thereby minimizing risk for the utility company, while also eliminating the need for upfront deposits, which are largely unpopular with new account holders or the un-creditworthy in particular.

Utilities can even introduce a points-based loyalty reward program, by providing those consumers who complete a payment promptly with well-earned points. Customers can gain rewards for maintaining positive balances, opting for paperless billing, or setting up recurring bill payments online, etc. This can help make controlling finances easier for the customer themselves, while providing a risk resistant alternative to those providing the services.

The technology is here for utilities to implement new and innovative ways to enable customers to manage corporate and household budgets, and to provide rewards for customers in good standing.

The future of EBPP

Last year, the utilities market was identified as one not fully recognizing the latest advancements in electronic bill payments processing (also called electronic bill payment and presentment), but one that would become increasingly under consumer pressure to offer customers ePayment facilities. Supporting mobile SMS/text payments provides a convenient option for utilities to quickly start supporting consumers on-the-go. Billers can leverage this technology to reduce costs associated with consumer contact, including time sensitive notices as well as the expense of traditional paper bills.

The rapid mainstream adoption of SMS/text messaging and demand for increased mobile commerce alternatives is shifting EBPP from what previously was almost exclusively on the desktop to the hand-held device and in particular for use on smart phones. The technology is here now for utilities to implement new and innovative ways to communicate with their customers about their services, and to provide them with interactive and mobile payment services in order to maximize the likelihood of payment - and payment on time.

ABOUT THE AUTHORS

Daryl Williamson joined Pulaski Electric System five years ago, prior to serving as a sales associate for Verizon Wireless where he became very familiar with SMS/text capabilities to reach customers. Daryl has more than 15 years of customer service experience and was instrumental in Pulaski Electric System's fiber-to-the-home deployment. He has a proven ability to carefully find and enhance customer service offerings. Daryl completed his BBA at Athens State University, followed by an MBA at Middle Tennessee State University and is currently working toward an accounting degree.

Randy Phelps served as the Vice President of Operations for one of BillingTree's clients prior to joining BillingTree's executive team as Chief Operating Officer. Randy was an early adopter of integrated payment solutions and has more than 15 years of experience in strategic planning, business unit development, project and product management, and turnaround strategic planning. His experience spans several industries and disciplines including Financial Services, Collections, Telecom, Healthcare, Utilities, Security, and Business Services.

SECURITY SESSIONS

It seems as if one of the major points of conflict and disagreement concerning cyber security standards and recommended practices derives from the "no man's land" that exists between the reality of computer-based automation systems and the ideal world of the IT security standard. Many of the current recommendations for making automation systems secure, be they EMS/SCADA systems, plant DCS systems, or safety/shutdown systems are derived from IT standards such as NIST 800-53 or the ISO 27001 recommendations (or the original ISO 17799 standard.) The NERC CIP standards, the NRC's RG 5.71 standard, and even the recent recommendations in the gas pipeline world (from the TSA and INGAA) all have a basis in the IT world. There is nothing basically wrong with most of the security practices used in the IT world. But applying them successfully to industrial automation and control systems in the real world can be quite a daunting (and sometimes frustrating) exercise. – ***Tim***.

If it ain't broke, don't patch it!

I have no issue with the goal of identifying best practices and creating recommendations and standards for cyber-securing our industrial automation systems. In fact, I'm all for seeing that it happens as soon as possible! There have already been enough examples of cyber security threats and incidents to make it obvious, even to the most reluctant instrumentation and controls engineer, that cyber security is a necessity – particularly since corporate connectivity and the insatiable demand for current-data needed to satisfy business decision-making processes is not going away. Plus, the recent Stuxnet malware discovery has shown that even measures like 'pulling the plug' and 'air gapping' our mission-critical automation systems do not constitute an adequate cyber defense.

The problem with many current cyber security recommendations is that the groups promoting these standards never seem to include anyone with actual industrial automation expertise and plant operating experience. As you read through most of these standards you get a clear sense of the IT mentality that guided their creation. They are filled with suggested technical controls and countermeasures that make sense if you are dealing with servers running Windows and linked with Ethernet, or perhaps TCP/IP networking and remote users who are just trying to figure out how to type a letter after being subjected to the latest incomprehensible changes to the Microsoft Office applications. But many of these technical and administrative controls don't work well with real-time industrial automation systems.

A SCADA, DCS or PLC-based automation system manufactured in the past few years will incorporate a lot of elements that are seemingly identical to what IT professionals deal with every day: PCs and servers running a Windows OS, Ethernet LANs, TCP/IP networking, web servers, etc. But those same systems will also include devices and equipment the IT people don't typically see in their training – and most never will.

The most obvious are process controllers – and I'm including RTUs and PLCs in this general term – with analog, pulse and contact I/O which are performing real-time data acquisition, alarming and control functions. There will often be other 'smart' devices such as analyzers and 'smart' instrumentation that may interface though asynchronous serial communication circuits (i.e., EIA-232, EIA-422 or EIA-485) and 'speak' industrial protocols such as Modbus or DNP3. There may be historians with proprietary databases and APIs and other types of application servers connected together using one or more variants of OPC or using the industrial protocols previously mentioned.

In a legacy SCADA system they may encounter low-bandwidth, bit-oriented legacy protocols that require special communications hardware. They will definitely run into analog leased and dial-up phone lines configured in a multi-drop arrangement – and many more legacy protocols. Today, they are also likely to run into wireless technology being used in ways they haven't seen before. A plant mesh network of instruments running WirelessHART protocol in a plant, or spread-spectrum radio repeaters linking a city-wide network of PLCs connected back to a control center, are very different wireless technologies than an office WiFi (IEEE 802.11) access point.

The issue is that these things are NOT what IT professionals are used to dealing with, and they don't conform to the notions of a 'computer' or a 'network' or a 'database server' as the IT world thinks of those elements. In many instances the suggested technical controls for cyber securing them are either not possible or not practical.

Consider that a protective relay, an analyzer and a PLC are all very powerful computer-based devices, and most even support Ethernet and IP-based communications, but they don't run a Windows or Linux operating system; they don't support complex passwords; they don't have separate user accounts and login IDs; and they generally don't respond well to being hit with a vulnerability scan. It is also very hard to find malware/virus scanning software that can be loaded into, and run, in such devices.

One basic problem with many such devices is that they have a minimal IP "stack" implementation, and their code doesn't handle communication exceptions very well, if at all. Similarly their configuration settings may not include much of anything beyond assigning an IP address and subnet mask. And yet, because these are 'computer-based' devices, most of the current cyber security recommendations for automation systems would suggest applying those IT cyber security mechanisms.

Other typical IT cyber security solutions – such as user account lock-out and time-out – would be considered dangerous if applied to an operator workstation on a plant DCS or EMS/SCADA system. One of the computers I use in my work is configured for the highest level of cyber security the system administrator could devise. If I turn away from that computer for just a minute, to answer a phone call for example, it automatically locks me out and requires that I login yet again in order to return to my work.

A control room operator would find it totally unacceptable (not to mention unsafe) if you tried to configure that operator's workstation in that same manner. If they have to login at all, most operators do so at the start of their shift and then expect the workstations to remain up and operating until they end their shift. I've seen operator workstations that were powered up when the system was installed, and no one has logged in or out of them since. Having to go through a login procedure in order to be able to make a control adjustment or change operational displays, particularly in the middle of a plant upset, would never be acceptable to plant operators. So applying typical IT security controls to an operator workstation, even though it looks like a PC, just doesn't work.

Another general problem with applying IT cyber security solutions to industrial automation systems is the fact that in the IT world, most computer and network equipment is considered obsolete – and usually replaced – after five years of service. This means that is it usually mostly up-to-date and still supported by its vendors. On the other hand, in many industrial facilities and operational control centers, the automation equipment is well over a decade old with some even decades old. The vendor(s) of that hardware and software may no longer support the system, or no longer even exist at all.

The plant personnel are not generally able to make any significant changes to these systems (i.e., other than the typical user-configuration tasks such as adding I/O, editing graphic pages, defining calculations, etc.). They are normally loath to implement patches or software upgrades – even assuming that such measures are readily available – because of the possibility of breaking something that could easily have catastrophic consequences. Their mindset is very simple: "If it ain't broke, don't patch it!"

In some plants it's not even a sure thing that the plant personnel could bring the systems back up and return them to fully operational status, were something to go seriously wrong. I have seen automation systems where the backup medium is a magnetic tape copy – usually made by the vendor when the system was initially commissioned. No one in the plant knows if it can actually be read or if the remaining legacy tape reader even works – and nobody is going to risk trying to find out!

Under such operating conditions, the procedures that would be considered as recommended IT practices, such as making and testing routing system backups, evaluating and installing security patches and even running and updating virus scanning software, might not be possible. For those older systems there is no longer a vendor who is providing patches, either because they are gone (no longer in business) or have dropped ongoing legacy support for the product. Even for newer systems, there have been instances where vendors have released patches that turned out to be inadequately tested (if at all) and downright dangerous. So, unless a plant has a separate test system, it may be preferable to avoid installing patches, thus precluding the risk of the patches causing unexpected outcomes and/or equipment damage.

One possible strategy for industrial automation systems that no longer have support available is to simply "wrap" them in a protective cocoon – usually accomplished using middleware – that doesn't require the modification of the system yet still improves security. By this I mean placing firewalls and intrusion detection/prevention systems between these old systems and any IP-based communication interface. Moreover, setting up a DMZ and placing a sacrificial data server between these systems and the corporate network can help to isolate them. It is even possible to use more dramatic approaches such as placing "data diodes" between these systems and any data requester to ensure that data can only pass in one direction.

Of course, another aspect of cyber security is having good policies and procedures (i.e., more than just "don't touch the system"). By now we all know that Stuxnet got into systems by being brought in on USB thumb drives. Smart, properly communicated and enforced policies and procedures would have gone a long way in preventing that sort of attack. Now this doesn't mean we ought to throw up our hands and forget about making our automation systems, even the old ones, more cyber secure. What is does mean, however, is that we may have to look at some unconventional alternatives... but that will be the subject matter for a future column. – ***Tim***

ABOUT THE AUTHOR

Dr. Shaw is a Certified Information Systems Security Professional (CISSP) and has been active in industrial automation for more than 30 years. He is the author of Computer Control of BATCH Processes and CYBERSECURITY for SCADA Systems. Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. He is currently Principal & Senior Consultant for Cyber SECurity Consulting, a consultancy practice focused on industrial automation security and technologies. Inquiries, comments or questions regarding the contents of this column and/or other security-related topics can be emailed to *Tim@electricenergyonline.com*.

Be Careful What You Wish For

By Gay Gordon-Byrne, President & Co-founder; TekTrakker

Customer facing equipment – e.g., in home displays and enabling technologies – will transform the customer support services that utilities will be called upon to provide. I don't think enough attention has been paid to how much investment is going to be needed to manage questions, confusion and problems on the consumer side of the meter. Before jumping off what may be a customer service cliff, I want to offer some insight from other industries with customer-facing service issues as food for thought.

First, utilities have to understand that customers expect the party that installs the equipment to provide support. If the utility supplies the equipment, they will get the calls. If the customer buys the equipment at Home Depot or Best Buy, those retailers or their service providers will get the calls. The more equipment provided by the utility – the more calls. The more complex the interface between devices – the more calls. I frankly cannot imagine the difficulty my elderly mother would have with any in-home device. She cannot operate her thermostat since we replaced it with a programmable model to save energy. (We get the calls.)

Customer service calls are not going to be just about loss of power or billing questions – they will be "How To" questions. Callers will also report problems with the devices themselves, some of which will need support to rectify, and some will eventually result in escalation to a repair specialist.

We cannot begin to project what these calls might be since virtually none of the equipment being considered actually exists, but – we can take a stab at the problems already faced by vendors of electronic technology products such as personal computers, cell phones, and cable TV boxes. The parallels are probably appropriate since all are portals for some kind of service, share circuit board technology, layers of software, and complexity of interface.

Most personal computer manufacturers support equipment purchases using toll-free Help Desks to manage calls for help with their equipment. The Help Desk function proved to be so expensive to operate that it was one of the first applications to be outsourced to India. Consequently, most PC buyers have come to accept that their calls for help will likely be taken by someone halfway around the world.

Regardless of the location, help desks and service desks for product support are essential to customer service. These groups are charged with helping triage calls about problems in order to assign the right team for problem resolution including running remote diagnostics. Domestically, costs to manage an inbound call are roughly $25 each (to start) when one includes the software licenses and employees needed to staff the system. Problems that cannot be resolved directly by the help desk are escalated to the associated repair provider at an additional cost of roughly $75 per call.

It does not take a lot of math to conclude that a single problem call from a customer about their in-home display not working can quickly cost the utility upwards of $100 before they spend a dime on the actual repair.

Repair at the consumer electronics level is usually done by having the consumer ship the product back to the warranty provider using a process called RMA (Return Materials Authorization). Warranty returns are only accepted after the customer service department authorizes the return and provides the shipping ticket or reference number for the package. While part of the customer service function, the costs to set up and manage the repair side of the business are not included in the help desk figures provided above. Shipping, warehousing, returning equipment to inventory, confirming restoration of service, etc. are all costs on the utility side of the RMA. At minimum, an allowance of $50 per device swap would cover shipping, plus another $75 for the management costs using the RMA approach for a total of $225 (i.e., $100 for the inbound call plus another $125 for the RMA).

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The RMA process works best for products that the consumer can do without for days or weeks. In order to speed the delivery of a replacement part, several variations on the RMA are common, including "spare in the air" where the replacement part or unit is shipped immediately and the returned part following at a later date. This is more complex from a tracking standpoint, as exchange is not as clean so many vendors (such as Dell) charge for the replacement part and then credit the customer when the broken part is actually returned.

Physical service centers – or "repair depots" – are used in some industries where the consumer can bring their defective equipment in for repair or exchange. This is particularly common for mobile devices such as cell phones and other devices where the retailer is also a source of customer service. Think Apple Stores or AT&T or Verizon retail locations for the staffing of this type of customer service function.

Clearly, the RMA, depot repair, or retail service program options don't fit the model of a smart grid where this equipment is merely a gateway to other device(s) and/or benefit(s). It is unlikely that a consumer would be willing to pull a smart device, package it properly for shipping, live without it for days (or weeks) and then return it to service. And it's almost impossible if the device is integrated with appliances, vehicle charging stations, or solar arrays to name a few possible attachments.

If In-home Devices (IHDs) are as impractical to service remotely as I suspect, the costs to provide repair/restoration jump dramatically. Each "truck roll" costs hundreds of dollars (about $275 each, according to NARUC), so even the most marginal device can be exceedingly costly to touch. The more equipment in the home, the more things to breakdown, the more calls for the customer service teams… and the more truck rolls.

The Cable TV industry offers some further sobering experience with in-home technology. The "cable box" is an electronic device designed to enable use of billable and desirable services through the portal. Because the equipment is provided by the Cable TV service, they have accepted the customer service burden for the equipment. Customers routinely call their cable provider for help with missing channels, poor signal quality, and lack of signal. The parallels are strong. After lengthy attempts to remotely correct the problem – including remote diagnostics and remote control of the box itself, the cable company dispatches a technician to make the repair.

The staffing needed to manage both the inside call volumes and travelling technicians for cable providers are roughly 4 times higher than for current utility operations. My local cable provider generates roughly $4.6 billion in revenue using 19,000 employees. By contrast, my local electric and gas utility generates $12 billion in revenue using 10,000 employees. I believe that substantial portions of these disparities are directly due to differences in the size of customer service and repair crews.

Time for some additional scary math: Consumer electronics have failure rates of 3-8% per year. (Failure rates are documented by various sources including warranty repair allowances, service industry specialists and TekTrakker.) These same repair resources confirm that roughly 90% of all calls for service can be resolved remotely or are simply software issues or user confusion. So, to have a 3% actual failure rate, the volume of calls for questions or problems may be as high as 30% of all devices generating a call for support each year. For a utility managing 100,000 meters with 3 IHDs each (i.e., 300,000 IHDs) may be expected to generate 90,000 calls. At $20 per inbound call – this is $1.8 million just to answer questions at $18 per year, per meter).

The remaining problems that require actual repair rack up further costs. Using 3% as a rosy projection – a customer with an "Energy Orb" plus an EV charging station, plus a third gadget of some kind, now has 3% + 3% + 3% – or 9% total – per year physical failure rate, requiring an onsite repair. For a utility managing 100,000 meters, this is 9,000 truck rolls per year they never had before at a cost of roughly $425 – for an annual cost of $ 3.825 million. (Based on $100 for the call management and escalation, $275 for the truck roll and $50 for the parts) For the consumer this means $38.25 additional per year for every meter.

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If the equipment deployed has failure rates at the high end of normal (8%) – we are now at 24,000 additional truck rolls per year for a total of $ 10.2 million, or an additional $102 per meter, per year, in consumer costs. Equipment selection for high-reliability devices is obviously critical to control costs as each small difference in failure rate calculates to enormous differences in support costs.

Some other questions to ponder…

How these costs would be allocated is an enormous issue. Would regulators agree to view this expansion of customer-service as a natural extension of existing system – or would they demand that these new costs be absorbed elsewhere? Is it possible to offer a separate service agreement for consumers with additional billable revenue as in the PC service model? Would consumers be willing to pay for a service plan for an IHD? Can a utility operate a consumer electronics field support organization profitably? Do any of the devices proposed suit the reliability profile necessary for profitable operation? Does a utility really belong in the consumer electronics business?

The easiest way for utilities to avoid exploding their customer service obligation is to end their engagement at the meter, and let the consumer electronics industry take on all of the problems with devices inside the home. Those that remain determined to be in the consumer electronics business will be wise to select only the most rock-solid devices to reduce the overall volume of trouble calls. Furthermore, unless utilities can bill appropriately for repair and support services for IHDs – the explosion of customer support costs can easily overwhelm any potential savings in other areas.

Be careful what you wish for!

ABOUT THE AUTHOR

Gay Gordon-Byrne is a 30-year+ veteran of the IT industry with acknowledged expertise in the area of electronic equipment reliability and repair. She is the current Chairman of the Service Industry Association International Competitiveness Council. She is also engaged developing a consortium of trade organizations (e.g., APPA, NRECA, EEI, DOE, NARUC, TVA, ECNE, etc.) to fund and collaborate on building a database of hardware failure rates of "smart" equipment. Failure rate data is the missing foundation layer for all electronic equipment selections and associated support programs. As the President and Co-founder of TekTrakker, she has unique insight into reliability issues for common computing equipment, as well intimate understanding of the customer service function as the front line of repair and support issues for technology equipment.

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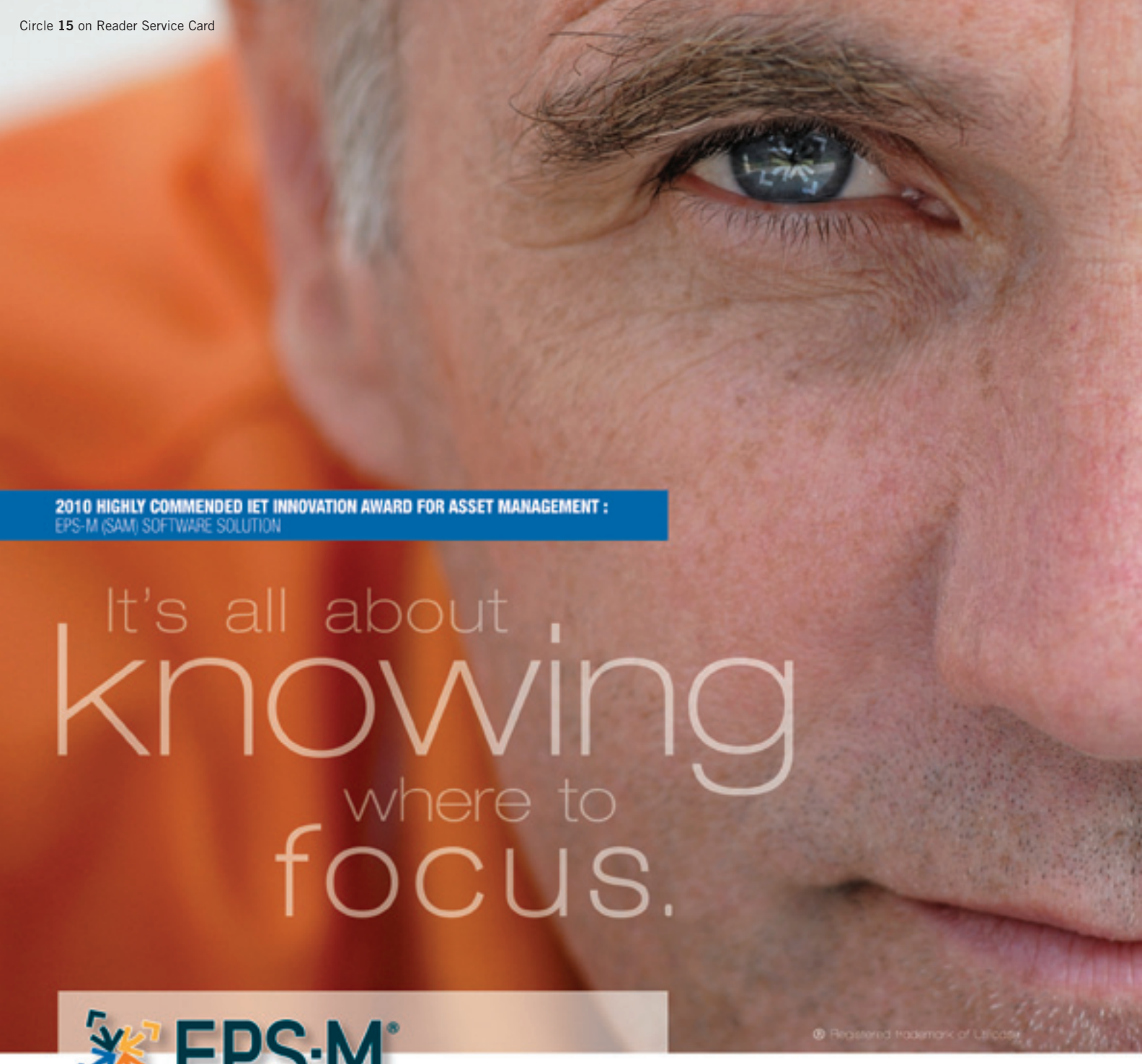

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