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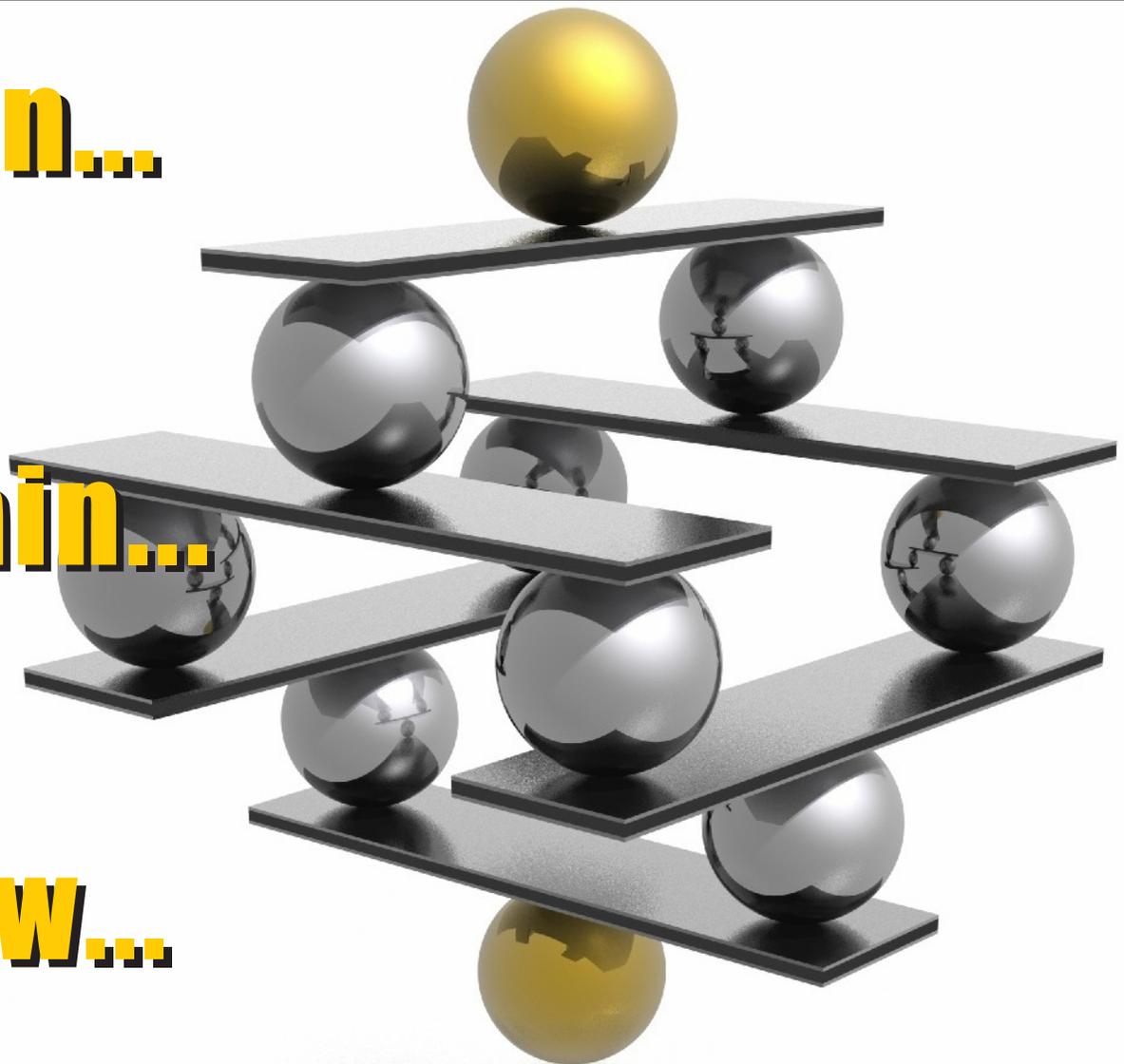
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Optimization Through Automation*

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In This Issue...

Balancing Human Capital with Infrastructure Optimization Through Automation

Theories, Themes & Things

As you may already know, the overarching theme we have chosen to guide editorial content in 2014 is: Shaping the Utility of the Future Through Automation. Within the context of that scope, we have also adopted a sub-theme for each quarterly issue with the goal of collectively establishing some rudimentary guidelines that a utility wanting to become a 'utility of the future' can follow, while also exploring the pertinent issues and trends that will likely guide such a transition.

Our first issue of the new year (Q1-2014) focused on establishing An Automation Blueprint for Utilities of the Future, combining market insights and observations from several of the industry's leading consulting firms and professional associations into a non-partisan view of how our industry is evolving – and how it will need to evolve – as we enter the uncharted territory of harnessing automation to help offset the negative effects of an aging workforce and our rapidly declining infrastructure.

This issue has as its focus, Balancing Human Capital with Infrastructure Optimization Through Automation, delving more deeply into the confluence of the aging workforce and declining infrastructure issues, as well as how these factors will necessarily affect the evolution of utilities themselves, as these dual challenges continue to escalate. The fact is, there is no panacea on the horizon, so these problems will only get worse before they have any prospect of getting better over the longer term. Still, it's not all bad news, by any means.

On another level, the growing influx of young(er) people into the utility workforce raises the

prospect of fresh thinking and innovative ideas that are not weighed down by legacy methods and ideologies. New technology alone won't fill the bill, however. Sometimes radical new ways of thinking and totally new approaches that amplify and expand the reaches of technology are desperately needed.

Merely using technology in the same ways it has been used for decades won't solve the problems.

Merely using technology in the same ways it has been used for decades won't solve the problems. And as the old saying goes, *"You'd be amazed at what can be accomplished when there's no one around to tell you that what you're trying to do is impossible!"*

The interview with **JD Hammerly (CEO, The Glarus Group)** in this issue (see Inside Tracks) talks about 'replacing circuit cards with silicon' as a logical next step toward a more comprehensively automated utility environment. This represents a potentially giant step toward the mitigation – or perhaps even the elimination – of the traditionally labor-intensive life cycle of electro-magnetic and electro-mechanical devices by replacing it with the "hands-off" experience associated with solid-state (i.e., silicon) implementations of what were once complicated, high cost, and usually high maintenance functionalities.

Similarly, the **San Diego Gas & Electric** story in the Fast Forward section details how the traditional 'expense' characteristic of municipal street lighting can actually be monetized by taking some fairly simple but pro-active steps toward changing "*the way we've always done it.*"

To quote the authors of the article... "*On the surface level, it [the streetlight project] means that cities can finally monetize the benefits of dimming streetlights. More importantly, however, it allows for sub-metering of third-party applications that the city may choose to plug into the street light grid. So that means that services like holiday lights, emergency response, Wi-Fi, and cell service can be turned into revenue generators to offset the entire costs of the system.*"

Also in Fast Forward, IEEE's **Steve Collier** has penned the second part of his 2-part editorial on why the Smart Grid is inseparable from the Internet. Steve's thought provoking views offer a refreshingly different way to look at grid transformation and evolution – be sure to check it out for yourself.

Our other regular features on **Education**, **Regulation** and **Standardization** come from an eclectic set of industry participants, analysts and observers that approach these topics from a variety of angles ranging from excruciatingly practical to creative and innovative. Or, if it's a

dose of cynical conjecture you crave, read the latest from our slightly abrasive, sometimes evasive – but always entertaining – industry veteran, Sparky Flamedrop.

Need market information? Don't miss our synopsis of the **GWI (Global Water Intelligence)** report on the global water marketplace, including the \$63 billion in projected spending on Automation & Controls, in our **On The HORIZON** feature.

Michael A. Marullo
Editor & Publisher
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Coming in the Q3-2014 Issue...

In our next issue we address IT-OT Implementation, Integration and Support – clearly a bit of a sticky wicket for a lot of utilities, many of which have been trying to organically pull off the IT-OT merger for a very long time, and most with only limited success. Practically everyone agrees on the integrated concept and the potential benefits of this IT-OT marriage, but after years – often decades – of trying to get both parties to the altar voluntarily, the shotguns are starting to come out. Don't miss this information-packed issue filled with many more informative articles and other interesting content that points the way forward during these changing and challenging times for the utility industry.

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Inside this issue...

- **FOCAL POINT (Cover Story): Utilities at the Crossroads: Coping with Staff Reductions and Infrastructure Declines**, starting on page 16.
- **Inside Tracks (Interview):** JD Hammerly, veteran technology innovator, international consultant and industry guru talks about the future of utility automation and how that future might be a little – or a lot – different than you think. (Hint: Think silicon.)
- **Fast Forward:** We Must Look Forward to Go Forward. Contributed articles from trendsetters and thought leaders across the industry who can take you there!
- **Topic Forums:** Industry experts address Regulatory, Education and Standardization issues and trends in a balanced and informative style
- **On The HORIZON:** Research-based Automation/IT market insights and commentary from hi-profile thought leaders
- **Intersections:** At the crossroads of electric, gas and water utility automation and information technology.
- **Sparky Flamedrop:** Anecdotal commentary about All Things Automation. Read it now: Sparky just might be talking about YOU!

PLUS: Industry News, Guest Editorials, Book Reviews and more!

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What Tomorrow May Bring

With John D. ("JD") Hammerly, CEO
The Glarus Group



On The HORIZON

A BRIGHT NEW FUTURE FOR WATER



Purviews

IS "DO NOTHING" STILL A VIABLE UTILITY STRATEGY?



Time to Call an Ace an Ace...



Michael A. Marullo,
Editor in Chief

First, there's the time factor. As utilities have slimmed down and streamlined their operating staffs over the years (Can you say, "right-sizing"?), practically all of what once was deemed critical support staff has been summarily eliminated. One of the many consequences of this migration to leaner organizations is the fact that

no one has 'time' anymore – not just time to write articles, but time for just about anything that isn't currently about to blow apart or is at least on fire. Productivity may be at an all-time high, but as a direct result, time is at an all-time low.

Second, is what I'd call fear of flying¹. What I mean by that is the fear of disclosing some sensitive piece of information that could at the very least, land you in hot water with your boss, and worst case, with your corporate legal department and possibly fired from your job. Naturally, some caution is appropriate when the topics are legitimately sensitive, but resorting to complete nondisclosure as a way to guard against full disclosure seems like unnecessary overkill.

Third, a lot of the fervor over information protection is being fueled by the widespread belief that talking (or writing) about one's projects, plans and programs violates NERC CIP² regulations. Although a lot of people truly believe that, I have it on good authority – from a friend who has personally helped craft a lot of those rules and regulations – that people who say that are simply misinterpreting the guidelines. Even so, once someone has that mindset there is no winning that argument by attempting to point out their implicit misunderstanding of the rules.

The good news is that there are other ways to get the kind of information people need to know without asking anyone to violate their conscience or even their better judgment. There is another source that is every bit as relevant and pertinent to the topics at hand and that is sometimes even more knowledgeable about those topics. That source is the one we primarily rely on today for most of our editorial content: Suppliers, including products, systems and services suppliers, integrators and consultants.

When we launched this magazine in November of 2012, we broke a lot of new ground. Part of that pioneering effort was the departure from the traditional 'Case Study' approach to editorial content, shifting instead toward more

For over forty years now I've been soliciting, writing and editing articles about automation and information technology products, systems and services. For most of that time, I've had to go to great lengths to get people to pen articles for the various magazines, newsletters and other publications with which I've been associated.

That difficulty goes double for getting authors from the user community (utilities) to come forward. And in the past few years it has gotten exponentially more difficult to obtain user-authored material. The reasons for this reluctance are several, as I will briefly summarize here, not as a rant, but simply in the spirit of sharing – a commodity that is in short supply these days.

¹ Fear of Flying is a 1973 novel by Erica Jong that exalts the benefits of what today we often refer to as thinking (and acting) outside the box.

² North American Electric Reliability Corporation's Critical Infrastructure

The QUEUE...

supplier-contributed content. It is important to note that that shift was not made out of desperation, but rather out of the realization that suppliers are not only a significant, but often the primary force behind technological innovation across the utility automation and information technology marketplace. Moreover, the fact that technology is advancing faster than ever before means that suppliers are the ones who can best articulate the details of solutions that are in the development pipeline and that will be vital to addressing challenges and solving problems that are only now beginning to unfold.

Finally, what sense does it make to keep writing and publishing stories about the past when utilities – now more than ever – need to be looking forward to what lies ahead? Users cannot talk or write with experience and authority about products or projects that have not even cleared the pilot stage and they cannot provide deep insights into tools and solutions that despite only recently coming online, will be desperately needed in the short term to address and solve already looming problems.

What I'm saying is that it makes no sense to hold back on reporting new tools and new technologies that will utilities save time, money and resources until they have been in the field for five or ten years. The fact is, at the pace of technology today, many if not most of those installations will be due for at least upgrades, if not total replacement, within 5-7 years from now. And before you say that's a crazy notion, consider the fact that the average shelf life of a particular laptop model in a retail store is only about three weeks! Granted, it's a long way from three weeks to five years, but that is exactly the point. As JD Hammerly points out in the Inside Tracks interview in this issue, forget about 40-year depreciation schedules for this kind of equipment – those days are over.

Let me also take this opportunity to acknowledge the 800-pound gorilla in the room. It's no secret that utilities have historically (and emphatically) preferred to get their information from other utilities – especially those they consider to be their equivalents or "peer" utilities. In some cases, utilities have followed the lead of so-called "bellwether" utilities (i.e., those with a characteristically pioneering spirit),

but they have also been emphatically reluctant to take their direction from suppliers, mainly for fear of being led down a path that locks them into to doing business with a particular supplier or suppliers – whether good, bad or otherwise. Seems prudent, right? Well, yes and no.



Back in the day when we lived in a parochial world of proprietary protocols and custom hardware, that was certainly a legitimate fear, especially when utilities had big engineering departments and scores of highly qualified staff that were capable of staying up on the latest new technological trends and developments. But as I often say, "That was then, and this is now." Today, utility engineering departments are barely a microcosm of what they were just a few years ago, and they are continuing to shrink almost daily – a trend that is highly unlikely to reverse itself anytime soon.

By contrast, suppliers are a primary force driving technological innovation, tasked with developing the tools and solutions that utilities will need to survive and thrive as 'Utilities of the Future' in the days, months and years ahead. Having shed the cloak of proprietary design years ago, suppliers today are not only a legitimate source, but are a robust and readily available source of information and enlightenment that can be exploited to the fullest by utilities without any fear of being locked into anything. On the contrary, most suppliers have long been providing utilities with the open systems and open standards that utilities have been requesting for decades, thereby allowing utilities to select the best-in-class, best-of-breed solution(s), in many cases even across multiple vendors and platforms.

In today's world, utilities that expect to survive and thrive in this still young millennium will have to shed their old fears and behaviors, and take advantage of the wealth of knowledge, insights and experience available from the many innovative, reliable and reputable suppliers that have honed their skills over decades of hard work and determination to providing excellent, yet affordable, automation tools and solutions. In that spirit, it's time to stop treating suppliers as interlopers and transients. It's time to call an ace an ace – and learn how to create and play that winning hand together. – Ed.

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May 1	Richmond, BC	Canada	<i>Clevest Launches New Smart Grid Visualization Product for the Utility Industry More...</i>
Apr 29	Exton, PA	USA	<i>Bentley Expands Reach of Bentley LEARNing Conference by Hosting Events Around the Globe More...</i>
Apr 25	Mississauga, ON	Canada	<i>Survalent Technology Commissions a New Advanced Distribution Management System (ADMS) for the REA Energy Cooperative, Pennsylvania More...</i>
Apr 23	Raleigh, NC	USA	<i>Tantalus Announces Peter Londa as President and CEO More...</i>
Apr 16	Middleton, NJ	USA	<i>Ed Melanson Joins T&M Associates to Lead Automation Practice More...</i>
Apr 15	Chicago, IL (IEEE-T&D Conference)	USA	<i>ABB US Substations Business Shifts to Renewables Focus with Two New Projects More...</i>
Apr 11	Denver, CO	USA	<i>RainCommander Launches a Device to Control Your Sprinklers from the Cloud More...</i>
Apr 8	Brooklyn, NY	USA	<i>Smarter Grid Solutions & HEVO to Collaborate on Smart Grid Technology for EVs More...</i>
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Apr 8	Munich	Germany	<i>Siemens and Accenture complete Omnetric JV More...</i>
Apr 7	Brooklyn, NY	USA	<i>First Minister of Scotland Opens Smarter Grid Solutions' New York Office More...</i>
Mar 28	Abilene, TX	USA	<i>Kenergy Selects Milsoft Geographic Information System, Field Engineering & Outage Management System More...</i>
Mar 26	Minneapolis, MN	USA	<i>Honeywell and CPS Energy Announce ADR Program More...</i>
Mar 18	Brantford, ON & Toronto, ON	Canada	<i>Corporation of the City of Brantford Completes CIS Infinity Implementation With Advanced More...</i>
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What Tomorrow May Bring

uhQ: As you know, the theme of this issue is: "Balancing Human Capital with Infrastructure Optimization Through Automation." How do you see the onerous challenges of our aging workforce and declining infrastructure being met by so-called 'Utilities of the Future' and by the industry at large?

Hammerly: Let me begin by saying that automation will be crucial. Historically, most automation initiatives in the utility market space have been focused almost exclusively on open-loop (supervisory) control. By contrast, the next wave of automation will focus on closed-loop control – essentially taking the human intervention and decision-making out of the loop. This shift is already beginning at the "edge" of the grid for electric utilities and will eventually migrate to the edge of other utility infrastructures, such as pipelines or what have you, for the other two utility verticals: gas and water.

uhQ: In what way(s) will that technology shift manifest itself?

Hammerly: Central to that transition will be the migration from circuit board-based devices to silicon-based devices, some of which will operate autonomously using low-cost sensor and control technology. While these devices will be internally complex, with some hybrid devices combining both traditional digital and high-power circuits, this will be a sea change from the

externally complex devices we are widely accustomed to working with in traditional systems.

uhQ: Can you give us some examples of how this will propagate across the industry from a market-application standpoint?

Hammerly: Yes, there are many. In the electricity sector, for instance, auto-restoration is a prime candidate. Slower than automatic re-closers, but faster than FLIR (Fault Location, Isolation & Restoration), silicon devices coupled with modern switches will appear first in microgrid configurations for campuses, military bases, and other institutional applications, but in the future they will also provide alternatives to network grid solutions in dense urban settings. Widespread usage in overhead, looped-radial circuits will most likely follow, leading to significant in reliability improvements.

Low-cost silicon based devices will also be the source of unprecedented amounts of new monitoring data that new predictive analytics will consume. These analytics will appear in at least three key areas: 1) Operations – where sophisticated load forecasting, based on historical meter data and improved weather modeling including solar and wind forecasts for renewable supply – will reduce

Master of Markets & Technology

In this issue our readers are fortunate to get an inside glimpse of someone widely considered to be one of the great minds of the utility industry. I had the good fortune to meet JD Hammerly during his stint at the helm of CGE-Alstom* – well before it became Areva T&D and more recently, Alstom Grid.

The thing that impressed me the most about JD was his innate grasp of both the technology side of utility automation as well as the business side of the utility industry in general – and electricity markets, in particular. When we first met, the term "wholesale market" was very much in its infancy, used mainly in backrooms (and occasionally in boardrooms) where financial types gathered to discuss the price of utility commodities.

It wasn't until shortly after he had explained the interrelationships of wholesale markets and SCADA/EMS to me that we started hearing those terms tossed around in the same conversation and eventually in the same sentence. But as you read along, you'll quickly see that this interview is about so much more than just markets and technology.

Over the years I've come to realize that JD has a purview of the utility industry that is rarely embodied in one person: Part highly skilled technologist and part exceptionally polished economist... with a flair for the bleeding edge of both!

A globetrotter for the vast majority of his career, JD provides a view of the utility industry that ranges from visionary to downright profound. Read the interview, and I'm quite sure you'll agree! – Ed.

(*This is not a spelling error; it was actually spelled with an 'h' at the time!)



reserve requirements and enable more efficient and sustainable generation dispatch; 2) Asset Management/Maintenance, where failure predictions for both improved reliability and more efficient spare and refurbishment management will become increasingly critical for leaner more agile utilities; and, 3) Engineering, mainly for predictive behavior analyses as well as some of the emerging challenges associated with areas such as vegetation management, load growth, renewables and electric vehicle penetrations, just to name a few.

uhQ: As we all know, the utility industry is losing many of its most experienced industry experts en masse, just when the declining infrastructure that they designed, built and maintained over the past 40+ years needs them most. What behavioral changes are needed on the part of utilities and/or automation suppliers to get through the difficult period that lies ahead?

Hammerly: I would see three key focus areas: First, utilities must find ways to capture the “tribal knowledge” that exists in their mid-tier staff, where many of the key day-to-day decisions are made. This includes the history of how and why events occurred in the past and making that history available in a readily consumable form.

Second, utilities should greatly expand their college internships so that knowledge transfer can take place on a personal level, and the potential new hires can be inculcated with the company’s philosophy at an early stage.

Finally, collecting and storing all of the data, all the time, and making it available in an easily accessible and consumable enterprise-wide resource for all to use is imperative. Most utility data has an implicit context, when and where the data was sampled. Although a large portion of that data is already stored in various locations, data integration and access remain major obstacles. as little attention has been allocated to correlating and accessing data based on its intrinsic context.

uhQ: In keeping with the workforce/infrastructure theme, what are some of the pros and cons of the profound changes now under way as veteran Boomers are being replaced with so called Gen X-ers and Millennials over the next 7-10 years?

Hammerly: There are most certainly both pros and cons. On the downside, the loss of expertise and culture within any given company – whether a

supplier, utility or consultant, weakens its ability to meet the breadth of emerging challenges. Further, the innate understanding of “applied” engineering (rather than just the theoretical side) cannot be accurately calculated, but the toll will nonetheless be extraordinary. On the positive side, however, don’t underestimate the value of having young minds with less dogmatic ideas and approaches to problem solving. Stronger technical skills outside of classical power systems engineering – computer skills for example – and fresh perspectives are likely to force reconsideration of traditional, organizational approaches. In the view of the next generation, the old way isn’t the only way.

uhQ: What measures should utilities pursue to position themselves for achieving balance and maintaining safe and effective operational continuity during this challenging period, from an automation perspective?

Hammerly: Relying less on existing staff to make detailed operational decisions and more on the fresh talents of the newcomers in the design and planning of systems in making those detailed decisions will help. A greater focus on measuring the holistic reliability impacts rather than what is often a de facto ‘run to failure’ for aging assets will also help improve the customer perception of the utility. This is a key area where automation can make a measurably beneficial, effective, and lasting effect and a place where the ROI can be almost immediate.

“What are the most important or critical areas of automation that will yield the most tangible benefits for the dollars invested?”

uhQ: What are the most important or critical areas of automation that will yield the most tangible benefits for the dollars invested?

Hammerly: As I mentioned earlier, I think closed-loop control, silicon-based sensors and advanced protection and control, along with predictive analytics, are among the most promising areas of technological advancement. Utilities will need to make greater use of formalized risk analysis techniques to sharpen this focus.

Inside Tracks...

Insider Perspectives on Utility Automation



uhQ: Let's move over to how these challenges – and the requisite solutions – differ across Electric, Gas, Water and combination utilities. Are the differences significant?

Hammerly: In some ways, yes, they definitely are. For example, the inherent economic profile – though changing extensively in all sectors – will favor more automation investment by gas and electricity, at least in the near term. In the water sector, water losses are becoming significant and should be the first focus as aging infrastructure requires replacement. From a timing standpoint, the impact of low-cost silicon-based solutions will hit electricity first, simply because the market is large, the requirement for speed is higher, and the electricity sector is arguably the most capable of paying the tab. In the gas sector, many if not most, legacy policies and automation systems will need to be changed or upgraded as a direct result of PG&E's San Bruno pipeline explosion. The focus, for at least the next five years, will therefore be on safety. Expansion of local gas distribution will also share the near-term focus, driven by the low natural gas prices and increased domestic supply.

“In the gas sector, many if not most, legacy policies and automation systems will need to be changed or upgraded as a direct result of PG&E's San Bruno pipeline explosion”

uhQ: Are there geographical issues that need to be addressed? In other words, do all utilities have the same general challenges around the world?

Hammerly: No, geographical considerations are very important. The first market split is between developing and developed countries/regions. As has been the case in other industries – telecom is a good example – given today's technology, any geography not having a significant legacy infrastructure will develop differently. These countries will skip entire generations of technology as they move forward rapidly to provide electricity, water, and gas. In many of these potential green-field areas in developing geographies, wholesale markets will appear and develop sooner, to drive investment in supply, wires, and pipes. Pre-pay smart meters will enable new utility business models, and communications embedded in the electric system

will change the nature of bundled service.

The second departure will be those geographies that have deregulated sooner and more extensively than others. In particular, geographies under retail deregulation will see more diversity in commercial solutions, such as bundling of services. This could include providing electric vehicles as a service (e.g., BMW in California and Washington), or unrelated services (e.g., insurance, entertainment packages or even credit cards). We can also expect to see the emergence of new public utilities operating with a minimal staff and relying on contracted services for the bulk of the utility's operations.

Lastly, the regulatory processes will be weakened as utilities search for ways to survive and thrive by selling less of what they make. This shift won't be as dramatic as what VOIP was in the telecom industry, but it will be significant as more transmission and generation moves to merchant service providers; renewables become even more distributed; and high-value residential customers become less reliant on their native utility as they self-supply with roof-top solar.

uhQ: How does the utility budgeting process for automation need to change, if at all?

Hammerly: The first question IOUs must ask themselves is how automation needs to be treated from a regulatory perspective. Today, automation assets become commercially obsolete in three to seven years – not forty. Technology deployments should include a required “reserve” for their replacement in no more than five years. This reserve should be part of the rate structure and include the internal and external costs to implement the replacement.

For Municipals, the problem is different, but no less challenging, in that they need to be able to “bond” for assets on a much shorter cycle. This could be more costly – possibly driven by higher interest rates and certainly driven by higher administrative costs. Bonding could be more complex because of the types of investors who are likely to choose bonds with shorter maturities.

The nature of long-term planning must also change, so that utilities can forecast budgetary needs more accurately in the face of possible revolutionary changes – not just evolutionary ones. For example, classical IRPs (Integrated Resource Plans) will need to be modified and expanded to address the impacts



of electric vehicles, distributed energy resources, and demand response measures, including both classic demand response as well as more comprehensive applications such as Integrated Volt/Var Optimization, etc.

uhQ: What is the relationship between automation and critical infrastructure, and how will it – or does it – need to change going forward?

Hammerly: Over the past 100 years, we have gone from a society that merely consumes electricity, gas, and water to one that relies on those commodities for survival. The loss of any of these, even for short periods, will immediately impact safety, health, and the economy, as we saw with the 2004 Northeast Blackout, and more recently, Superstorm Sandy. Electricity is the most vulnerable of the three from a reliability standpoint.

“Much of the infrastructure we have today, relies on security by obsolescence and lack of sophistication... So far, we have been fortunate, but going forward we need rigorous policies on both new and existing assets to evaluate their value and the impact of their loss.”

Substations and key transmission lines can be geographically remote and difficult to protect, yet clearly visible – at least for above ground facilities. Moving those assets underground, however, comes at a significant cost that causes most ratepayers

to balk when it comes to accepting those financial consequences.

uhQ: No interview like this would be complete without mentioning the S-word: Security. In particular, what steps can utilities take to address the looming security issues associated with legacy automation installations? What is the right approach for automation assets that are in decline and will probably need to be replaced sooner than later?

Hammerly: Much of the infrastructure we have today, relies on security by obsolescence and lack of sophistication. The use of old, non-routable protocols and less familiar devices that are difficult to find and identify actually does provide a certain level of security. So far, we have been fortunate, but going forward we need rigorous policies on both new and existing assets to evaluate their value and the impact of their loss. Utilities need to ask themselves the hard questions, such as: What is the risk profile of a given asset? What is the likelihood of intrusion? Is it local or can it spread across the entire system?

uhQ: Are there measures that can be taken to help mitigate these concerns?

Hammerly: Clearly there is a need for secure, encrypted protocols and the ability for assets to operate and recover autonomously; both can help to mitigate some of the implicit vulnerabilities. Perhaps the most important aspect of automation security, however, is treating utility communications as part of the operational footprint – not merely an afterthought. Utilities need to have a Network Operating Center (NOC) with security monitoring built in. The remaining looming question is where does the funding for these critical migrations come from, and how does the public deal with this financial dilemma? That’s a question that I’m afraid I don’t have an answer for, Mike. Maybe some of your readers can weigh in on that one, and we’ll both be enlightened! **uhQ**



John D. (“JD”) Hammerly is the founder and CEO of The Glarus Group, which provides advisory services to utilities such as technology direction, project triage, market design and implementation and tactics as well as strategic services to industry suppliers for portfolio analysis, new product design, and alliances/acquisitions. JD can be reached via email at: jd.hammerly@theglarusgroup.com

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Balancing Human with Infrastructure Optimization Thru Automation

Building A Better Mousetrap... for a Different Kind of Mouse

There's a mythical story about an engineer who worked for years toward developing a better mousetrap. Prototype after prototype uncovered sometimes glaring and sometimes subtle design flaws and various other problems. Each successive design got a little closer to the perfect mousetrap, but somehow also identified new design errors, which in turn, allowed the test mice to remain free. After spending many years trying to perfect the design and having grown weary of the protracted process, the engineer finally tore up the drawings and gave up, at least temporarily. Then, after a brief respite, the engineer – not to be outdone by the likes of a mere rodent – embarked on a new quest – that of breeding a dumber mouse.

The widespread notion that technology can solve all of our problems and fix all that ails us is a wonderful theory – if only it were true! Technology undeniably makes it possible to do a lot of things we couldn't do before. In many cases, products we once only dreamed about are now commonplace. In the broader view, technological advancements allow us to do things we never

thought would be possible in our lifetime. Even so, most technology still cannot fix problems without some type of human involvement – at least not yet. Despite advances in areas like artificial intelligence and fuzzy logic, most of the time a human being must still identify the problem, come up with a solution, and then actually apply the solution. That might sound obvious, but that third step (application) has been severely lacking in the utility space for decades. Although the tools are there, use and application has been fairly minimal for a variety of reasons.

So why hasn't the use of automation technology already leapt to the forefront of utility problem solving? A great deal of the technology needed to keep our legacy infrastructure even more resilient and sustainable than it is today has been around for many years; much of it for decades. Why haven't we made use of these wonderful tools? And why hasn't automation achieved its rightful place as an essential tool of the trade, alongside cutting pliers, pipe wrenches and the like? The reasons are several, but they are concentrated in two main areas:

- 1) Regulatory requirements, and 2) budgetary

n Capital re ough

issues, both of which feed both sides of the usage equation.

Regulatory Requirements

The positive side of regulation has been contained in mandates requiring automation, either directly or indirectly. Examples include gas/liquid pipeline leak detection (which without automation is limited to visual fly-overs) and “first flush” analysis for wastewater systems, which is virtually impossible to do manually. The down side, however, is that utilities rarely spend money on any significant purchases that do not have a provision for rate-based cost recovery. Therefore, spending on automation has been severely constrained since regulatory mandates containing implicit automation requirements rarely include explicit language that guarantees cost recovery.

A Different Breed

It is a well established fact that a large portion of our most experienced industry veterans – those with 20, 30 or even 40 years of experience (mainly Baby Boomers) – are retiring and in most cases, are being replaced by younger, less experienced workers. This is a trend that is only

Infrastructure is Tactical... Automation is Strategic

This is the second installment in our 2014 initiative to examine the daunting – and unprecedented – challenges of “Shaping the Utility of the Future Through Automation.” In the first quarter we focused on what an Automation Blueprint for Utilities of the Future might look like. Now that our most experienced workers are leaving the workforce – just as the infrastructure they designed, built and have maintained for most of the past fifty years is headed toward its own sort of retirement – we share some thoughts around how utilities can start preparing themselves for the steady rise in automation usage that now seems inevitable.

In this issue we begin to delve more deeply into the nuts and bolts of how automation can help bridge the gap between our aging workforce and declining infrastructure. The very first thing that should be noted is that this is not just the normal evolutionary change – this time it will be different, meaning that the changes will be far more strategic rather than tactical. Classical infrastructure components such as pumps, valves, transformers, pipes and cables represent the tactical dimensions of utility operations, since they typically perform singular and fairly simplistic functions. Automation is far more strategic – providing a way to do many things within a single integrated solution set. How that plays out will fundamentally change the way utilities operate, in the future relying far less on physical labor and more on automation... starting now.

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now starting to become visible, but one that will last for most of the next two decades. And while we will never completely get past the need for designing better mousetraps, we already have vast amounts of proven technologies – and the resultant products – that are capable of solving many of our problems, simply by using the tools that already exist today. Most of these tools were designed by Boomers but are certainly capable of being used by those just coming into the workforce.

Although we are beginning to see a different breed of ‘mouse’ coming into the industry mainstream, they are by no means dumb or dumber than their predecessors – quite the contrary. The influx of these replacement workers (mainly Gen X and Millennials) will result in profound changes, some of which will occur naturally in the course of progress and some of which will be driven by these newcomers themselves as they rapidly take over both leadership and execution roles during the next decade and beyond.

Utilities at the Crossroads

Hardly anyone would disagree with the notion that (traditional) utilities are at a crossroads. On the one hand there is the long-established utility infrastructure – wires, pipes, pumps, valves, breakers, and the like – that were designed, built and operated by a largely homogeneous and deeply experienced workforce that is now collectively approaching retirement. On the other hand, we have an opportunity – no, the necessity – to rethink the established infrastructure, not just from a logistics standpoint, but also from an operational perspective. It is in this rethinking process that there perhaps lies a silver lining to the otherwise dark clouds gathering ahead. There is no implicit or explicit rule that says utilities must dogmatically follow the same path they always have. In fact, there is a mounting body of evidence to the contrary, driven by pervasive factors including, but not limited to, environmental changes, fluctuating demand profiles, incident and disaster mitigation, and of course, aging workforce, declining infrastructure, security and service reliability considerations.

With both the legacy equipment itself and its veteran ‘handlers’ simultaneously reaching their

twilight years, the time to not merely sustain, but also expand and repurpose much of our infrastructure is at hand. Just as roads and bridges are in urgent need of upgrades, repairs, and even total replacements, so too is our electricity, gas and water infrastructure due to the prolonged lack of reinvestment over a period of not just years but, in most cases, decades. At this point in time, the ship that might have smoothly carried us through this difficult period of dwindling resources without radical changes being made has already sailed – long ago.

When it comes to designing, building and maintaining critical utility infrastructure, society’s expectations for increased capacity, flexibility, streamlined operations, service reliability, safety and security are at an all-time high. Moreover, most utility customers expect this transformation to be accomplished quickly and at essentially the same, or even lowered, costs. That would be a tall order under even the best of circumstances, which these are clearly not. It is a much bigger deal than most people – both inside and outside the industry – realize, and over the next seven to ten years, the urgency of the situation will move from magazine articles and conference presentations to empty chairs and project backlogs that utilities will have neither the human nor the financial resources to address unless steps are taken immediately to put more progressive, pro-active plans in place – plans involving a substantial increase in automation.

That Was Then, That Was When...

For most of the past century, utility infrastructure maintenance and support – including what we now routinely refer to as remedial maintenance and asset management functions like calibration, testing and inspection services – could be summed up as a “*Joe and the Pickup Truck*” methodology. That is, whenever something went wrong at a facility such as a substation, pump station, compressor station or some other remote location, the shift supervisor would get on the squawk box – usually a radio or a radio-telephone (“Walky-Talky”) – and shout out something like this:

“Hey Joe! If you’ve got your ears on, hop in your

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pickup, drive out to station XX, and see why [insert malady here]. When you get there, give us a call back, and let us know what's going on!

...after which the headquarters crew would sit back and wait for the radio to squelch or the phone to ring with Joe's expert onsite assessment.

If Joe couldn't immediately identify the problem or come up with a quick solution using the resources he could easily muster – those usually being whatever he happened to have in his toolbox or perhaps threw in the back of his truck before he headed out – a series of radio/phone calls with headquarters and possibly others among his field crew colleagues would be required to discuss likely problems and potential solutions. These sessions were often far from optimal due to communications issues or other problems like not being able to reach the right person or find the right drawings. Eventually, however, things got back to normal, and Joe drove back to the shop to wait for the next emergency call to come in from operations.

However, since Joe was more often than not a veteran field troubleshooter – that's why he got the truck – most of the time he could just do a little checking around, maybe take a few readings, and sometimes just listen to how the offending piece of equipment sounded, to make his diagnosis... and he was usually right more than he was wrong. He could do this because he had been there when the equipment was designed, installed, tested and commissioned, and he knew every fix, patch or other modification that had ever been made to 'his' portion of the utility's asset deployments.

Often, Joe could even identify both the problem and the solution just by simply being told what wasn't working properly or how it was misbehaving. In those cases he didn't even have to drive out to the station until he could gather up whatever he knew he would need to correct the problem when he arrived onsite. This was important because sometimes the drives could be very long – hours or even days, in some cases. Yet in many instances, Joe would wind up making multiple trips to and from the site, either because he didn't have what he needed to fix the

problem with him, the problem was a compound one that required more and/or different parts and/or tools, or he simply ran out of time and had to go back another day.

This scenario has been repeated with myriad variations for literally decades, mainly because Joe and his pickup truck were always there, ready to spring into action. But now the truck is long gone, and Joe is counting down his final days to retirement. Now, when the new guy sitting in the chair that Joe used to occupy gets a call about something malfunctioning in the field, it's easy to just lean over to ask Joe for some sage advice. Learning that way comes easy when there is someone handy to ask – but also very slowly.

The reality is that the new guy won't ever be able to know what Joe knows. That's not because the new person isn't smart or doesn't have the proper education or aptitude; the problem is that Joe learned what he knows over decades – not weeks, months or even years. There simply isn't enough time to learn it all before Joe retires, and to make matters worse, there is a strong likelihood that little or nothing is written down. So once Joe retires and goes off to play with his grandkids, there won't be any more leaning over to ask Joe. It will be a new world for these newcomers once the Boomers retire, and unless steps are taken now – today – to lessen the blow, it isn't going to be pleasant for anyone... except perhaps, the retirees.

Newbies vs. Boomers



Newbies: The influx of younger people into the workforce is far from being a bad thing. On the contrary, these new workers – we'll call them Newbies

– are generally smart, well educated and much more in tune with technology than most of their predecessors. While Boomers might have invented the lion's share of the technology that pervades the industry today, Newbies grew up surrounded by it. They not only embrace it, they

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absolutely expect it to be there, now.

Newbies are quick studies on all things technical because of their lifelong familiarity – and in some cases, their romance – with technology. This acceptance of technology is in stark contrast with Boomers, many of which had to be nudged – or sometimes pushed – into embracing technical solutions at various points in their careers. By contrast, despite having an inherent experience deficit, Newbies are generally eager to learn and are highly motivated to succeed. Because they march to a different drummer, however, their incentives to do so are very different from the things that motivated the Boomers, focused more on social and quality of life issues than money and what it can buy. Newbies also tend to be adventurous, which is both a vice and a virtue: A vice because they can be impatient and may go off into uncharted territory without proper guidance, but a virtue because they are prone to challenging the status quo and willing to try new things.

Boomers: Baby Boomers have comprised the mainstream of the utility workforce for nearly five decades. They possess a wide range of unique knowledge, skills and experience that can be



neither easily nor quickly transferred to others, especially those with less practical experience. They are highly disciplined, insightful and assertive, most having spent substantial portions of their careers conquering increasingly formidable challenges. In the course of doing so, most Boomers have gained, at the very least, an appreciation (though perhaps not a love) of technology and not usually by pushing the envelope. Their tolerance for deviation from established norms is limited, and unlike the Newbies, they are loath to change the rules of whatever task they may be pursuing without a strong – and preferably unanimous – consensus.

The fact that Newbies and Boomers are very different kinds of people raises the possibility

of a severe culture clash. But although the depth and breadth of skills and knowledge that will be required of utility workers in the next fifty years will be markedly different than those of the past fifty, it will take both kinds to successfully navigate the transitions, now and especially into the future. While the brain trust of what was, currently resides with the Boomers, the challenges of what will be resides with the Newbies taking their place and forging new pathways into technological exploitation. Therefore, a delicate balance must be achieved between moving to a new model either too fast, or not fast enough.

What Happens Next?

Until a substantial portion of the most experienced utility personnel actually retire over the next 5-10 years, the full impact remains difficult to predict. We aren't quite there yet, but we will be soon, and when it happens – if we let it proceed without taking some mitigating measures – what happens next could very well be devastating. By that time mitigation will be tantamount to applying a tourniquet to an amputation; that is, you can probably stop the bleeding, but the patient might still die.

If this sounds melodramatic, it is meant to be. So far, there is little evidence that a significant number of utilities has or will heed the warnings. Industry associations and private companies have stepped up their efforts to provide training for those who want it – and can afford to take advantage of the courses being offered – but the OJT (On-the-Job Training) is still woefully lacking at most utilities. So far, only a handful of utilities have formal succession plans in place (i.e., beyond the executive level), and there is a marked deficit of in-house knowledge transfer programs across the boards.

The steps toward averting a catastrophe are not that complicated, but neither are they necessarily going to be easy just because they are straightforward. Here are a few simple steps that every utility should be taking to prepare for this unprecedented changing of the guard:

- **Succession Plan:** Every utility needs one, from the CEO down to the line managers and even to their subordinates, anywhere there

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are critical positions needing to be – or remain – filled by qualified personnel. A properly designed succession plan will rotate multiple employees through multiple job disciplines so that there will be more than one person who can carry out mission-critical duties after not only future retirements, but also in tolerance of normal attrition.

■ **On-the-Job Training:**
A formal plan to document and capture as much of what the senior staffers know before they retire is essential, even if the method is as basic as audio-recordings. Alternatively, ask each person to list the most important things s/he does that someone else could not do without their help (or equivalent experience), and have them document at least one or two of them each week until the list is exhausted.

■ **Formal Education:**
Make education and training a top priority, and make sure that everyone in the company is informed with specific supporting actions; not just words. That means setting up formal in-house training programs in critical areas and integrating those sessions into your succession planning. It also means budgeting for formal training and educational courses, both inside and outside the company for employees who need it, regardless of their title, position or pay grade.

■ **Incentives:** It is in our nature as human beings to be competitive. Not everything has to be a race, but there is plenty of room to make a game out of otherwise difficult challenges. Try it! You might be surprised at how motivated people can be when the proper incentives are laid out and fully supported.



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■ Automation: The utility industry can no longer afford to treat automation as a luxury or as something that is only done when required by legislative or regulatory mandate. Automation tools and solutions abound. Start now to set a course toward using them as a first response rather than as a last resort. Also, keep in mind that suppliers can be invaluable as allies and partners in learning how to best apply available automation tools, and newer employees are likely to be ready and eager to learn.

The Ultimate Balancing Act

A delicate balancing act must be achieved at this juncture. A simultaneously aging workforce and declining infrastructure will have to be rationalized with the influx of a new breed of utility workers (“Human Capital”) while also recognizing ongoing constraints on capital spending. Channeling those investments, needed to not only maintain, but also to transform and in some cases, repurpose our infrastructure will require a new vision of how the infrastructure will be replaced over the longer term. Simply replacing that which exists today will probably not serve the needs of the future. Beyond the obvious financial challenges, however, this also opens the door to more streamlined operating models, which can in turn, lead to a leaner and much less labor-intensive infrastructure overall.

areas where the tasks being performed are very straightforward and either too impractical, too expensive, or in some cases, too dangerous to be performed by people.

Tasks at the Advanced Level in the diagram are much more sophisticated but still do not penetrate the most advanced areas of operations. This is mainly due to concerns about giving computers too much autonomy and a tradition of humans making the most critical operating decisions – a mold that may prove quite difficult to crack until all other levels of automation are fully exploited.

It is the middle (Intermediate) section, however, where automation could make potentially huge reductions in cost while boosting operational efficiencies and also improving safety and reliability. However, this is where jobs performed by humans were – until recently – the most deeply entrenched, making it difficult to find anyone interested in eliminating large numbers of mainstream jobs. However, those jobs are now being vacated as Boomers retire, leaving few if any alternatives to automating as many of those processes as possible, as quickly as possible.

In **FIGURE 2**, we can begin to get an idea of the near-term future (e.g., 1-3 years) by taking advantage of the available automation measures to replace – not displace – veteran

FIGURE 1 depicts the salient elements of today’s balance between Infrastructure, Human Capital and Automation. As this diagram shows, costs are highest where automation is used least – at the upper and lower edges of the operational spectrum and especially in the middle, where the most labor-intensive activities (and the bulk of infrastructure hardware) have traditionally resided. Entry-level automation, though widely proliferated, is deployed mainly in

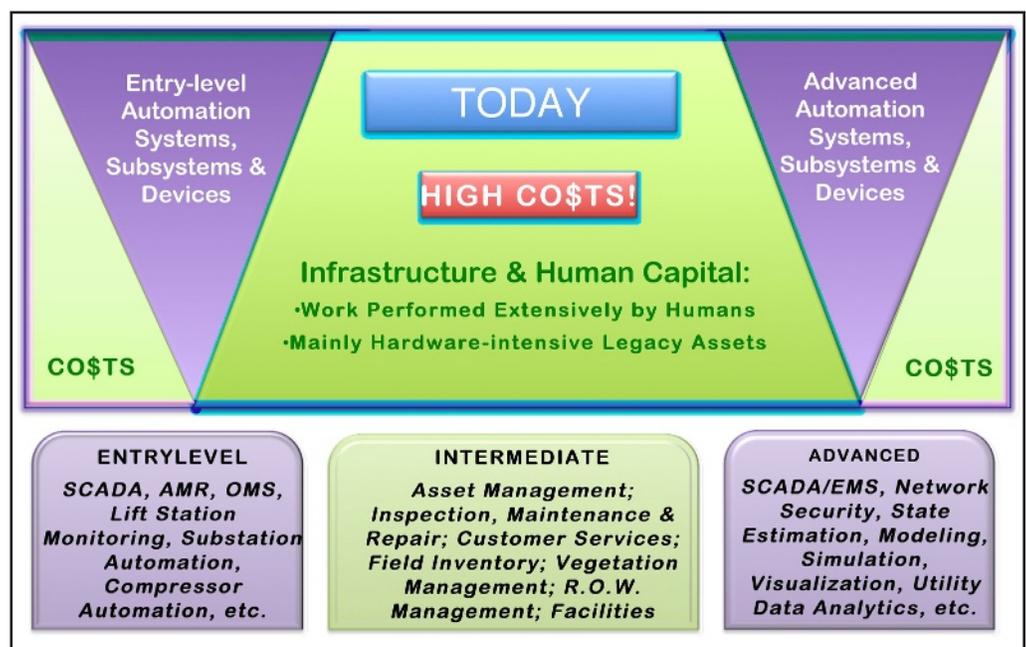


FIGURE 1: Human Capital, Infrastructure & Automation Balance Today

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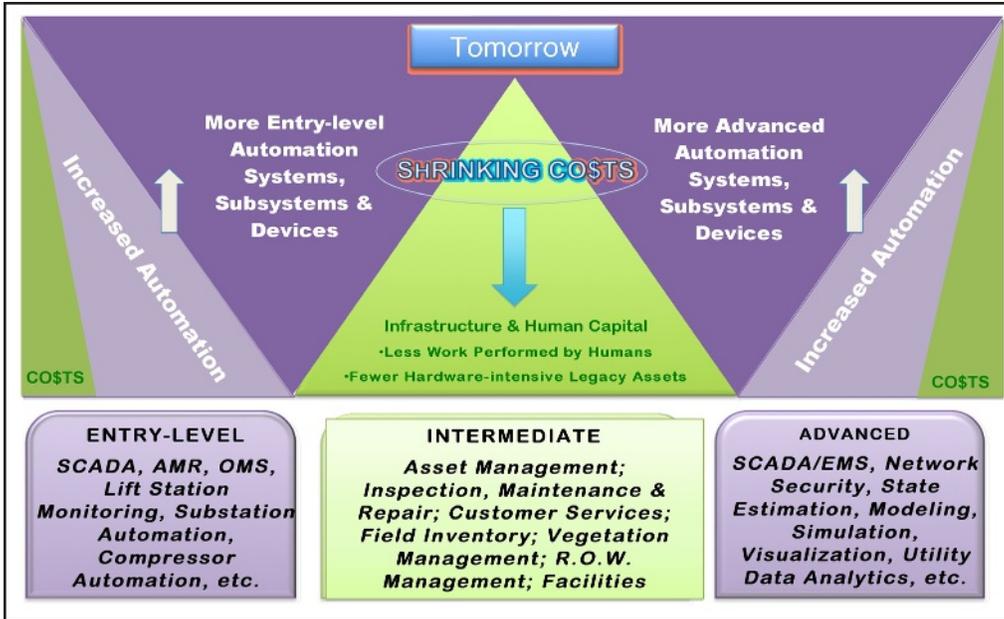


FIGURE 2: Near-term Outlook for Automation Expansion (1-3 years)

utility personnel that are retiring or will be retiring soon. As automation takes hold, we will see significant cost reductions, with labor being the most expensive capital there is in just about any operating scenario one might pick as an example. Moreover, pushing automation downward to cover more of the Entry-Level applications depicted here as well as possibly addressing some of the higher level (Advanced) applications could also lead to significant cost reductions while increasing safety, performance and reliability in areas that previously involved regular human participation or even periodic human

intervention.

FIGURE 3 shows what might be achieved within the next 3-7 years if automation is steadily deployed. In this scenario, labor and costs are driven down to absolute minimums, while other parameters such as safety and efficiency continue to climb. At the same time, organizational changes and operating methodologies undergo drastic changes as safe, efficient and reliable operations can now be managed and carried out by a fraction of the staff that was once required. **uhQ**

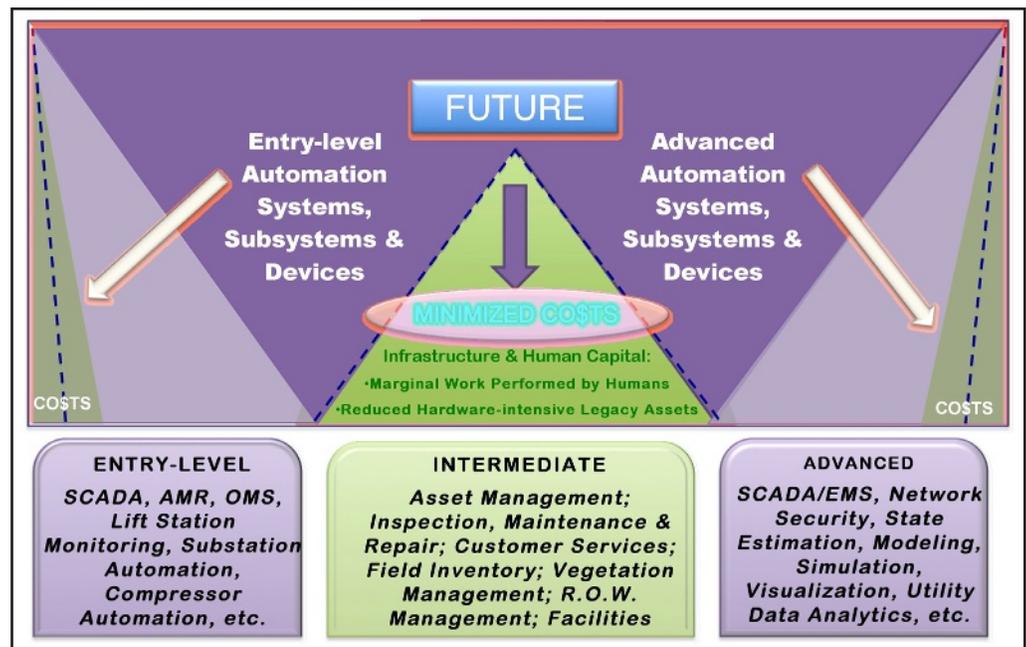


FIGURE 3: Imagine the Possibilities!

Coming in the Q3-2014 Issue...

Much has been written and said about the interrelationships between *Information Technology (IT)* and *Operations Technology (OT)* and how those sometimes complementary and sometimes adversarial relationships have intersected and will eventually have to integrate with the rising tide of automation. The theme for that issue, "*Automation, IT & OT Implementation, Integration & Support*" will examine the legacy of previous attempts at IT-OT integration as well as how that integration is likely to evolve from this point forward. Tune in for the full story in the Q3 issue!

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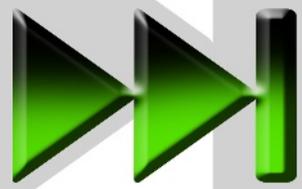
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The Smart Grid Is Inseparable from the Internet (Part 2 of 2)

Editor's Note: Part 1 of this article (appearing in the Q1-2014 issue) posited that: "A Singularity is Near for the Electric Grid." A singularity was first defined in astrophysics as an event horizon – say passing through a black hole – beyond which all accepted points of reference, units of measure and analytical methods are meaningless.

Ray Kurzweil's vision of a singularity is the point at which computers are as intelligent as humans, making them indistinguishable from each other. For the electric grid, it's the point at which customers can bypass their utilities, making the grid indistinguishable from customers.

Imagining the Possibilities

A century old, highly successful U.S. electric grid model began to fray in the late 1970s and in the past decade began to disintegrate at an accelerating rate. Deterioration of the foundations for the legacy grid model combined with the rise of difficult new demands and constraints changed the industry's trajectory. At the same time, the exponential development and deployment of new energy, electronics, telecommunications and information technologies began accelerating the electric energy industry toward

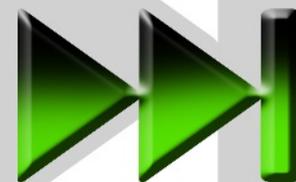
an event horizon. Some call this a "utility death spiral" after which electric utilities, as we know them, would cease to exist.

On this side of the singularity is a grid that is owned and operated by some 3,000 monopolies, which provide all of their customers' power and energy needs with some 10,000 centralized generation plants fueled primarily by burning carbon and uranium. Just making this legacy grid more observable, controllable and sustainable (i.e., Smart Grid) means deploying many more monitoring, analytical and control devices throughout utility distribution systems. This already surpasses the capabilities of conventional electric utility monitoring, communications, analysis and control systems. On the far side of the singularity much more will be required, and more importantly, even more will be possible.

Electric utilities serve about 145 million meters in the US. Customers, utilities and non-utility providers will be monitoring, analyzing and controlling an increasing number of points on the customer's side of the utility meter: distributed generation, distributed energy storage, energy management systems, smart thermostats, equipment, appliances, lights, EVs, transactive energy market purchases and sales, etc. This will ultimately result in hundreds of millions, even billions, of new endpoints.

Enter: The IoT

How can these billions of independent variables even be tracked, much less optimized, to ensure economical, reliable, quality, secure and sustainable electric energy? It will require new methods, specifically distributed monitoring, analysis and



control. Distributed, autonomous automation will be required at the edges of the grid. This is already being done in more and more of our lives and businesses through what we now call the Internet of Things (IoT).

The Internet is the result of a transformation of telecommunications and information made possible by persistent, exponential improvement in the performance versus price of electronics devices. In a sense, those three industries have already experienced a singularity and the other side is the Internet. It not only makes it possible to do many things better, it makes it possible to do things that have never been done before. As a result, the Internet is increasingly essential to every aspect of life and business.

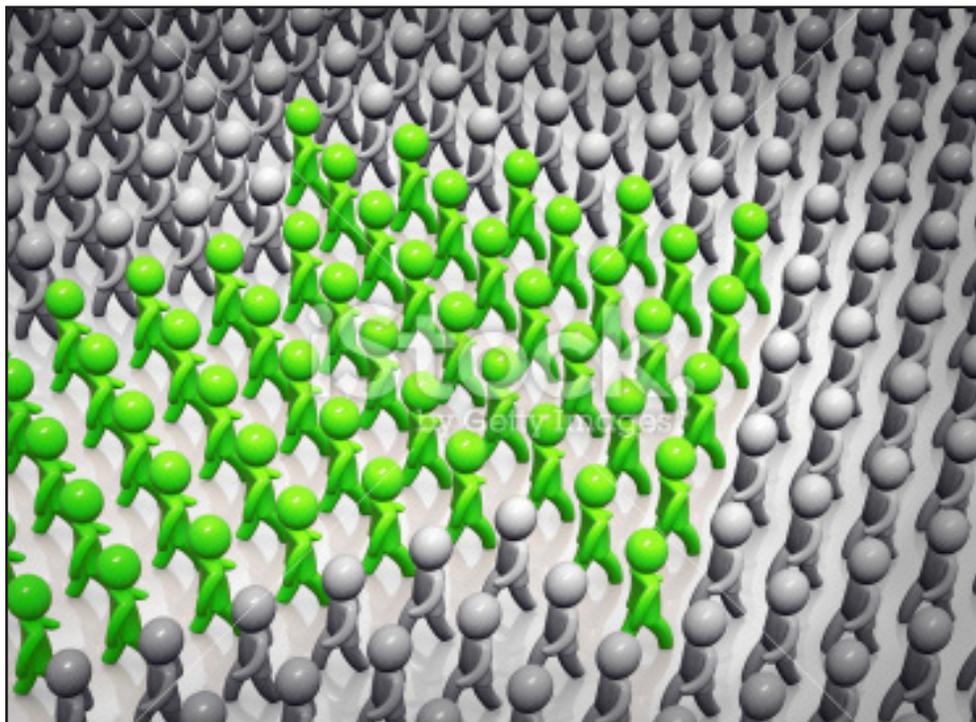
The Internet began as the connection of people to people and people to things. That is rapidly being surpassed by the connection of things to things. There are orders of magnitude more things that can benefit from this connection than there are people. As a result, Cisco predicts that nearly 50 billion new connections will be made to this IoT over the next decade.

The IoT is the network of physical objects connected to the Internet. These objects contain embedded technology to interact with their external environment and internal states. How does this turn reality inside out? When objects can sense, analyze, communicate and act, individually and in concert with other objects with high-speed, two-way, digital communications, it changes how and where decisions are made, and who makes them. Sensing, analysis and automation become distributed and autonomous. This is the very definition of what the emerging grid needs. And it will make possible monitoring, analysis and automation beyond anything that we are doing or even contemplating now.

Great Expectations

The Smart Grid is already considered to be one of the first and largest examples of the IoT. Many more things use electricity than are connected to the

Internet today, and essentially everything that uses electricity can be made more convenient, useful and efficient by connection to this network. Thus, the Smart Grid part of the IoT could be larger than the Internet is today.



The IoT will be the new reality of the grid. The electric grid will converge with the Internet. It will become an “Enernet” as expressed by Bob Metcalfe, “*Over the past 63 years, we met world needs for cheap and clean INFORMATION by building the Internet. Over the next 63 years, we will meet world needs for cheap and clean Energy by building the ENERNET.*”

All of us rely on the Internet for an ever growing part of life and business. We will expect to be able to do so with electric energy supply, management and utilization. Customers will not be content to be limited to the proprietary, closed-system data, communications and applications provided by their utilities. Also, the Internet as the basis for electric energy applications maximizes prospects for widely usable innovations by developers everywhere.

A severe constraint on the Smart Grid is the lack of integration and interoperability of devices, data and applications. The common first step toward the IoT is converting networks on proprietary protocols to IP-based networks. What better way to accomplish



new grid integration and interoperability to replace the complex mosaic of proprietary systems and multifarious industry standards? Think of the seamless integration and interoperability of so many different kinds of things via home and business Wi-Fi.

Finally, in the long run, there will be no way that electric utilities, dis-intermediaries or vendors will be able to economically deploy, operate and maintain

proprietary data communications with the capacity, speed, ubiquity, security and reliability of the IoT.

A new grid for the 21st century not only requires the capabilities offered by the Internet of Things, but it will be so much more than we imagine... because of it. **uhQ**

Author Profile



Steven E. Collier is Director of Smart Grid Strategies at Milsoft Utility Solutions. Operating from Austin, Texas, he assists Milsoft with corporate business development and industry relations. Since starting his career at Houston Lighting & Power in the early 1970s, he has worked as a consultant or executive with energy, telecom and technology companies in the United States and abroad. Steven has degrees in electrical engineering from the University of Houston and Purdue University and is a designated IEEE Smart Grid expert. Besides blogging as SmartGridMan, he writes and speaks widely on new and emerging energy, telecom and information technologies. He can be reached via email at steve.collier@milsoft.com.

For more information on IEEE's involvement with IoT, please visit: iot.ieee.org.



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Avoiding the Effects of Brain-drain on Power Grids



National Lampoon's "Vacation" movie series provided some of the most hilarious comedy scenes in movie history. In particular, I remember Chevy Chase's character in the "Christmas Vacation" movie, Clark Griswold, spending hours decorating his house with an over-the-top display of lights.

After inviting the entire extended family to witness the victorious moment where he powers them all on, the climactic crescendo is met with a deafening thud as he plugs in the cord – and absolutely nothing happens! (Unknown to Clark, the power to the main outlet is controlled by an obscure switch in the basement that gets repeatedly flipped on and off, causing the display to 'magically' follow suit. Who knew?)

At one time or another, we've all faced the mystery switch, tricky latch, or the oddly placed device that serves some seemingly unknown purpose. These oddities are quite common in the real world for practical applications – or perhaps compensation for not-quite-perfect equipment operation.

For example, a switch on the wall controls a power outlet in my bedroom, but unfortunately, it also controls the outlet where my alarm clock is plugged in. So, to avoid accidentally powering off my clock and oversleeping, I hard-wired the clock connection to bypass the switch and always remain on.

However, if I forget to wire the switch back up – or at least explain what I have done – to the next occupants of my house, they may well be the next Griswolds, faced with a switch that seemingly does nothing...

Now, multiply this scenario by hundreds, or maybe thousands, and that's a pretty good overview of how the electric grid is set up by many utilities. Unfortunately, the grid and its electrical loads are not perfect. With the ultimate goal of "keeping the lights on" commonly referred to as "Kit-Lo", field engineers and technicians often make adjustments to the distribution system that make perfect sense for how it is operating today, and the inside knowledge of these tweaks are taken into consideration when addressing the system every day. However, when those small but relevant changes are not documented and exist only in the wisdom of the current crop of employees, they can wreak havoc on the next generation of workers who must spend considerable time figuring out what in the world the staff that preceded them has done.

The legacy career staff

It seems like every time you turn around, there's a new statistic showing how many job and career changes the average person will make throughout his working life. Twenty years ago, the common knowledge was that most young workers would make 5 or 6 significant transitions during their careers. Nowadays, that number is even higher. The world of utilities seems to be an anomaly in that it is not uncommon to find engineers, linemen, etc. who have over 35 years of experience with the same employer.

This poses a unique challenge for the utility industry that has two connected parts: First, new employees may walk into decades of knowledge and wisdom that they must absorb and comprehend before getting to a solid starting point for truly understanding the intricacies of a particular grid. Second, since transitions have been so rare, utilities have become accustomed to operating without experience disruption, relying on the knowledge of the people on staff who often have decades of experience. Thus, when transitions do occur, they are potentially quite disorderly and can introduce significant confusion.



Progression to a Smart(er) Grid

Today, however, as distribution technology is becoming smarter, new graduates enter the workforce armed with an array of technical knowledge learned in class using tools like modeling, simulation, theories, and case studies – but often with very little, if any, hands-on experience. Contrast that with established utility personnel, who regardless of academic expertise, almost always possess years of field experience and practical knowledge. Though it may seem that the superb technical acumen of young employees positions utilities in a position to more easily transition to a smarter grid, in reality, it is generally not that simple.

The fact is that in almost all cases, the transition to newer technology is not a transition at all, but rather a progression. That's mainly because distribution components are frequently run to the point of failure, or at least until the end of – and more recently, past – their projected life cycles. Smart grids are typically not constructed from the ground up but instead are the result of years and even decades of replacing old technology with smart technology when it makes the most sense to do so – usually when the equipment fails. Hence, most utilities experience (or can expect to experience) a period of many years operating a combination of old technology, smart technology, and upgraded, enhanced or retrofitted equipment. Given that reality, it's easy to see why technical prowess alone cannot replace practical knowledge and experience overnight; at least not for any utility interested in preserving reliability.

Passing the Baton Effectively

This is a period of great transition for utility human resources. Retirements and downsizing have already eliminated sources of older knowledge at many utilities, but it is common to see these employees return to work in consulting roles. Since a large number of utility staffers are close to the end of their careers, the window of opportunity to ensure a smooth knowledge transfer is shrinking rapidly. Here are some strategies that smart utilities can implement in order to limit the hiccups that always occur with generational shifts in technological industries:

1. On-the-Job (OJT) Training

Regardless of how prestigious a college or university, one thing that is very difficult to provide in a higher learning setting is field training. Virtually all graduating engineers enter the workforce

having never touched a working power line. OJT is a well-understood concept in practically every organization across all sectors of the economy because each specific job and situation is unique and requires institutional knowledge. Utilities are no stranger to this type of training, and new employees can expect proper orientation to systems and operations – which may, or may not, include field work.

With increasingly sophisticated distribution technology, higher education and master degrees



are more important than ever for successful engineers. This necessity has introduced knowledge barriers that make it increasingly difficult for field crewmembers to work their way into operational roles, creating a silo effect with lessening communication and understanding between the disciplines. Utilities will soon find themselves with entire staffs that have never step foot in the field unless they take specific action to provide that experience.

All new engineers should be provided an opportunity to spend time in the field and gain hands-on experience to provide insight into the end result of decisions they make from control rooms. Field experience also provides an excellent overview for what technology is being used and where it is located on the grid as well as what special circumstances may exist that would produce results not expected from a textbook example. Further, utilities need more employees ready and able to pitch in and perform more tasks during emergency situations or during strike



situations in markets where labor unions are common.

Field training should be provided early in a new engineer's career path to complement technical knowledge gained on the job. Utilities can also recruit interns and offer cooperative education opportunities to students enrolled in engineering programs at colleges and universities to provide practical experience even sooner. By doing so, newly hired engineers who have previously completed an internship or co-op will have a wider breadth of knowledge to start from on their first day as a full-time employee.

2. Documentation

If there's one thing that every computer science professor tries to drill into the heads of students, it's to write proper documentation. Document often, document clearly, and document completely. Though different employers and project leaders have different requirements for documentation, often times it is the first thing to go when faced with a looming deadline. Reducing or eliminating documentation in programming usually pays off by allowing the code to be written faster, and the negative ramifications of taking shortcuts are rarely apparent until the damage has already been done.

No wonder incomplete or non-existent documentation is so rampant. And this principle isn't limited to computer code; proper documentation is also sorely lacking in a wide variety of facets in utility operation, as it is in almost every industry. To avoid risk of reprimand or disciplinary action, impromptu fixes implemented by knowledgeable technicians in the field were almost never documented if they varied from specifications, even when completely safe and effective. In many instances, knowledge of these alterations exists only in the minds of the technicians that created them because their priority is "Kit-Lo".

Even when equipment and modification changes were made that were within specs, proper documentation has not always been kept for a variety of reasons. Luckily, most utilities have employed documentation standards that are well followed, but these are relatively new. It's a wise practice to ask experienced staff to retroactively document modifications made in years past that are not yet accompanied by accurate records. Doing so will save ample time and effort in the

future when additional work is carried out on these components.

3. Practical Training

Modern smart grid technology is intelligent enough to provide a variety of useful information about distribution and power usage and is even equipped to engage in self-healing when an error or disruption occurs. This, however, is only the case once the equipment is successfully provisioned and implemented. Even the smartest new technology is not plug and play. With so many variations in grid design and layout, this type of approach would not be practical.

Formalized education and training is excellent at providing a useful base of understanding for new engineers, but practical training on the actual equipment that is to be used is equally necessary. Though manufacturers include comprehensive specifications and usage manuals with equipment, this is no substitute for "getting your hands dirty" by working on the equipment. Most vendors are willing to provide this training for clients that ask for it, and nobody is better equipped to fully explain how products work than the equipment's designers and manufacturers. Utilities interested in having the best prepared and most efficient staffs should inquire with vendors about providing this practical training.

This is also an excellent opportunity to help bridge the gap between employees. Newer engineers are likely to have the best educational base for understanding the theories of modern technology while older staff typically have a more pragmatic understanding on how to best implement it. The most effective training exists on a continuum that involves senior staff, junior staff, and vendors, with each participant helping to educate the others.

4. Blur Job Descriptions

A traditional model for utility workers includes engineers, linemen, and grid architects, all working within the defined limits of their job descriptions. This made sense at a time when the separation of duty accurately mirrored correspondingly separate tasks. However, modern power distribution is more dynamic and draws from a broad cross-section of disciplines. Limiting the duties of professionals to fit into narrow descriptions is increasingly crippling in an environment where cumulative knowledge often trumps specialized know-how.

A better model to follow is: meet, convene,



display, and share. An example of this mentality might involve a meeting of utility professionals where an engineer presents his/her knowledge on a particular component. Drawing from respective areas of expertise, meeting attendees can then discuss the implications, advantages, and challenges of different variations on the component providing executives with a holistic vantage point upon which a purchase decision can be based.

Using this type of cooperative information exchange, each department/employee is better equipped to make the best decisions for the utility. When these types of information exchange sessions are held on a regular basis with a rotating list of presenters, everybody benefits from gaining more information faster. Not only can information pass through departmental silos, it also crosses intra-departmental silos, sharing knowledge across varying levels of experience.

5. Do More with More (Information!)

One of the core benefits of Smart Grid technology is that it provides better information without relying on human intervention. For example, when a lineman makes a change to a circuit, it used to be that the only record of the new design relied upon documentation from the person who implemented it. Intelligent remote monitoring now allows engineers to see the change immediately through variations in the load.

This is a new way to build intelligence on grid conditions rather than relying on employees to remember and document what actions they took, and load monitoring makes it apparent. When engineers are trained to understand how to interpret variations into real world conditions, reliance on human memory diminishes. Moreover, this concept can be applied to a variety of applications, including Volt/VAR optimization, peak demand planning, distribution automation, and self-healing disruptions and outages.

Even with these tools, however, comprehensive understanding cannot not exist in a vacuum. Grid intelligence is most effective when it is combined with a historical database of information that is accessible to any engineer at any time. Over time, this pervasive knowledge leads to more effective distribution and response by mitigating human error in the decision making process. Simply put, better information = better decisions.

Blending Old and New

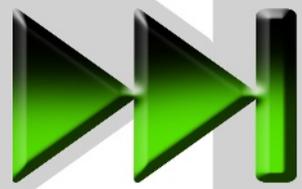
Expectations for the preservation of reliable grid performance and in many cases, aggressive demands for reliability improvements are on the rise due to increasing populations, ubiquitous consumer electronics, and the addition of renewable energy sources and electric vehicles, just to name a few. This increased usage, when coupled with governmental mandates for better efficiency, makes Smart Grid technology an excellent choice since it can achieve both performance and reliability objectives while increasing efficiency and reducing costs. While the rate of progression varies depending on the grid specifics, there is always a period during which old and new technology must coexist and cooperate. This period cannot depend exclusively on legacy knowledge or solely on progressive thinking; it requires a merging of the two.

As utilities forge ahead toward a truly smarter grid, bumps in the road are inevitable and must be anticipated as an integral part of that progression. A well thought out and implemented strategy of knowledge sharing and transfer among all employees – both new and old – will pave a smoother road and reduce the possibility of major issues when access to the expertise of the last generation of experts is no longer possible. The window of opportunity to harness this immeasurable knowledge and experience is shrinking daily – the time to act is now. **uhQ**

Author Profile



Kevin Mays is a product/application engineer at IUS Technologies with over 20 years of engineering design, product development, and technical sales experience. He holds a BSEE from Northeastern University and his circuit design and technical expertise was gained while employed at Motorola, Uniden-America PRC, and Maxim Integrated Products.

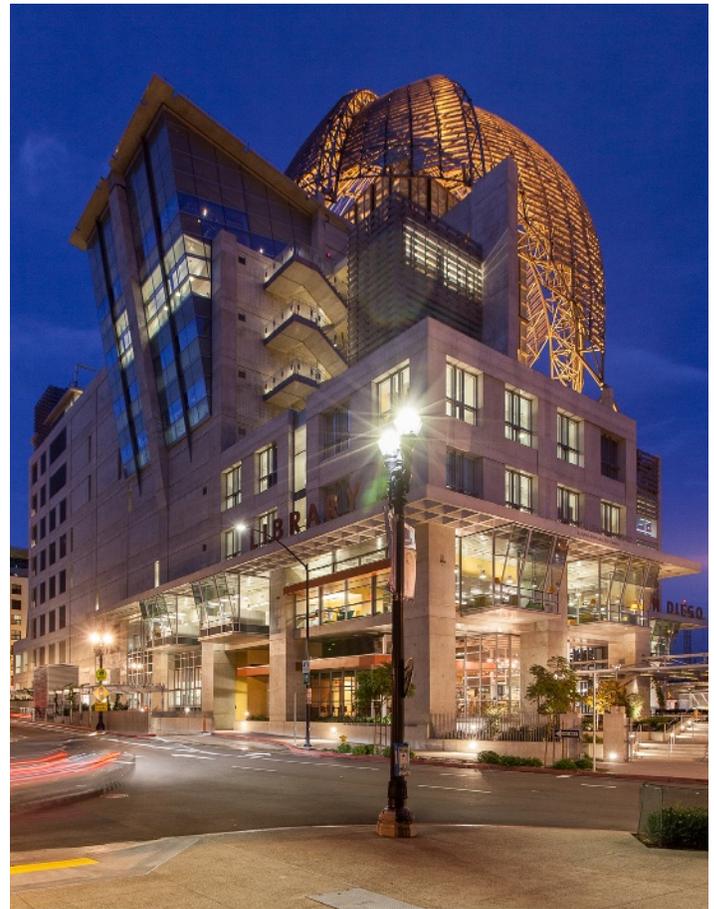


San Diego Tests Project to Turn Street Light Network into Mini Smart Grid

What do holiday lights, wireless water meters, security cameras and chemical sensors have to do with streetlights? For the city of San Diego and local utility San Diego Gas & Electric (SDG&E), a lot.

SDG&E, the City of San Diego, and industry group CleanTECH San Diego are collaborating on a first-of-its-kind project to test a pilot to create a smart streetlight grid. One of the biggest energy cost centers in any given city is often the street light network. But imagine a city where the streetlights are not only cost- and energy-efficient, but serve as a mini-energy grid and one of the key building blocks for a smart city.

Along with strategic partners like Qualcomm and GE, that's what San Diego is trying to do...



Street Light Working Group

The partnership is officially called the Street Light Working Group (SLWG) and it is piloting post-top streetlights with GE adaptive controls as part of its “enLIGHTen San Diego” vision. The group might not have a sexy, cutting-edge name, but it’s attempting to do what no other has done: create a grid that monetizes the streetlight network. This group of visionary leaders is collaborating for a common goal to create a cleaner, connected, safer and smarter region, and they’re hoping that it becomes a model that other public/private partnerships can replicate.

The Beginnings – Reducing Energy Use

In 2009, SDG&E supported the formation of the working group through its Local Government Partnerships program, spurred by stimulus funding through Energy Efficiency and Conservation Block Grants (EECBG). At that time, the working group was conducting a Phase I pilot evaluation of broad-spectrum street lighting options to reduce energy usage. During Phase I, the working group retrofitted 60,000 streetlights in 14 cities, saving 20 million

All photos courtesy of San Diego Gas & Electric



kilowatt-hours (kWh) and \$3 million in taxpayer savings annually, and spurring \$25 million in economic development for San Diego County.

Harnessing Adaptive Controls and the Internet of Things

The working group's new phase II adaptive control pilot is taking their work to the next level. The group realized that advanced information, automation and communication technologies can make our cities smarter, enabling enhanced services and quality of life. To start, the group installed GE's LightGrid Outdoor Wireless Control System with two-way communications on several thousand antique-style post-top and roadway streetlights in downtown San Diego. Harnessing the power of the industrial internet, or the Internet of Things, the GE adaptive controls enables the group to map and monitor every individual street light fixture, continually reporting energy usage and lighting data to a central management system accessible through a Web-based interface.

The adaptive control module connection is made externally through an optional UL-listed dimming control receptacle. Each node also provides GPS and self-commissioning, which automatically connects to the network and displays GPS coordinates in Google Maps. Updates to the nodes are easy with "over the air" firmware upgrades. Users can access scheduling, customized reporting, grouping and user access level management through an online dashboard.

These adaptive controls also have utility-grade metering in each node, which provides 0.5 percent power measurement accuracy. The combination of the utility-grade meters and a new metered billing rate allows for sub-metering and billing of third-party applications.

The 'Mini-grid' is Born

By leasing space on the pilot's smart street light grid, cities can enable a variety of community-enhancing applications, including holiday lights, chemical

sensors and video for enhanced homeland security, wireless water meter reading, enhanced cellular service with micro cells, and so much more. The group anticipates that the street light grid will even be able to deliver Wi-Fi to under-served neighborhoods. To make this happen, the City of San Diego has initiated collaboration with San Diego-based Qualcomm, Inc., the global leader in 3G and 4G wireless chipsets, to add this key core competency to the evolving smart city development team.



New Streetlight Metering and Billing Scenarios

Currently, in the State of California, there are no means for metering the actual energy usage of streetlights. A fixed monthly tariff rate is based on the light's wattage and amount of time in service. The current model does not encourage energy efficiency, because cities cannot reap the monetary benefits of dimming streetlights. To address this, SDG&E has deployed a cross-functional team to work with the City of San Diego to map out new streetlight metering and billing scenarios, which will likely create a new metered rate for the streetlights.

Converting from an existing flat rate to a new metered rate brings a number of benefits. On the surface level, it means that cities can finally monetize the benefits of dimming streetlights. More importantly, however, it allows for sub-metering of third-party applications that the city may choose to plug into the street light grid. So that means that services like holiday lights,



emergency response, Wi-Fi, and cell service can be turned into revenue generators to offset the entire costs of the system.

SDG&E supports the establishment of a 'street light metered rate/tariff' because it will help municipalities save energy. The utility is looking to keep customer rates low and this is one way to achieve that. Additionally, California has established the most aggressive greenhouse gas (GHG) reduction goals in the U.S., requiring SDG&E to reduce emissions to 1990 levels by 2020. Energy efficiency is the most cost-effective way to reduce GHG emissions.

In fact, California governor Jerry Brown signed AB-719 into law on Oct. 7, 2013, which orders SDG&E and other investor-owned utilities (IOUs) to file a tariff to be used at the discretion of local governments, on or before July 1, 2015, to fund energy efficiency improvements to IOU-owned streetlight poles.

AB-719 requires the tariff to allow local governments to remit the cost of the improvement over time. It prohibits the shifting of costs to nonparticipating ratepayers, except for use of rebates and incentives and requires the cost of the improvement to be identified separately rather than included within the charge for electrical service. Despite prohibition of cost shifting to nonparticipating ratepayers, AB 719 specifically will allow these retrofits to qualify for



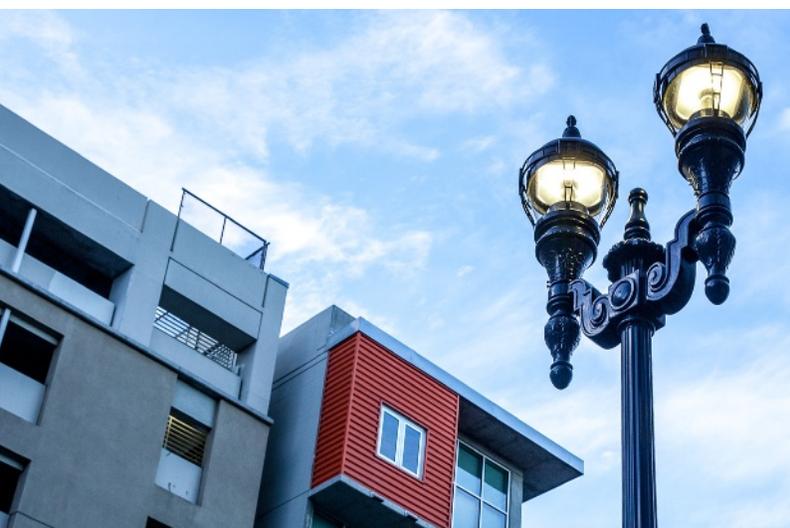
energy benefits to city governments and local communities. In this trial, SDG&E seeks to discover whether LED streetlights with embedded smart battery systems could provide usable emergency response and demand response.

Additional Benefits

In addition to creating a mini-grid, the automated two-way communications technology in the adaptive controls nodes brings a number of other benefits. Service will improve across the board, because the technology provides real-time asset monitoring capabilities. Because services like Wi-Fi, holiday lights, and more are connected to the smart grid, the software automatically alerts where there are potential problems. This early diagnosis of issues and immediate alerts allows utility managers to address problems before there is a service disruption. This is much more efficient than the current process where a citizen needs to notice and report an outage.

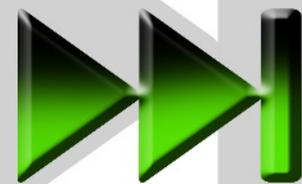
Adaptive controls also offer light flashing capabilities to alert citizens in the event of an emergency. The lights can also be dimmed during off-peak hours to achieve greater savings. And, because the human eye actually perceives these lights as brighter, it also helps to address "dark sky" concerns by light tuning to reduce light pollution. The new post-top luminaire's full cut-off design better serves local residents and the local astronomy community with a 90 percent reduction of up light.

Finally, simply changing the lights from high- or low-pressure sodium lights to induction or LED lighting produces 50 percent energy savings. With the adaptive controls systems, there is additional 30



rebates and incentives through ratepayer-funded energy efficiency programs.

In supporting AB-719, SDG&E is conducting an additional, separate field trial test of an advanced LED street lighting system that would deliver significant



percent energy reduction on top of the 50 percent. The systems last longer, too – in fact, they have double the life span of traditional sodium-vapor street lighting.

Working Together – Model for Other Cities to Replicate

Given that there are so many parties involved in the working group, it uses a variety of tools and techniques for collaboration. For example, the group uses an online file-sharing application, Dropbox, to post and share lighting specifications, RFPs, and successful bids. The working group has made these resources available to all cities in Southern California and has advocated for an innovative ‘piggyback’ or Public Agency Rights clause. The clause is written

into all RFPs and gives vendors the option to allow other public agencies to procure the identical equipment and services from them with similar price and terms. In other words, when one city develops its project specifications and successfully completes a competitive procurement process, another city can piggyback and use the same specifications and vendor to streamline their street light retrofit procurement.

The working group believes that streetlights can do much more than illuminate our roadways. Through this project, the group hopes to prove that streetlights can become one of the most valuable smart grid assets in a city, making our cities smarter, and enabling enhanced services and quality of life. **uhQ**

Author Profiles



Ted Reguly is the director of customer programs and projects for Sempra Energy’s regulated public utility San Diego Gas & Electric (SDG&E). He is responsible for overseeing the development, implementation and integration of comprehensive customer offerings related to energy efficiency and demand response, while overseeing customer facing projects, and privacy. He was recently named one of the Top 15 Smart Grid leaders in the electric industry by FierceSmartGrid. Reguly’s was previously director of SDG&E’s smart meter program where he was responsible for the development of SDG&E’s smart meter business case, regulatory approval, and program implementation.



Marty Turock manages CleanTECH San Diego’s Greening San Diego program, which involves accelerating sustainable best practice implementation across the region including CREBs renewable energy, EECEBG energy efficiency projects, and as the leader of the Regional Lighting Working Groups. Previously, Turock worked in General Electric’s Chem-Met Management Program in GE’s Engineered Materials Group. During his 20-year tenure at GE, Turock was one of the company’s top global operating managers and restructured the GE Silicones Canada division and also launched the GE Silicones Asia-Pacific division in Hong Kong. In 2001, Turock pursued his entrepreneurial spirit in his post as vice president of sales with the wireless networks pioneer, Graviton,

Inc. He also led global business development for smartcard fare collection systems at Cubic Transportation Systems. Turock holds a bachelor of science degree in chemical engineering from Princeton University.



Lorie Cosio-Azar is a Project Officer leading the Adaptive Control Street Lighting program for the City of San Diego’s Environmental Services Department, Energy Sustainability and Environmental Protection Division since 2010. Lorie has worked for the City of San Diego for more than 20 years.



Boomers: Outdated or Wise?

Millennials: Innovative or Naïve?

Is Your Utility Ready for Retirement?

At a recent gathering of utility executives and senior managers hosted by PURC, a knowing chuckle spread across the room when retirement was mentioned. A show of hands revealed that one fourth of that audience would retire within 5 years and about half within 10 years. That magnitude of loss was true from the company managers all the way down to the craft workers. Everyone agreed that this presented a challenge. Was it a technical problem that could be solved through hiring practices and training programs? Or, was it an adaptive challenge where employees and the company would have to make hard decisions about what they valued most?

Aging workforce is a well known problem for utilities, as it is for other industries. When utilities expanded in the 1960s and 1970s, they hired a large number of people that were just entering the workforce and these employees – many of whom have now worked for the same company for 30 years or more – are nearing retirement. Some people worry that when these employees go, a lot of knowledge, wisdom, and loyalty goes with them. Others are happy to see the older generation go.

Who is right... those who worry or those who can't wait? The answer is probably both. Aging workforce presents both a threat and an opportunity for companies facing a changing economic and regulatory climate. The key questions most utilities will have to

answer include:

- ◆ What from the past do we need to retain to be successful in the future?
- ◆ What from the past holds us back from future successes?
- ◆ Which losses are the older generation experiencing that may cause them to sabotage knowledge transfer?
- ◆ Which beliefs and attitudes do the new generation possess that may cause them to reject the most important lessons from the past?

Some of the knowledge necessary to retain is obvious: Where are problems likely to occur in power lines, pipelines or other infrastructure? What is the best way to communicate with emergency management officials when a major storm or another type of disruptive event occurs? However, some traditions that pass for knowledge may hold a company back. Rivalry between organizational silos can throw up barricades to adapting as circumstances change.

Memories of failed expansions into new lines of business can cause organizations to become overly conservative, while predominance of close relationships with like-minded companies can reinforce conventional wisdom. Of course, these are not uncommon characteristics for utilities of all shapes and sizes. How can a utility develop a culture that can determine what from the past to remember and what is best left behind?

One company – not a utility – developed interdisciplinary experiment teams, whose mission was to identify and carry out trials that would test conventional wisdom and new ideas. Another company organized its “rebels” to explore what was generally considered unthinkable in the management ranks. In a third company, the CEO allowed disgruntled

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employees to vent at him publically, thus establishing a culture that celebrates the discussion of elephants in the room.

How can a utility address the losses, beliefs, and attitudes that separate generations? Some establish programs that honor the roles of aging employees and help them establish new roles outside the company, maybe within the community or in an organization that celebrates the company's past. Other companies hire pools of talented, young employees that rotate through the company during their first few years of employment. Yet others develop leadership academies that bring younger employees together with senior managers from all aspects of the company in interdisciplinary teams to pursue experiments of their choosing that test new strategies and operating models.

The wrong approach to addressing the aging workforce issue is to assign it to HR, treating it as a personnel

The wrong approach to addressing the aging workforce issue is to assign it to HR, treating it as a personnel issue. The adaptive challenges of aging workforce cut across all dimensions of an organization and involve everyone.

issue. The adaptive challenges of aging workforce cut across all dimensions of an organization and involve everyone.

What happens if a company ignores the adaptive challenges of the aging workforce? The 50 percent or so of employees who are going to retire will do so, and the company left behind will be a consequence of attempts to put new wine in old wineskins: It won't be the company created by the retired generation because that will be gone. It won't be a company formulated by the new generation because they are simply being fit into the old generation's structure. Nor will it be a company jointly developed by the best that the two generations have to offer because they never worked through what to keep from the past and what to create anew. At best, the company will be an accident of history. At worst, it will belong to somebody else. **uhQ**

Author Profile



Dr. Mark Jamison is the director of the Public Utility Research Center (PURC) at the University of Florida (Gainesville) and also serves as its director of Telecommunications Studies. He provides international training and research on business and government policy, focusing primarily on utilities and network industries. He co-directs the PURC/World Bank International Training Program on Utility Regulation and Strategy. Dr. Jamison is the former associate director of Business and Economic Studies for the UF Center for International Business Education and Research and has served as special academic advisor to the chair of the Florida Governor's Internet task force and as president of the Transportation and Public Utilities Group. He has also served as chairperson of the National Association of Regulatory Utility Commissioners (NARUC) Staff Subcommittee on Communications.



Ms. Araceli Castaneda is the director of Leadership Studies and director of Business Development of the Public Utility Research Center (PURC) at the University of Florida, where she is responsible for conducting training on leadership topics, developing client relationships and managing business negotiations. Since joining PURC in February 2003, Ms. Castaneda has held various positions including assistant director, director of the PURC/World Bank International Training Program on Utility Regulation and Strategy, and has coordinated a number of programs and research projects in the U.S. and abroad. Ms. Castaneda has led international leadership workshops involving over 20 different countries.

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Smart Standards for a Smarter Grid

What is ZigBee Smart Energy 1.x?

ZigBee Smart Energy is the world's leading standard for interoperable products that monitor, control, inform and automate the delivery and use of energy and water. It helps create greener homes by giving consumers the information and automation needed to easily reduce their energy consumption and save money. ZigBee standards are mapping out new paths to automation and interoperability that serve as integral ingredients in the future of the Smart Grid.

Key Features

ZigBee Smart Energy provides a variety of features, including metering support, demand response, and advanced pricing. ZigBee Smart Energy's metering support includes the ability to process multiple commodities (e.g., electric, gas, water, and thermal), as well as handling multiple units of measure for international support. This standard also includes support for delivery of real-time and

As the World Turns...

The grid, our electric power infrastructure, was once the most suitable solution for meeting our electrical energy needs. But as the world changes, so must the grid. The capabilities of modern technology have brought possibilities for a new grid reality: the Smart Grid.

So here we stand on the brink of a smarter, automated, and more convenient grid, but the lack of appropriate regulation and interoperability guidance threatens to make the journey to an efficient and resilient Smart Grid a messy and confusing process. Standards, however, can streamline that process and bring us to the future more quickly than we thought possible.

The answer to an efficient, interoperable Smart Grid lies in the use of open, global standards that allow a multitude of vendors to provide products that can operate within a universal Smart Grid.

historical information with the ability to record both generation (delivered) and consumption (received).

ZigBee Smart Energy also supports demand response and load control so that utilities may better balance energy use throughout the grid. Customers are able to override these load control events with the ability to target specific groups of devices, including HVAC, water heaters, lighting, electric vehicles and generation systems.

In addition to metering support and demand response, ZigBee Smart Energy also provides advanced pricing options. Pricing features such as prepayment, multiple currencies, and support for price tiers are just some of the convenient aspects of this standard. It also handles multiple commodities, including electric, gas, water and thermal. Other features include text message

capabilities, security benefits, and others, plus easy upgrading capabilities within version 1.x.

A Multiplicity of Benefits

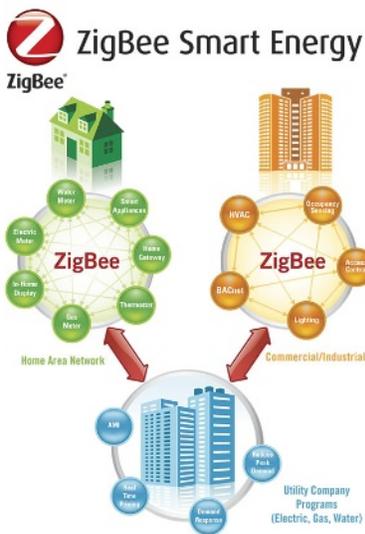
ZigBee Smart Energy is widely deployed in tens of millions of meters around the world and is delivering benefits to consumers today. For example, it improves affordability by creating an open standard, allowing the marketplace to become more competitive. Another benefit is ease of use. Certified interoperability is a benefit to utilities, OEMs, and consumers alike, affording a choice of innovative products with assurance that products will simply work. Moreover, the standard operates at a globally available 2.4 GHz frequency, easing adoption and simplifying installation and operation.

ZigBee Smart Energy also reduces energy consumption and environmental impact. As an increasing number of people are “going green,” this standard is another step toward environmentally conscious homes and businesses, while also enabling consumers to save money by better understanding their energy usage and taking action to become more efficient. According to a January 2014 article by Rebecca Smithers, consumer affairs correspondent for The Guardian, smart meter usage by British Gas customers has led to 54 percent of consumers taking steps to lessen energy usage saving, equaling average savings of 124 USD a year.

ZigBee standards continually improve energy efficiency and lessen environmental impact, no matter the industry. Today, many regulators are pushing utilities to implement energy savings programs, and ZigBee Smart Energy is one way to give consumers the tools to reduce their usage. Of course, increasing efficiency also lessens the negative impact of energy usage on the environment.

SEP 2.0

Smart Energy Profile 2.0 (SEP 2) is an evolution of ZigBee Smart Energy 1.x. SEP 2 offers a global standard for IP-based control, both wired and wireless, for energy management in Home Area Networks. It supports new functionality such as control of plug-in and hybrid electric vehicle charging,



deployments in multi-dwelling units (e.g., apartment buildings), support for multiple energy service interfaces into a single premises, and support for any transport based on IETF IP compliant protocols.

The SEP 2 standard offers IP-based Home Area Network energy management functionality and ensures interoperability between ZigBee and other network technologies. Being IP-based, it also specifically addressed the needs of utilities that prefer to use IP addresses to the end point. Additionally, the standard is

transport agnostic, working with a variety of network communications protocols – both wired and wireless – and supports future utility requirements and forward-thinking developments like PHEVs, Distributed Generation, and more.

SEP 2 was developed by working closely with SAE, IEC, CEN, CENELEC, ETSI, ESMIG, NIST, Wi-Fi, HomePlug and other relevant standards-making organizations. The ability for consumers to manage their usage and generation of energy is a key component of the Smart Grid and SEP 2 products will further extend consumers’ ability to take control of their own energy usage.

ZigBee’s Interoperable NAN Initiative

The Neighborhood Area Network (NAN) is the most recent standard the ZigBee Alliance and its members have undertaken. Utilities around the globe are clamoring for an interoperable NAN, a network that connects smart meters and distribution automation equipment to Wide Area Network gateways. The Japanese market has already mandated use of interoperable standards at the NAN level, while the U.S. is working toward a similar conclusion, and several other markets – such as China, Brazil, and India – are showing increasing interest in an interoperable NAN.

With such obvious market demand, the ZigBee Alliance has begun development on a communication standard specifically designed to achieve plug-n-play interoperability between NAN products and solutions.

NANs connect smart meters and distribution automation equipment to wide area network gateways, such as RF collectors or data concentrators and field devices by providing smart grid infrastructure. NAN is used to communicate with smart meters, distribution automation, and substation automation equipment.

With each vendor offering different automation systems and equipment, it is often exceedingly difficult for utilities to obtain a common view of their infrastructure. This lack of interoperability is a stumbling block to automation and information gathering. With a NAN standard, however, interoperability will be made a

Notably, only three percent of NAN communications is currently standards-based. However, according to Pike Research, as much as 70 percent will be standards-based by 2015, and 85 percent will be standards-based by 2020.

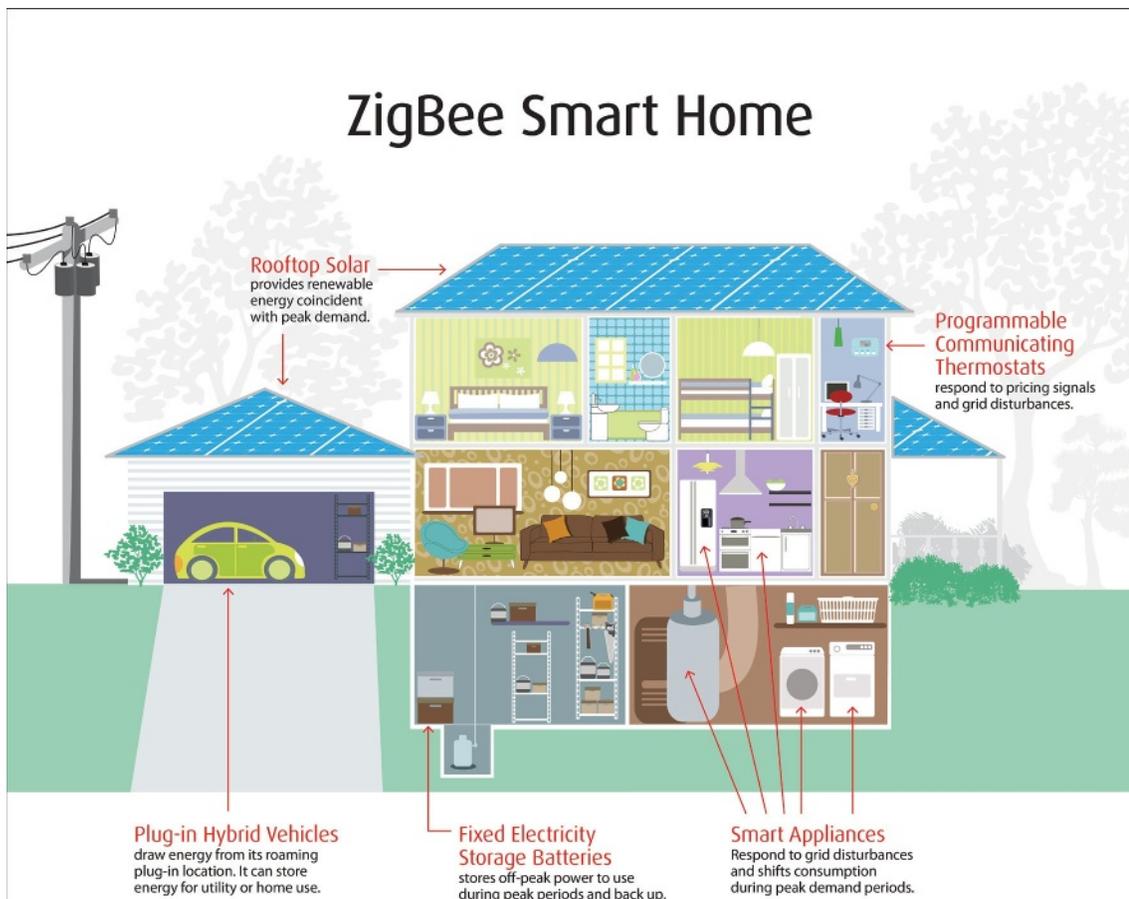
reality, increasing productivity and streamlining data collection. This improvement in data collection will lead to innovation in technology and applications. In turn, improved technology and applications will soon give way to lower costs as grid reliability improves and the cycle of information gathering results in improved technology.

Success Breeds Success

ZigBee's broad success in creating market-relevant standards that are widely accepted by utilities made the Alliance an ideal candidate to take on NAN standardization. With its extensive and impressive resume, ZigBee's experience creating, testing, and

certifying standards further underscored their suitability for the NAN initiative. Moreover, despite being a relatively new application to ZigBee, defining the interoperability specifications for NAN is similar to current ZigBee applications.

Member expertise is yet another reason for ZigBee's suitability as a NAN developer. The Alliance membership includes leading smart metering and smart grid solution authorities with an extensive and comprehensive blend of experience and innovation, thus ensuring that a standard designed by these members will be one that can benefit the utility



ZigBee Smart Home



industry in general and the smart meter industry in particular.

Utilities have been seeking interoperability to avoid their current state of being locked into single vendor solutions. The NAN standard will define protocol Layers 1 through 4 of the OSI communication stack, providing a harmonized transport network supporting different IP-based applications. The Alliance will create this interoperable standard by defining optional features of other standards, including IEEE 802.15.4g and IETF transport protocols such as RPL, UDP and TCP.

ZigBee Certified

While these ZigBee standards are driving the reality of an interoperable Smart Grid, certification actually fulfills the promise of these standards. The ZigBee Certified program benefits from the expertise of hundreds of engineers and business people who have helped create a testing and certification program that ensures devices conform to ZigBee standards and interoperate with other devices. In particular, product developers use this certification process extensively to achieve interoperability and verifiable adherence to the standard.

The promise of any standard must be that the use of the standard will be the same in every situation, in every device and that those devices will be able to work together seamlessly. ZigBee Certified means that any certified device will work as expected and be fully interoperable with other products communicating with ZigBee – regardless of its manufacturer – and provides assurance to developers and consumers alike that their devices will perform in full compliance with the ZigBee standard.

Testing vs. Certification

Whereas testing verifies conformance and interoperability, certification grants official recognition and permits products to carry the ZigBee Certified logo as proof that the product manufacturer has conformed to all the relevant policies of the ZigBee Certified program. Once certified, a product can carry a ZigBee Certified product logo to demonstrate its certified status. The Alliance has authorized test service providers around the world.

ZigBee Certified maintains a strict distinction between testing and certification. Independent testing laboratories must be qualified by the Alliance as experts in ZigBee standards with the requisite equipment before performing such testing. All authorized test service providers are registered to ISO/IEC 17025, the international standard defining operations of testing laboratories.

The Future of the Smart Grid

ZigBee Certified is a mature program, certifying hundreds of devices while maintaining the high level of scrutiny that a working standard demands. Despite this extensive experience, the Alliance continually seeks to grow and stretch this program to improve current processes. Every day, new products and manufacturers are experiencing the benefit that the ZigBee Certified program provides. As utilities and consumers realize the benefits of standardization, the future grid – the Smart Grid – will become a reality. **uhQ**

About the ZigBee Alliance

The ZigBee Alliance is a not-for-profit association of companies creating open, global standards for wireless device-to-device communication. With approximately 400 members, the Alliance is driving worldwide adoption of innovative, reliable, and easy-to-use standards. One of ZigBee's most successful markets has been the Smart Grid industry, with several standards either created or under development. ZigBee Smart Energy 1.x, ZigBee Smart Energy Profile 2.0, and a burgeoning project on NAN are all notable ZigBee standards influencing the industry. The Alliance's goal is to establish the open, global standards necessary to establish a truly convenient and interoperable Smart Grid.



Evolving NERC Compliance Standards and Their Impact on Today's Utilities

NERC-CIP: The Evolution Revolution

NERC-CIP: The Evolution Revolution
Grid-scale energy storage is gaining momentum as a way to increase grid resiliency. In fact, electric utilities already are among the largest owners and users of electrochemical battery systems. To ensure that these systems are reliable, all North American utilities must comply with the standards established by the North American Electric Reliability Corporation (NERC), a not-for-profit entity whose mission is to ensure the reliability of the bulk power system in North America.

In 2013, NERC finalized NERC PRC-005-2, a standard designed to document and implement programs for the maintenance of all protection systems affecting the reliability of the Bulk Electric System (BES) so that these protection systems are kept in working order. It was approved in December 2013 and effective February 24, 2014.

While other published standards and guidelines identify recommended maintenance tasks, the

PRC-005-2 defines maintenance and monitoring activities for substation batteries and, for the first time, adds time frames. NERC PRC-005-2 also is enforceable by the Federal Energy Regulatory Commission (FERC).

In short, the standard requires battery inspections every four months, with additional testing, such as float voltage, battery continuity, battery terminal connection resistance and battery intercell/unit-to-unit connection resistance every 18 months. Also, the standard requires internal ohmic value testing every 18 months or battery capacity testing every six years (as per IEEE 485).

NERC PRC-005-2 is spurring many utilities to rethink and, in some cases, change current battery maintenance procedures. While some utilities already may monitor to these standards, it is our experience that many are not recording the data with this frequency.

Considerations for Automated Data Collection

NERC PRC-005-2 raises a number of key questions, such as should the standards be applied to all substations and should utilities rely on manual or automated monitoring. Here are several factors to consider when deciding between manual and automated monitoring for NERC compliance:

Documentation

Automated testing simplifies the monitoring, testing and documentation associated with NERC compliance. By having the correct documentation ready to go, utilities will avoid the costly penalties associated with non-compliance and incomplete records.



Having correct documentation can help with any potential battery warranty issues, too. When a customer raises a warranty issue, the manufacturer typically asks: How are you using the battery? What are the loads? How is it performing under load? What is the temperature environment? How is it charging? These questions can be answered more easily if there is data on hand to address them.

Labor Investment

Manual testing requires a significant investment in direct labor. Substation visits may require a half-day or more of a technician's time. While automating for compliance with NERC PRC-005-2 will not eliminate the need for technician visits, it will enable utilities to use technicians more strategically – a benefit given the decreasing number of skilled technicians in the field.

Capital Investment

Automation requires an upfront capital investment to install the measurement equipment and validate and analyze the batteries. However, utilities may earn a return on their investment in as little as a year, according to some maintenance organizations, by reducing the number and length of technician visits.

Accuracy

The NERC PRC-005-2 Standard is a 40-page document that specifies what measurements are required, but not how to make them for optimum accuracy. There also is no guidance to indicate compliance with the standard. This puts a tremendous burden on utility management to consistently deliver accurate results, while coping with the natural effects of human variance and error. With an automated system, the measurements are taken exactly the same way each time.

Trending

A big benefit of the NERC maintenance requirements is that it will reveal trending

information that most utilities have never seen. Technicians may only visit each substation once or twice a year, while an automated testing system can check measurements every day, several times a day.

Using this comparison, it can take a technician up to a year to identify a potential problem with a battery. With an automated system, however, that same problem might be identified in as little as a month, allowing technicians to fix the problem right away and potentially extend the life of the battery. Initially, however, trending data also may cause some concerns for utilities. For example, it may be difficult to identify if a shift in float voltage is a natural occurrence or an indication of a problem. Since many utilities have not seen trending data like this before, it may be hard to know the difference. It is going to be important for utilities to learn to weed through this “noise” of data.

The Value of Big Data

The new NERC standards are designed to ensure greater reliability, but does NERC PRC-005-2 go far enough and does having a lot more data ensure greater reliability?

The NERC regulations allow utilities to choose either the NERC internal resistance tests or the IEEE capacity test. From a battery manufacturer's perspective, the standard should require both, as the capacity test is a more reliable indicator of battery health. The NERC impedance test comes the closest to this, but, from a manufacturer's perspective, a capacity test showing performance under load is still the best indicator of overall battery health and predictor of future longevity.

Voltage testing also is not nearly as reliable. Since batteries are tested in a string, they can migrate away from each other. Voltage migration is not necessarily an indicator of failure. All of the batteries may be performing well, with some performing even better than the others.

Performance under load puts the spotlight on actual response to the demand load. Performance under



load is affected by other application parameters, such as the age of the cell, the structure of the cell (i.e., number, configuration and thickness of the plates) the temperature environment, etc. Having additional data on hand is especially helpful in terms of interpreting the performance under load results.

When there is a suspected problem with the performance under load, the knee-jerk response is to assume that the battery must be at fault. It is important to note that this is not always the case. It may be a change in the environment or even the load itself. When the battery is first installed, the load is well known. However, if a battery has been in place for several years, it may be that the load profile has changed due to changes on the grid.

Given the many variables impacting performance under load, it can be difficult to pinpoint which ones may be causing a battery failure indication. A seasoned technician can be invaluable in this situation. However, with fewer seasoned technicians in the field, utilities will be well served to work closely with the battery vendor directly. Ideally, the utility should work with the manufacturer of the installed batteries rather than a competitive manufacturer, as the manufacturer of the installed batteries may be more likely to seek a solution to the problem, rather than simply replacing the battery.

Data interpretation is another potentially frustrating aspect of NERC compliance. Since the NERC standard does not set performance limits, utilities must rely on experienced in-house personnel to set the policies and also to contact the battery manufacturer when a problem arises. The battery

manufacturer can also help set performance limits for each application – and help technicians identify the warning signs.

Summary

NERC PRC-005-2 defines maintenance and monitoring activities for substation batteries according to enforceable time frames. While designed to ensure greater reliability for power utilities, the new standard allows for a good deal of flexibility in terms of what tests are best for checking battery health. As a battery manufacturer, we strongly recommend that utilities employ capacity testing to check performance under load. The NERC standard also makes utilities responsible for setting performance limits. With a dwindling work force of seasoned technicians, many utilities likely will turn to automated systems to comply with NERC PRC-005-2 and to gather the necessary data to evaluate their batteries.

With a flood of trending data now available, utilities must be able to recognize when a disparity means a problem. Battery manufacturers can be of invaluable help in establishing performance limits, determining the best test data to collect, interpreting this new data and recommending the best solution. In this way, battery manufacturers can help utilities realize the complete value of their data, ensuring that the utility achieves optimum battery performance and reliability under the new NERC standard. **uhQ**

Author Profile



Jennifer A. Eirich, is a product manager (Utilities/Rail), at EnerSys. Eirich joined EnerSys a year ago as part of the team responsible for launching the EnerSys line of stored energy solutions, the company's first utility-scale energy optimization system. Eirich has more than a decade of experience in project management and systems engineering and holds a Bachelor of Science degree in chemical engineering from Pennsylvania State University.

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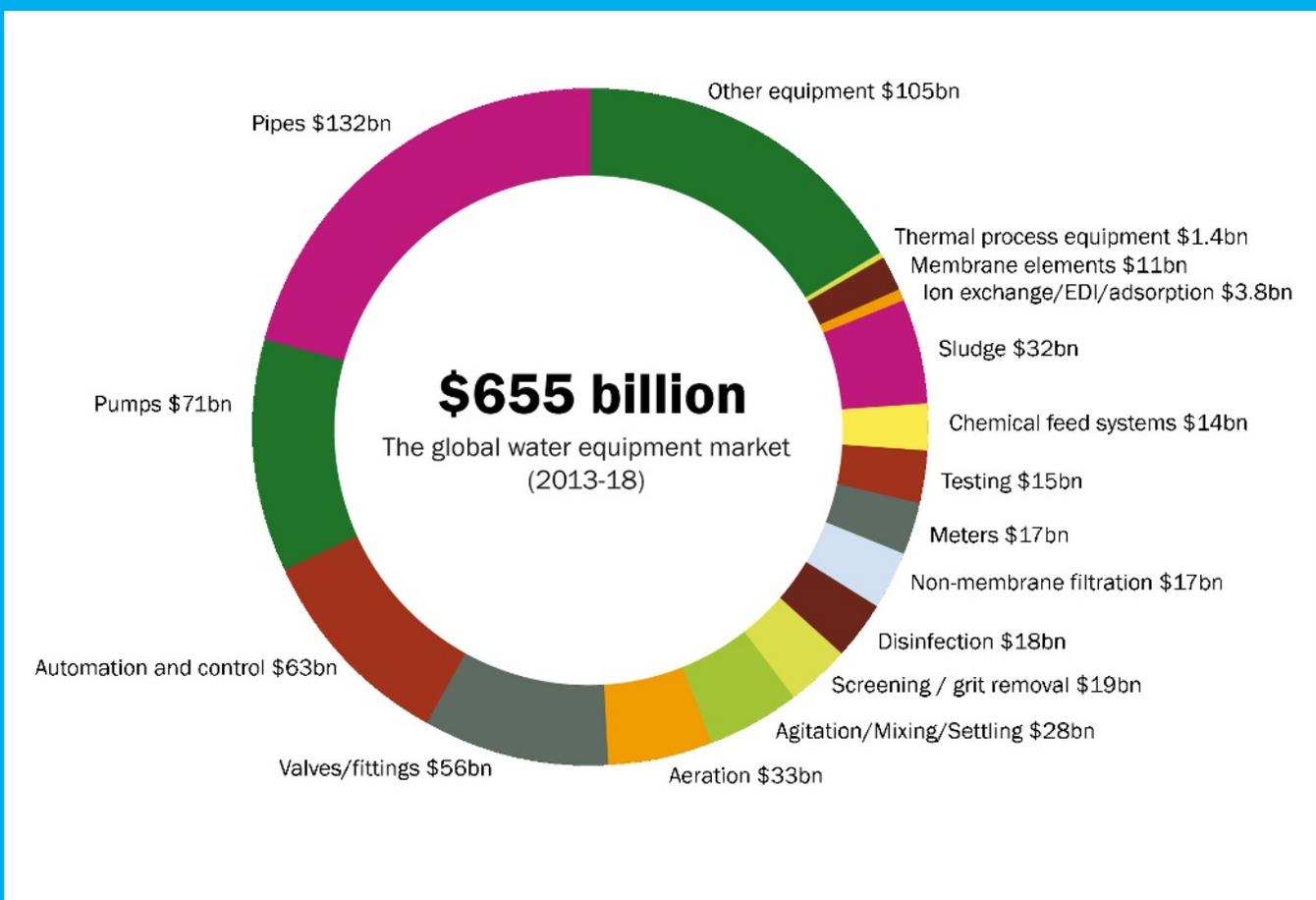
WHY GROWTH IN THE GLOBAL WATER MARKET COULD OUTSTRIP THE REST OF THE GLOBAL ECONOMY

Global Water: Things Are Different This Time

The International Monetary Fund believes that the global economy will grow by 3.3% in 2013, compared to 3.2% in 2012, according to BBC news. Meanwhile, according to the newly published Global Water Market 2014 report, capital expenditures on water infrastructure will grow by 4.9% in 2013, up from 3.7% in 2012 – including a whopping \$63 billion on automation and control. (See graph below)

In this report, Global Water Intelligence explains why they believe that water will outperform the economy so convincingly both this year, and over the years included in the report's forecast period out to 2018.

The water industry has a history of disappointing investors, but things are different this time – read on and find out why.



The Global Water Market (2014 – 2018)

Christopher Gasson, Owner and Research Director for Global Water Intelligence, emphasizes that water markets in different parts of the world are moving in very different ways. In its report titled, "Global Water Market 2014: Meeting the world's water and wastewater needs until 2018," GWI provides detailed forecasts of the outlook for water in 100 different countries and looks at various aspects of expenditures, including resource development, water and wastewater networks, treatment, and industrial water.

Among its extensive and detailed outlook projections, the report forecasts that China's expenditures on water resource development (excluding desalination) will fall by 75% over the years to 2018, as the first

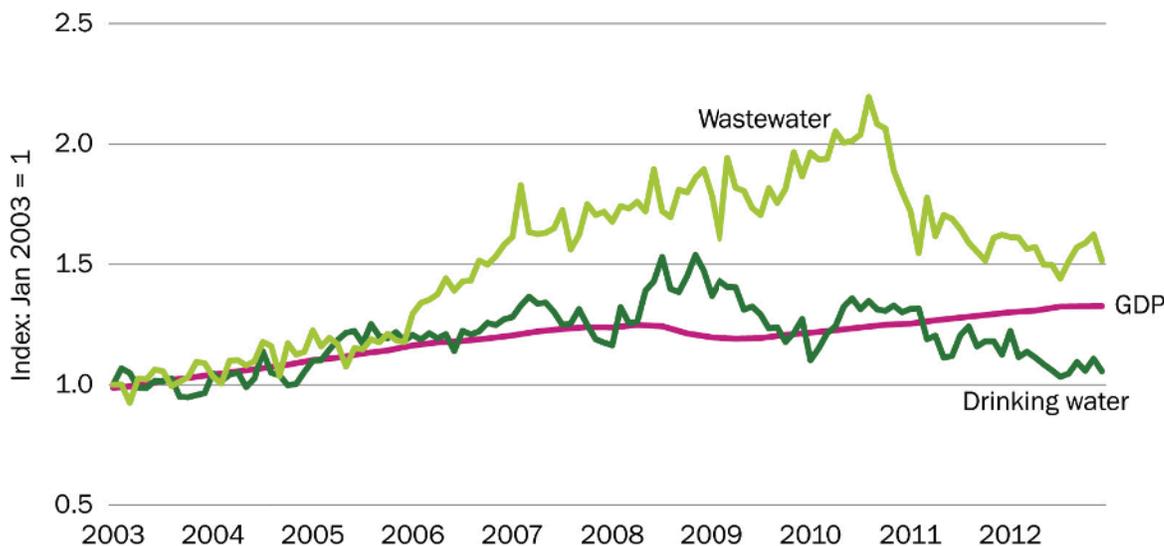
distance transfer, desalination and water reuse will rise from 1.8% in 2011 to 5.7% in 2030.

Although low-cost water resources will remain the overwhelmingly dominant source of supply, GWI believes that the high cost of developing non-traditional resources will cause expenditure on developing new water resources to grow by 8.2% over the period 2013-2018.

Water is a Late-cycle Business

Around 92% of capital expenditure on water infrastructure comes from the public purse. GWI's Gasson goes on to explain what that portends for the marketplace this way...

"Public sector spending tends to peak late in the economic cycle, because that is when public finances are strongest. They may continue a little into an economic downturn in the form of stimulus spending, but during the early stages of recovery, public finances are at their weakest, and that is where we were in 2013, with levels of capital expenditure on water well below what they were at the peak."



phase of the South-North Water Transfer reaches completion, but also predicts that China's expenditure on wastewater treatment plants will rise by 81% as it pursues plans to improve wastewater treatment in smaller towns and cities.

Stepping back and looking at the market as a whole, however, the report pinpoints five distinct themes that are driving expenditures in the U.S. water market at a rate quicker than the overall US economy, as depicted in the graph below.

The Rising Marginal Cost of Water

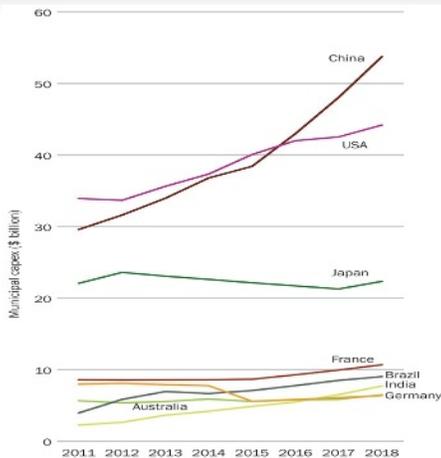
The report findings estimate that industrial and municipal water users withdrew around 1,182km³ of water from the environment in 2011. By 2030, that total demand could rise to as much as 1,562km³, but not all of this water can come from cheap and convenient resources. Instead, the share coming from long-

The report predicts that there will be a significant increase in wastewater spending over the next five years in a return to previous trends. The US because they are nearing recovery; Southern and Eastern Europe because many countries still have outstanding commitments to EU directives; and the BRIC countries (Brazil, Russia, India and China) will experience strong growth as a result of this late cycle business – infrastructure spending will accelerate as GDP growth is starting to slow.

Urbanization Drives Wastewater Spending

Wastewater collection, treatment and sludge management are the forgotten necessities of urban life. The reality is that rapidly industrializing countries cannot avoid spending money on wastewater collection and treatment for very long. GWI expects

On The HORIZON...



capital expenditure on wastewater infrastructure to outstrip capital spending on drinking water systems over the next five years. In the developed world, much of the spending will focus on combined sewer overflow

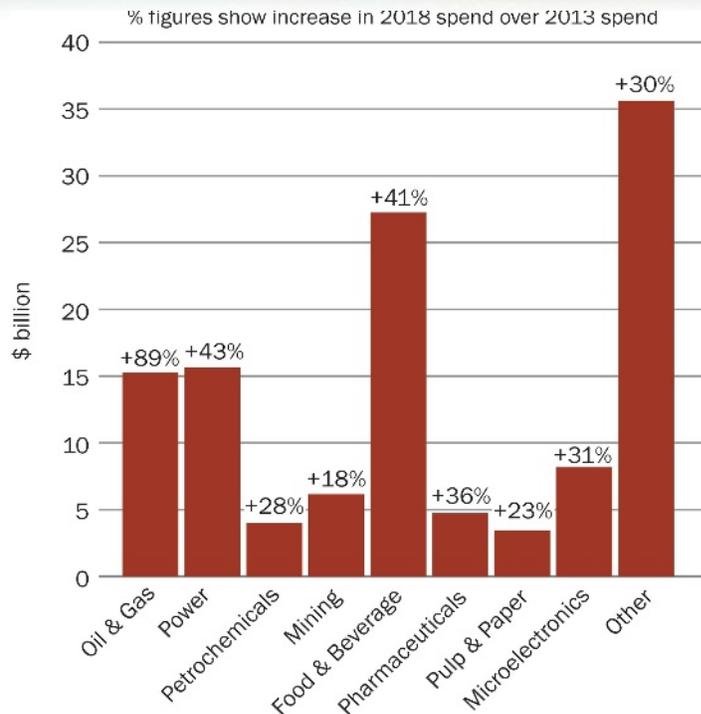
correction, and sludge management.

In the developing world, sewer networks and treatment plants will be the most significant expenditure items. Overall, capital expenditure on wastewater infrastructure is growing by 5.0% per year, but certain niches such as anaerobic digestion (9.7%) and aeration (6.2%) are growing more rapidly.

Industry Needs to Spend on Water

GWl predicts that water spending by industrial users will grow more quickly than the municipal water sector. This reflects a number of additional pressures affecting industrial water users. The natural resources industries are increasingly pursuing more marginal resources such as low-grade ores, shale gas, oil sands, coal bed methane, and tertiary oil recovery.

Typically, these involve significant wastewater treatment challenges, although many of these resources lie in areas of the world, where meeting process water needs requires significant expenditures as well. In other sectors, brand management and corporate social responsibility are driving greater investments in water-efficient technologies, while tighter regulations on discharges are also a significant



catalyst for future expenditures.

Forecasts are Fallible

The moment to tear up these forecasts is when growth in the Chinese economy slows below 6%, Brent Crude falls below \$80, or US growth grinds to a halt. The report anticipates that China will become the largest single water market by 2016, and through the commodities market, it is also a major driver of the industrial sector. The oil price is especially significant for the Gulf Cooperative Council (GCC) municipal water markets, as well as industrial water spending in oil producing countries. The rate if the US recovery is also a key factor in water market growth, for obvious reasons.

uhQ

About Global Water Intelligence

Global Water Intelligence (Oxford, UK) is a leader in high-value business information for the water industry. Its monthly magazine, published both in print and digital forms, is widely read by water executives and managers at all levels. GWI also publishes four market intelligence reports each year, of which the report summarized above is one. Each report provides in-depth data and promotes a comprehensive understanding of specific water sector markets and/or regions of the world.

For more information about this report, please visit <http://www.globalwaterintel.com/GWM2014>, or email Chantal Marchesi at cmarchesi@globalwaterintel.com.

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Cyber Security: It's a New Day for Utilities

The potential consequences of a successful large-scale cyber attack on the utility sector are difficult to overstate. As previous power failures have demonstrated, any event that causes prolonged outages over a large area would not only be extremely costly, it would also create chaos for millions of people's daily lives and could greatly disrupt the delivery of essential services, including communications, food, water, health care, and emergency response.

Additionally, cyber threats, unlike traditional threats to utility reliability such as extreme weather, are less predictable in their timing and more complicated to anticipate and address. Given the size and complexity of utility infrastructures, a cyber attack could target many potential vulnerabilities. For this reason, experts agree that the risk of a successful attack is significant, and that the system and its operators must be prepared to contain and minimize the consequences.

Efforts to spur optimal levels of investment in cyber security by the utility industry are complicated by the sheer diversity and number of entities involved in the utility sector. In the power sector alone there are more than 3,200 individual companies and organizations that play a role in the generation, transmission, and distribution of electricity across the electric grid. Additionally, numerous vendors supply the software and advanced grid technologies that are laying the foundation for a modernized grid, which, despite its many benefits also implies new sources of vulnerability and an increasingly complex supply chain. And because of the interconnected nature of the grid, individual entities are unlikely to fully capture the

It's a New Day for Utilities

Recent breaches at Neiman Marcus, Target, and elsewhere have brought the issue of cyber security to the forefront. While media reports are increasingly highlighting the risks of cyber attacks, these reports typically focus on banking and e-commerce. Utilities find themselves in an even more vulnerable situation, as they not only need to address the cybercrimes that are financial in nature, but they must also contend with cyber threats in the form of terrorism and from state actors focused on attacking the infrastructure that is crucial to so many aspects of modern life. As a result, the infrastructures of utilities represent an attractive target to a wide range of actors who seek to deal harm.

benefits of their own cyber security investments.

The U.S. utility industry is already subject to mandatory federal reliability standards that include some cyber security protections. In the power sector, for example, critical infrastructure protection standards are developed by the North American Electric Reliability Corporation (NERC) and approved by the Federal Energy Regulatory Commission (FERC). These

standards cover critical cyber asset identification, security management controls, personnel, training, electronic security, physical security, systems security, incident reporting, response planning and recovery plans. While standards provide a useful baseline level of cyber security, they do not create incentives for the continual improvement and adaptation needed to respond effectively to rapidly evolving cyber threats.

Over the last decade many efforts have been made to deal with the security of the nation's utility infrastructure, and particularly its security from cyber threats. The federal government has made efforts by enacting legislation including the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and the American Recovery and Reinvestment Act of 2009. Respectively, these bills granted the Federal Energy Regulatory Commission (FERC) authority to oversee the reliability of the bulk electric systems, made it the policy of the United States to support the modernization of the electrical grid, and invested over \$4 billion to accelerate the development of smart grid technologies.

Despite industry and government efforts, the nation's utility infrastructure still remains vulnerable. It is apparent that new polices and public-private partnerships are needed to address the growing threat of cyber attacks on the North American utility infrastructure. These approaches should enlist the respective capabilities and strengths of government and the utility sector, promote effective risk-management strategies that can evolve in response to the ever changing nature of cyber threats, and work to limit the costs of any successful attacks. Utility sector companies need tools and incentives that will enable them to invest in cyber security in ways that benefit the broader system and to support the development of advanced cyber security solutions.

Additionally, stakeholders should also work together to foster rapid information sharing and improved situational awareness across government authorities and utility companies, prepare and test response protocols to plan for possible conditions under worst-case-scenario events, and determine how the costs of managing cyber security risks should best be allocated.

The sharing of information is not without its own challenges. There does appear to be a general reluctance to share data for fear of triggering regulatory non-compliance actions, violating antitrust or privacy protections, or potentially disclosing proprietary or confidential business information. Additionally, utilities have found it challenging to obtain intelligence information from government authorities that is sufficiently timely, specific, and actionable.

Moving forward, policymakers and federal agencies should work with the utility industry to better understand how much sharing of customer data is needed to provide relevant threat and vulnerability information. This would help all parties gain a better understanding of how privacy concerns relate to utility infrastructure cyber security.

The need for aggressive and effective cyber security throughout the utility industry is clear due to increased "digitization" of the system as well as evolving threats and vulnerabilities. As investments and technologies in grid modernization are made to create a "smarter" utility system, increased automation and complexity require that security measures must be designed-in to be as cost-effective as possible. The safety and reliability of the grid to the meter and beyond increasingly depend on cyber security of critical assets as well as the networked automated equipment throughout the system. **uhQ**

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Christopher is founder and President of Perdue Energy Research & Consulting, LLC, a research and consulting firm serving clients worldwide. He holds a bachelor's degree in economics from Belmont University and a master's degree in economics from Vanderbilt University. Throughout his career as a market researcher, analyst and thought leader, Christopher has published more than 200 articles on a wide range of topics including energy and utility industry trends; emerging energy technologies; economic development; energy policy initiatives; customer service; call centers; billing, credit and collections; and Smart Grid technologies.

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EVENTualities

EVENTualities				
Event Name	Event Owner	Starts	Ends	
IntelliSub Europe 2014	Phoenix Forums	27-Nov-2014	28-Nov-2014	Fr
Grid Analytics Europe 2014	Phoenix Forums	23-Oct-2014	24-Oct-2014	Lo
IEC 61850 Europe 2014	Phoenix Forums	15-Oct-2014	16-Oct-2014	Pr
Big Data & Analytics for Utilities	IQPC/IDGA	7-Oct-2014	9-Oct-2014	Lo
Distribution Automation Europe	SMI	29-Sep-2014	30-Sep-2014	Lo
Telecoms for Smart Grids	SMI	22-Sep-2014	23-Sep-2014	Lo
Power Grid Resilience	IQPC/IDGA	15-Sep-2014	17-Sep-2014	Sa
CIO Utilities Summit	CDM Media Inc.	28-Aug-2014	29-Aug-2014	Sc AZ
Energy Storage USA 2014	Energy Storage Update	25-Jun-2014	26-Jun-2014	Sa
Customer Experience Transformation: Utilities	IQPC/IDGA	24-Jun-2014	26-Jun-2014	Bi
Meter Asset Management and Operations	SMI	23-Jun-2014	24-Jun-2014	Lo
Utility Energy Storage Europe	SMI	18-Jun-2014	19-Jun-2014	Lo
Cyber Security for Oil & Gas	IQPC/IDGA	16-Jun-2014	18-Jun-2014	Ho
UtiliNet Europe 2014	Phoenix Forums	12-Jun-2014	13-Jun-2014	Br
Oil and Gas Cyber Security	SMI	3-Jun-2014	4-Jun-2014	Os
ENTELEC 2014	ENTELEC	20-May-2014	22-May-2014	Ho
Critical Communications World 2014	IIR Conferences & Events	20-May-2014	22-May-2014	M Sa



Key to Events Chart: A solid square ■ denotes primary/heavy focus on a particular area
 Boldface Denotes Conferences and Events Sponsored/Supported by Utility Horizons QUARTER

Events Calendar

Location	Country	Event URL (www:)	ELEC	GAS	WTR
Frankfurt	DE	intellisub-europe.com	■		
London	UK	gridanalytics-europe.com	■		
Prague	CZ	iec61850-europe.com	■		
London	UK	bigdatautilitiesevent.com/	■	□	□
London	UK	smi-online.co.uk/2014distribution-automation7.asp	■		
London	UK	smi-online.co.uk/2014telecoms-smartgrids34.asp	□	□	
San Jose, CA	USA	powergridresilience.com/	■		
Woburn, MA	USA	cioutilitiessummit.com/	■	■	■
San Diego, CA	USA	energystorageupdate.com/usa/	■	□	
Birmingham	UK	customerexperienceutilities.com/	■	■	■
London	UK	Smionline.co.uk/utility/uk/conference/Meter-Asset-Management	■	■	■
London	UK	smionline.co.uk/utilityenergystorageeu57.asp	■		
Houston, TX	USA	oilandgascybersecurity.com/		■	
Brussels	BE	utilinet-europe.com	■	□	
Oslo	NORWAY	http://www.smi-online.co.uk/oilandgascybersecurity35.asp		■	
Houston, TX	USA	entelec.org	□	■	
Singapore	SINGAPORE	criticalcommunicationsworld.com/about-critical-communications-world/	□	□	□

■ denotes a primary focus; an open square □ denotes a secondary or peripheral focus.

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Beer-fetching Robots:

The Future of Automation (?)

Sparky has recently come to the conclusion that he isn't as young as he used to be and has to start planning for the eventual decline in his ability to do all of the things he used to be capable of doing.

It seems that my beloved Sparkle is also getting along in years, and I've noticed lately that she seems less inclined to come into my man-cave to change the TV channel, fluff-up a pillow or fetch me a beer, even when I remember to say please. Thus, the main impetus for my retirement project!

Sparky has always enjoyed playing around with automation technology, despite the fact that he has occasionally been accused of sharing some common engineering traits with Rube Goldberg. Nonetheless, Sparky can see the day coming when calls for cold beer could go unheeded – so

My Retirement Project

Sparky was working on his retirement project the other day – a beer-fetching robot – when his lovely wife (Sparkle) sent him to the store for some essential supplies involving toilet paper, paprika and cheese slices. (Don't go there!)

Since Sparky's favorite pub just happens to be on the way back from the store, he decided that he would briefly interrupt this vital mission long enough to score a few hubby-points – and maybe a beer or two besides.

Okay, a bit of background is probably needed here, so let's take it from the top...

having a backup plan seems prudent. Anyway, back to the problem at hand...

To Sparky's way of thinking, a robot is just a composite form of automation technology. That is, by combining vision technology with voice recognition technology and a little GPS navigation, Sparky hopes to come up with a more obedient personal helper. Sparky figures that once the robot can be taught to fetch a beer, adding other skills like pillow fluffing and TV channel manipulation shouldn't be a major leap, right?

So far, we have already learned that stairs are not a robot's friend, that beer bottles look a lot like ketchup bottles and that a minor increase in claw gripping pressure can mean the difference between a can full of beer and an opportunity to improve Sparky's mopping skills. We have

Thinking IT Through...

with Sparky Flamedrop

also learned that a robot needs to make an audible beeping sound as a warning that it is approaching. (Sneaking around like a Ninja is definitely NOT cool.)

While I was driving to the store I began to think about how I was aging. It wasn't long before I got to wondering how the skilled personnel that make up the core workforce at many utilities – and who are also aging – will eventually impact (or have already impacted) their utilities. As we all know, 'Baby Boomers' like Sparky are retiring in large numbers, just as their innate expertise is needed more than ever to rescue and repair our intricately designed and widely deployed networks of wires, cables, transformers, pumps, valves, switches, transformers and myriad other apparatus. As we also now know, much of that apparatus has been in service for 30, 35 or even 40 years or more and is now approaching its own 'retirement'.

Unfortunately, these won't be the proverbial Golden Years for our infrastructure. There simply aren't enough appropriately skilled workers – and probably not enough money to pay them all, even if there were – to carry out the massive modernization that will be needed to maintain reliable electric, gas and water services for the next fifty years. So maybe, if Sparky can work the bugs out of the robot, it could be trained to replace those skilled workers. (Assuming I can figure out some way to deal with those darned stairs, that is!)

Automation has always been promoted as providing a range of potential benefits, but a big one has been in reducing the man (or woman) power needed to get a particular job done. The total labor hours required to assemble an automobile or an airplane has been reduced several hundred-fold, and in no small way, as a direct result of automation. Likewise, the direct labor hours required to operate a plant have been greatly reduced through decades of improvement in process automation technologies. Of course, automation has its limitations, and it can also introduce potential dangers.

We've been talking about how benefits like knowledge capture, knowledge engineering, and artificial intelligence would allow us to encapsulate human expertise into a program

or database for more than two decades. But the actual ability to comprehensively document – let alone program the knowledge, experience and common-sense of a skilled worker – into an automation system still eludes us. Even today, creating an affordable beer-fetching robot would actually be pushing the state of the art in automation and robotics technology. (Hmm, maybe Sparky should add some flowers and candy to the shopping list. It would seem that I'll probably need to keep Sparkle motivated and on the job for a while longer, at least.)

As it is designed and implemented today, automation invariably involves computers and all of the associated IT and networking technologies, which in turn – and quite unfortunately – opens us up to the threat of cyber attacks. There have been, and continue to be, too many examples of malicious cyber activity to downplay the potential threat to automation technologies. Automation can quickly change from being a useful benefit to a major liability when the 'bad guys' are controlling it rather than the 'good guys'. But Sparky is wise in the ways of industrial cyber security and knows that it really is possible to build secure systems... IF you plan for that requirement from the very beginning by making security a fundamental and ongoing focus of your business and engineering practices, religiously.

So far, we have been unable to create an artificial intelligence based expert system that can replace skilled workers, but there are still many ways that automation can be leveraged to multiply the capabilities of the workers we still have. An incredible number of labor-hours are wasted every year because of the absence of available measurements, information and communications. For example, Sparky knows of municipal water/wastewater utilities that still have people driving trucks to and from various field sites to make weekly equipment and process measurement spot checks. That's definitely a place where some of those wasted labor hours could be saved or at least put to better use, don't you think?

The vast majority of those sites already have RTUs or PLCs linked into a SCADA system, so if only a few additional sensors were installed and wired to the local RTU/PLC, it would only take one person working from the comfort of an

Thinking IT Through...

with Sparky Flamedrop

office to make all of the required checks in as little as an hour or two each week. Likewise, field locations where the utility already has network connectivity, a remotely operated webcam could provide real-time visual inspection at those sites without the need to ever dispatch a crew or roll a truck – another big waste just waiting to be eliminated.

Sparky has also heard that some electric utilities still have inspection processes involving hours – sometimes days – of manual data collection and data entry. Engineers at these utilities routinely collect inspection information on pre-printed forms and then return to the office and type all of the collected data into an application that uploads it into a centralized database. With the availability of tablet PCs and wireless networking, it is not only possible but relatively easy and inexpensive, to totally eliminate the manual data entry process and the inherent data-transfer errors. By the way, those same tablets could also host all of the documentation needed to eliminate the task of locating and copying relevant drawings and prints prior to going to a worksite, while also providing data input validity checking. (Gosh, this really seems like a no-brainer.)

Understand that automation doesn't have to mean a DCS or a network of PLCs... or a beer-fetching robot, for that matter. Virtually any task that requires a lot of labor, especially skilled labor, is a candidate for automation. Moreover, the ubiquitous availability of mobile phones in the past decade alone has had a major impact on

productivity. The same can be said of the Internet over a longer period. Guess what: these are both automation technologies. Putting essential information into centrally accessible – especially Web accessible – databases has increased productivity – also an automation technology. Even the use of Web-based collaboration tools, such as those used for Web conferencing, is yet another example of automation technology.

What I'm trying to say here is that automation – which Sparky has been evangelizing his whole career – has reached a point of necessity. Today we're at a juncture where automation is moving beyond the 'good idea' stage and may well be the only way to keep things running with an ever-decreasing workforce and an installed base as old as it's creators – maybe older. At the very least, automation is a tool to be leveraged to the max while utilities address the problem of developing a new generation of skilled workers to replace us old codgers. Thinking about that reminds me that I probably need a beer. Hey, Sparkle...

This conversation is far from over, so stay tuned. The next time Sparky just might be talking about you! – **SFD**

Sparky Flamedrop is the gadfly of the global electric, gas and water utility automation and information technology marketplace. Sparky's candid (and sometimes irreverent) commentary speaks to all things good, bad – and yes, sometimes ugly – across the global utility marketplace. A gifted visionary, Sparky is on top of technology as well as market drivers, issues and trends, economics, and well, pretty much everything.

As a seasoned insider with deep subject matter knowledge and experience, Sparky often knows where markets are going, even before the market players have themselves noticed that things are changing – like THAT ever happens! You'll probably want to follow Sparky's column in each issue of Utility Horizons QUARTERLY, because the next time... Sparky just might be talking about YOU!

Is "Do Nothing" Still a Viable Utility Strategy?

Controlling Repair and Useful Life

As I travel around the industry, I don't see much change in the utility business model itself. The fact is, the utility industry is still mostly fully regulated. We are still working within silos that define the three (or more) business segments of the industry – generation, transmission and distribution still being at the the core. We are still responsive to building a rate base that determines our earning potential, and we are still reluctant to take on any significant investment that is not wholly supported by our regulators. What's changing?

When Smart Grid came into vogue, I was frequently asked to define what Smart Grid was and what it included. There was no shortage of existing definitions, including the scope of Smart Grid proffered by the USDOE. Yet as I looked at what each utility was categorizing as Smart Grid, it became clear that it was whatever the regulator allowed. For some utilities it was smart meters; for others, it was renewable generation and transmission to move the energy to market; and for others, it was something else. In short, each utility viewed Smart Grid as whatever the regulator would allow into the rate base. No wonder a single definition was hard to come by.

It is indeed difficult to find a motivation to change the utility business model without a significant change in how utilities are regulated (or not). It may be that the not quite 100-year-old regulatory model will have to change before we see any significant change in how utilities do business. (Isn't it interesting that in markets significantly deregulated, prices to consumers are not demonstrably lower?)

Of Regulations, Rogues & Relics

The prospect of significant change to the 100-year-old public utility business model is a common topic of conversation among utility professionals, energy journalists, and "energy" futurists. And every change, no matter how small, that occurs in the way utilities do business is picked up as an example of how utilities have to adjust to new customer demands or respond to the "disruptive forces" that reshaping the industry.

We all seem to think that there has been significant change in the utility industry since PURPA¹ and the initiatives to deregulate in the 1990s.

But wait a minute... what "big" changes are we talking about?

1- PURPA, Pub. L. 95-617, 92 Stat. 3117, (enacted November 9, 1978) is a United States Act passed as part of the National Energy Act. It was meant to promote energy conservation (reduce demand) and promote greater use of domestic [energy] and renewable energy (increase supply).

Over the past decade or so I've been asking the question, "What IS the real utility?" It seems to

me that the Texas jurisdiction has answered that question fairly well. There's a pipes and wires company that Texas feels the need to regulate and there's retail and generation companies, which they do not significantly regulate.

In Texas the 'real utility' is the pipes and wires company. However, if the prices Texas consumers pay for electricity have not plummeted with retail competition, why not? Largely this is because there has been little change in the pipes and wires business model in face of deregulation of the generating and retail business models. In Texas, both the real utility and the regulator of the real utility continue to operate much as they have for the past 75 years.

At the same time, the energy retailer in Texas has rapidly become an effective competitor in its retail market. What do retailers do when they can't compete on price? They differentiate on other attributes of the sale. In other words, Texas retailers have become packagers and information providers. The retail offering is designed to meet unique and special needs of segments of electricity consumers, and consumption information is provided to help the consumer manage – within narrow bounds – their use and consumption of the commodity. Interesting Fact: No regulation; plenty of change driven by competition!

If we are to change the utility business model, we will have to change what motivates investment in the "real utility" (i.e., the pipes and wires company), and this will require a change in how pipes and wires companies are regulated (or not). Otherwise, we will continue to invest in whatever is allowed in rate base – exactly as we have traditionally managed our electric, gas and water utilities for decades. Put another way, so long as the 'real utility' has no competition and earns a regulated return on investment, it will continue to operate exactly as it has in the past, only taking risks and making investments that an equally risk-averse regulator approves of – hopefully, in advance.

Utilities today are faced with an overextended infrastructure, many components of which are dangerously aged. We are also being presented with new digital technologies that offer real advantages, both for refurbishing and automating existing physical infrastructure as well as for

improving the quantity and quality of information available to manage new infrastructure as it is deployed. How much and how quickly utilities take advantage of these technologies for automation, however, remains in the hands of the regulator. Even when the economics are compelling, and even when it makes great sense for a utility to step into the operating model of the future, the motivation to act remains mired in the business and regulatory models of the past.

I have always described a utility as one of – if not the only – business where "*Do Nothing*" is a viable strategy. Not many competitive businesses can afford to adopt such a strategy. Over the past fifteen years, however, more than one utility attempting to exploit a more aggressive unregulated strategy in parallel with their utility operations has ceased to exist. In spite of much discussion of deregulation, competition and unbundling of the vertically integrated utility, "*Do Nothing*" proved to be one of the most successful strategies during this period.

In his seminal dissertation, "The Structure of Scientific Revolutions," author Thomas Kuhn coined the term "paradigm shift." He noted in the dissertation that the shift or change in a paradigm (the commonly accepted rules by which we do business or define a body of knowledge (e.g., physics, biology, etc.)), generally comes from outside the field or business. An example of a paradigm shift in our digital world is the emergence of Amazon and its on-line book store, displacing brick and mortar approaches to the same business. Or, NetFlix unseating Blockbuster, replacing music and video renting with online streaming. Or, Elon Musk (Tesla Motors, SpaceX, SolarCity) driving and inventing new eco-friendly ways of using energy itself. This kind of sea change is promulgated by either young entrants to a field, by businesses that don't accept the existing rules, or by entrance into the field of professionals of other disciplines, who obey and apply the rules of a different discipline to the existing field.

To put this in context, do we expect a large influx of Millennials into the utility industry over the next decade? I think we do, and this new breed of utility operator will bring a fresh view of operating rules and practices, without the bias that keeps us locked in our old operating models.

We see Google (e.g., with their purchase of Nest) and MicroSoft making forays into the utility industry, typically on the consumer side. Yet even these giants have so far been unable to take on the embedded regulatory model and generate a success – at least not yet – but there’s no evidence that they’re giving up. It’s very likely only a matter of time before they crack the code.

Given the proper motivation, there is much that utilities can do to improve on how we generate and distribute utility commodities and relate to and serve customers and markets. Not only are there new digital technologies that can lead to more automated, self-healing physical systems for the transmission and delivery of practically any utility commodity – whether electricity, gas or water – but there is also a host of opportunities for automation that can materially reduce the risk of service disruption, improve management of outages when they do occur, and provide billing options that allow the consumer to choose and pay for the level of service and reliability they desire. Perhaps more importantly, there are viable options for the consumer to generate and consume the commodity autonomously (as ‘pro-sumers’ if you like), thereby becoming a part of the business model rather than merely the last stop in the value chain.

Indeed, there is a stickiness to the 100-year-old utility business model that is implicitly and explicitly reinforced by the stickiness of the roughly 80-year-

old regulatory model. And don’t get distracted by all the small adjustments to these models that we generously cite to frame the utility business as a rapidly evolving industry. Much like the telecommunications market, it will likely require a disruptive change at least on par with bypass for the telecommunications industry to cause radical rethinking and bring real changes to the existing utility business and regulatory models. We are finally beginning see some changes within the context of our existing paradigm – one formed in the early 1900s and modified a bit in the 1930s – but with renewables becoming ever more economic and distributed generation increasingly abundant and reliable, many believe that an effective “bypass” is just around the corner for the utility business model as well.

Regardless of the timing, the smart utilities are looking ‘outside the bubble’ for harbingers of change and are actively (i.e., within the limits of regulatory realities) preparing for a utility market that obeys new rules and offers new opportunities. In a perfect world, the icons that have electrified America will still be around to serve consumers and prosumers in the new energy paradigm, but this will require a regulatory model that leads the utilities into the future – not a model that mires them in the past. And *Do Nothing* is no longer a viable strategy.

uhQ

Author Profile



CD Hobbs is Vice President and Executive Partner with Gartner, Inc.’s Executive Programs, where he serves as an advisor to Gartner’s top tier clients. In addition, he is responsible for creating and sustaining Gartner’s Energy Utility Community of Excellence, an initiative designed to enhance the strategic understanding of the energy industry for Gartner’s energy executive support team worldwide.

Earlier in his career, Hobbs served for 16 years in various executive roles at Portland General Electric Company and served as CEO for several energy and utility suppliers and market research and consulting firms. He is also an adjunct lecturer in economics and finance and Senior Fellow with the Public Utility Research Center (PURC) of the University of Florida, the mission of which is to expand the body of knowledge in public utility industry structure and practices, regulation, market reform and infrastructure; teach the principles and practices that support effective utility policy, operations and regulation; and, provide ongoing professional development for industry and regulatory professionals. Hobbs holds an MBA in Finance from the University of Florida (1968).

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