



# Electric Energy T&D

## MAGAZINE

MARCH 2011 Issue 2 • Volume 15

# Changes Ahead

## CHANGE OR DIE:

Effective Utility Business  
Readiness Through  
Change Management

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We've all seen the commercials on TV with the elderly person lying on the floor, unable to move or get to a telephone. And then comes that classic line: "I've fallen... and I can't get up!"

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It seems as if you can't pick up a magazine on automation or read an article about automation without running across an ad for or reference about some wireless instrument or device. Wireless is the new "hot" technology.

### Publisher:

Steven Desrochers: [steven@electricenergyonline.com](mailto:steven@electricenergyonline.com)

### Editor in Chief:

Mike Marullo: [mam@electricenergyonline.com](mailto:mam@electricenergyonline.com)

### Contributing Editors

William T. (Tim) Shaw, PhD, CISSP

[tim@electricenergyonline.com](mailto:tim@electricenergyonline.com)

Gregory K. Lawrence, Partner; McDermott Will & Emery LLP

[glawrence@mwe.com](mailto:glawrence@mwe.com)

### Advertising Sales Manager:

Jimmy Desjardins: [jimmy@electricenergyonline.com](mailto:jimmy@electricenergyonline.com)

### Account Executive

Eva Nemeth: [eva@electricenergyonline.com](mailto:eva@electricenergyonline.com)

### Art Designers:

Anick Langlois: [alanglois@jaguar-media.com](mailto:alanglois@jaguar-media.com)

### Internet Programmers:

Johanne Labonte: [jlabonte@jaguar-media.com](mailto:jlabonte@jaguar-media.com)

Sebastien Knap: [sknap@jaguar-media.com](mailto:sknap@jaguar-media.com)

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1160 Levis, Suite 100,

Terrebonne, QC Canada J6W 5S6

Tel.: 888.332.3749 • Fax: 888.243.4562

E-mail: [jaguar@jaguar-media.com](mailto:jaguar@jaguar-media.com)

Web: [www.electricenergyonline.com](http://www.electricenergyonline.com)



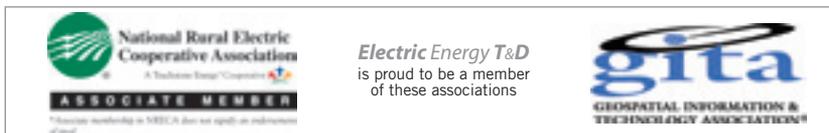
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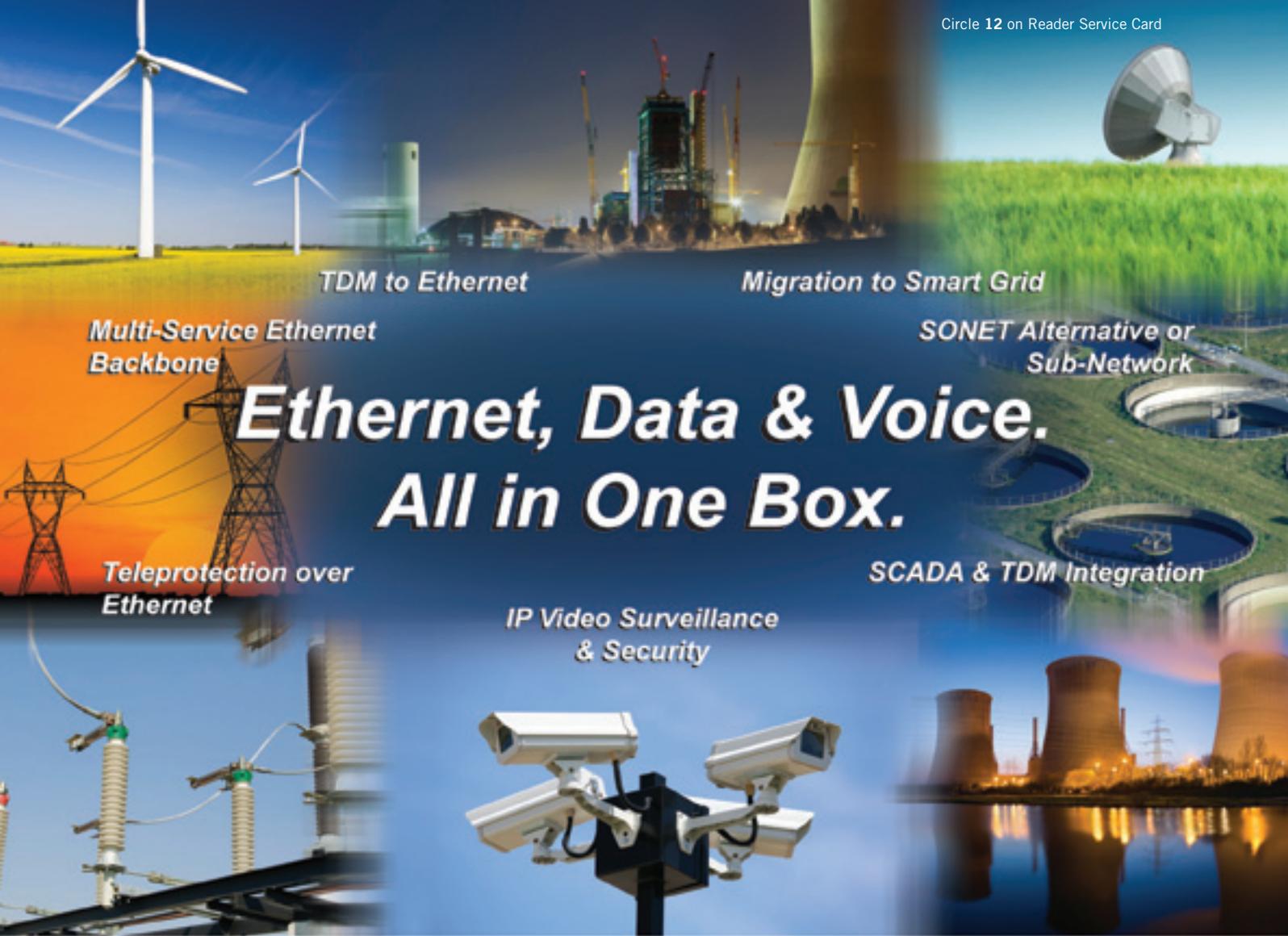
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## Old Dog – New Tricks!

We've all seen the commercials on TV with the elderly person lying on the floor, unable to move or get to a telephone. And then comes that classic line: "I've fallen... and I can't get up!" Irritating (and/or amusing) though it may be now that we've all heard it countless times, it's actually becoming a very real scenario for our aging population and subsequently, our aging workforce – and yes, even the grid itself.

Indeed, the vast majority of challenges we face in our everyday lives extensively, if not predominantly, emanate from either the very young (mainly our children) or from the elderly (mainly our parents and grandparents), depending on your age group. But there's also a corollary to these metrics in our professional lives. Terms like "infant mortality" and "end of life" are very familiar to us in real life, but they also have significant meaning in the power industry as well as in practically any industrial field.

Despite temperature cycling and other stress tests, we are still plagued by the early component failures that we collectively refer to as infant mortality – usually occurring within the first few days, weeks or months after a device is deployed – as well as lifecycle failures that start to appear when a device enters into the final trimester of its life – end of life, if you will. For the uninitiated, this latter term is the "decline" portion of what reliability engineers fondly refer to as The Bathtub Curve, characterized as a bathtub lying upside down.

Or, another way to visualize this is to picture the letter "D" lying on its back with the curved sides facing upward. The leading curve is the infant mortality period when most early failures are most likely to occur once the device is placed into service and starts to experience the real-world environment. The lagging curve marks the decline into this last phase when things finally just wear out and ultimately fail. (The long, relatively flat period between these ups and downs is the most reliable period, of course!)

But it's really just a matter of *when* – not if – these failures will occur. That is, the harsher the operating environment; the more rapidly the infant mortality appears. The more hospitable the environment; the longer it takes for the end of life ("lifecycle") failures to start. But in both cases, infant mortality and lifecycle failures will appear, especially where electrical and electronic components are involved – of that much you can be assured. Something else you can take to the bank is that the older a device becomes – the lagging curve of the "D" – the less reliable it will become until it finally fails altogether. These same principles can be applied to the grid as a whole, which rather than being a single device, is merely a giant collection of devices – and in many cases, OLD devices.

Anyway, as you might have guessed by now when we talk about the grid we're already way past the infant mortality phase, and we've

spent most of the past 50 years or so enjoying that long flat line between the up and down curves. That's the part where everything just sort of works, provided you don't stress it unnecessarily or otherwise abuse it. But that nice long, smooth ride is coming to an end.

Where we are today is on the backside of that Bathtub Curve – the part where things start failing for no other reason than because they've reached the end of their useful life. Whether measured in years, hours of run-time, number of operations or some other lifecycle metric, the vast majority of devices comprising the underpinnings of the grid today are staring down their own mortality with a large portion of the devices that comprise the grid reaching that critical 35-50 year age when reliability becomes an increasingly prevalent factor.

And making matters worse is the fact that the human component of this equation is in roughly the same place as the physical infrastructure when it comes to lifecycle issues. As we've been hearing and reading for some time now, a very large portion of the utility workforce is composed of Baby Boomers, which are now retiring at the rate of about a thousand workers a day – a trend that will continue for the next 19+ years. But before you panic, this doesn't mean that everything is going to come to a screeching halt at some predetermined deadline – this is not a Y2K (Year 2000) kind of problem and certainly not a doomsday scenario.

However, unlike Y2K this problem is real, and failure to address it could be catastrophic. For example, there's a tendency to forget – or at least gloss over the fact – that a large contingent of our existing automation and IT infrastructure is also heading down the backside of that Bathtub Curve, with many of our SCADA, GIS and even some OMS installations celebrating their 30<sup>th</sup>, 40<sup>th</sup>, or even 50<sup>th</sup> birthday.

To offset the effects of the decline (in both equipment health and human resources terms), some companies are starting to make plans for combating the coming crisis by adding an entirely new layer of sensors designed to keep a much closer eye on the grid. By adding this blanket of sensors – usually very low-cost, ultra low-power single sensor endpoints – we'll have the ability to monitor grid operations much more closely, much more accurately, and much more reliably – and with far fewer people than some would ever imagine possible.

The deployment of these devices – sometimes called USNs (Ubiquitous Sensor Networks) is projected to gain momentum and rapidly accelerate over the next few years until we achieve a point where we've got 'eyes' on virtually everything, in one form or another. That way, if something starts looking like it's about to fall down, we'll know about it and have the time needed to take corrective action, well before any serious damage is done. Who says you can't teach an old dog new tricks? – *Ed.*



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**Sensus Becomes First Smart Grid AMI Company to Complete International Security Certification**  
Achilles Practices Certification validates cyber security best practices from design through deployment

**Sensus** is the first Advanced Metering Infrastructure (AMI) company to achieve overall cyber security certification after an eight-month collaborative effort with industrial testing and certification firm, Wurdtech Security Technologies. Sensus has achieved the Wurdtech Achilles Practices Certification (APC), a security best practices benchmark, in addition to the Achilles Communication Certification previously awarded for the Sensus FlexNet™ AMI communications system. The Wurdtech Achilles Certifications are based on standards set by the International Instrumentation Users Association (IIBA).

“Securing the smart grid is essential to furthering the adoption of technologies that can help us better serve customers and conserve energy,” said Joe Sagona, Information Security Manager for Southern Company. “We support efforts across the industry to commit the time and resources necessary to define and achieve common standards for security.”

The APC testing covered more than 200 Sensus processes in specific areas designed to improve and proactively maintain security throughout the product lifecycle including organizational support and governance, product functionality, and commissioning and maintenance.

“At its core, Sensus is a technology company that customers respect and trust,” said David Ayers, vice president of engineering at Sensus. “The ability to offer internationally certified technology solutions extends that trust by achieving a standard of security embraced by global industrial leaders.”

The Achilles Communication Certification, awarded last October, verified that an end-to-end FlexNet AMI system, comprised of ten components and all intercomponent communication, possesses robust communication architecture and an overall resilience against intrusion or other malicious acts.

“Sensus has demonstrated impressive foresight in pursuing the Achilles Communication and Practices Certifications and we commend their dedication to continual improvement,” said Nate Kube, CTO of Wurdtech. “As the smart grid industry looks for ways to improve the security and reliability of AMI formal cyber security benchmarks heavily utilized in other critical infrastructure sectors, such as the Achilles Certifications, can help lead the way.”

To date, Sensus customers have more than eight million endpoints installed and communicating at over 225 electric, water and gas utilities.

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**The Department of Energy Launches Cyber Security Initiative**  
Collaborative effort will develop a risk management process guideline

The Department of Energy is launching an initiative to enhance cyber security on the electric grid. The initiative, led by the Department's Office of Electricity Delivery and Energy Reliability (OE), the National Institute of Standards and Technology, and the North American Electric Reliability Corporation, will be an open collaboration with representatives from across the public and private sectors to develop a cyber security risk management process guideline for the electric sector.

Traditional cyber security approaches for electric utilities are segmented, with different approaches for control systems and information systems. This has resulted in cyber security requirements that are overly restrictive in some cases, and not restrictive enough in others. At best, requirements are overlapping, but more often result in gaps in cyber security coverage. A common approach is needed to address the unique cyber security risks that a nation-wide smart grid will pose.

“Cyber security is vital to the development of a modern electric grid,” said OE Assistant Secretary Patricia Hoffman, “We recognize that each utility faces different risks; now we need to provide them with standard, adaptable solutions to manage those risks.”



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“Electric sector asset owners in North America are a vast and diverse group of individual companies,” said Gerry Cauley, CEO of the North American Electric Reliability Corporation. “This collaborative approach to develop security guidelines for managing risk across the electric grid is an innovative process that addresses the diversity and will provide greater benefits to industry.”

“Effectively managing cyber security risk in the electric grid will require utilities to have an integrated approach across missions, business processes and the control systems and information systems that support those processes”, said George Arnold, NIST’s National Coordinator for Smart Grid Interoperability. “Placing cyber security into the broader organizational context of achieving mission and business success will enable utilities to make strategic risk management decisions.”

The leadership team has invited stakeholders from across the electric sector to participate, including representatives from the Federal Energy Regulatory Commission, the Department of Homeland Security, and both publicly and privately-owned utilities. The group will develop a risk management process guideline that provides utilities a flexible, fundamental approach to managing cyber security risks through a three-tiered approach, addressing risks at the (i) organization level; (ii) mission/ business process level; and (iii) information system level. This process will allow a utility to better understand its risks, assess the severity, and allocate resources more efficiently to manage them.

A draft guideline will be made available for public review and comment before it is finalized and issued.

For more information, visit DOE’s Office of Electricity Delivery and Energy Reliability website.

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**Poll Finds New Incentives Needed to Persuade Americans to Make Their Homes More Energy Efficient**

A national poll released on February 7 finds new incentives will be needed to persuade Americans to make energy-efficient improvements to their homes.

Beginning this year, tax incentives that once rewarded Americans for energy-efficient improvements have been slashed. For many Americans, the survey found, those incentives were a prime reason for making such improvements as replacing windows, adding insulation and buying energy-efficient appliances.

The national poll, one of four conducted each year by Shelton Group, examined the state of power in the United States: how consumers are saving electricity and why.

The survey found almost one quarter (23%) of Americans who made energy-efficient improvements said they’d received a rebate or financial incentive. Of those, most said they’d received either a utility rebate (41%) or a federal tax incentive (39%).

A full 25% of respondents said they wouldn’t have acted without the incentive, and another 7% said the incentive encouraged them to pay slightly more for a higher-efficiency model.

“That means at a minimum, about one third of Americans who made their homes more energy efficient would likely not have done so if it weren’t for the incentives,” said Suzanne Shelton, president of Shelton Group.

The new tax law chops incentives from 30 percent to 10 percent of costs for many improvements -- reducing the maximum cumulative credit from \$1,500 to \$500. In addition, there are now lower caps such as \$200 for energy efficient windows, compared to \$1,500 in credits before.

“That means utilities, manufacturers and retailers are going to have to step up their incentives – and get a lot more creative and targeted in marketing energy efficiency,” Shelton said.

Among the survey’s other findings:

Thirty percent of Americans who have undertaken improvements said they haven’t seen the bill reduction they’d expected. Most said this was because their utility rates had gone up, but 44 percent said that they likely needed to make more improvements. In fact, the survey found that the number of improvements completed is strongly correlated with achieving the expected savings. The tipping point: about five improvements.

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"This isn't an easy process. Doing one or even two things isn't going to get consumers the savings they expect," Shelton said. "Making homes energy efficient is a multi-step process."

There is significant interest in time-of-use billing plans, smart meters and online energy information management systems. Over half of respondents, if given access to more information about their energy use, said they would utilize it regularly to try to shift or reduce their consumption. That includes 61% who are interested in receiving a smart meter that would notify the utility if they lose power and offer more information about when they were using electricity.

"When it comes to meeting customer needs, many utilities fear the vocal minority," Shelton said. "They're concerned about resistance to smart meters and slow to roll out time-of-use billing. As a result, utilities are missing out on a huge opportunity to help people take control of their energy use by giving them the information they need and the choices they want."

Asked what specifically they've done to save energy, the largest percentages of Americans had replaced most incandescent bulbs with CFL's (63% of homeowners and 61% of renters), added sealing/caulking/weather-stripping (55% of homeowners and 29% of renters), purchased ENERGY STAR appliances (49% homeowners; 38% renters) or added insulation (36% owners; 27% renters).

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## **Xcel Energy Announces Changes to Its Solar\*Rewards Program**

Program incentive to reflect drop in solar panel and installation costs

Xcel Energy announced changes to its Solar\*Rewards program to include an immediate reduction in the combined program incentive and a filing with the Colorado Public Utilities Commission (CPUC) for approval to lower the rebates offered through the program for on-site solar energy installations.

The changes are prompted by the decline in solar panel costs and increasing subsidization from government programs. Together, these developments have reduced the level of Xcel Energy incentives needed to support customer participation in Solar\*Rewards. The new incentive levels will continue to provide support to the market while investing customer funds prudently.

"We established Solar\*Rewards to stimulate interest in installing solar systems on homes and businesses, and to make sure the technology is part of Colorado's energy mix," said David Eves, president and CEO of Public Service Co. of Colorado, an Xcel Energy company. "The program has been successful in doing that. We're increasingly optimistic in our ability to meet the goal for customer-sited solar as required in HB 1001, which increased Colorado's Renewable Energy Standard to 30 percent by 2020. We look forward to the industry's continued progress so that it can ultimately become self-supporting."

Starting February 16, the combined Solar\*Rewards incentive for small, customer-owned systems (0.5 - 10 kilowatts) will be paid at \$2.01 per watt, from the previous \$2.35 per watt. The medium and third-party-owned programs will be adjusted similarly. There will be no incentive change for applications already approved; they will be paid at the previously agreed upon amounts.

Xcel Energy also is filing with the CPUC for approval to change the rebates for participants at the four program levels. For example, upon commission approval Xcel Energy plans to offer a combined incentive of up to \$1.25 per watt for small systems.

The company will accept applications for up to three megawatts of customer-site solar energy between February 16 and the commission's approval of its filing. By the end of the year, Xcel Energy projects that it will have committed for up to 59 megawatts of customer-site solar, compared to 27.5 megawatts in 2010. Since the program began in March 2006 and through the end of 2010, 76 megawatts of on-site solar energy have been installed, with \$178 million paid in incentives.

According to Deutsche Bank, the cost of solar panels has dropped 50 percent from 2008 to 2009. The Colorado Solar Energy Industries Association reports the industry grew by 91 percent last year.

"Just as wind energy is now more competitive, solar energy is moving in that direction too," Eves said. "Xcel Energy is committed to creating a clean energy future for Colorado at a reasonable cost to our customers."

Xcel Energy will file a Renewable Energy Standard Plan with the CPUC this spring that outlines the future of Solar\*Rewards, consistent with market conditions. This will include a plan for 2012 and beyond, including Solar Gardens. [Circle 19 on Reader Service Card](#)



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## Illegal entry into substations not worth the risk

Electric utilities across the country are falling victim to intruders who believe electric utility substations are an easy mark for obtaining metals such as aluminum and copper. That attempt to make a few dollars could end up in the loss of life.

Reports of theft of copper and metal have increased in recent months, causing concern not only for the protection of substation equipment, but also the safety of those who enter illegally. Substations, many located in remote areas and away from residences, have been targeted in the past. While the theft of materials is a serious issue for the Nebraska Public Power District, individuals who gain access into a substation may be putting themselves at risk of injury or death by facing exposure to several thousand volts or more of electricity.

Substation intruders in Virginia, Kentucky, Florida, and Texas have been electrocuted while attempting to steal copper. A recent attempt caused 3,000 customers in Ohio to lose their electricity for several hours. By trespassing in substations, these individuals gambled with their lives and lost.

“It just isn't worth the risk of any individual to illegally enter a substation and attempt to remove any metals,” said NPPD Transmission and Distribution Manager Tom Kent. “Entering a substation with all the warning signs is trespassing, and removing metal or other objects can land an individual in jail.”

Electric utility substations are clearly marked with warning signs that read “Danger – High Voltage.” This means think “safety first” and walk the other way. Kent added, “Substations that handle power for thousands of households are not designed for the public to enter at will, and that is why we fence them off and lock them. Only trained, well-equipped professionals should ever enter a substation.”

Kent stressed that safety is NPPD's top priority and District personnel are trained to safely work the electric system. In addition, the utility uses various security measures to guard substations against intrusion. Individuals who attempt to remove items from a substation are not trained to properly deal with the facility and risk becoming a fatality.

While copper theft creates the potential for electrocution through illegal entry, it is also a felony crime, and offenders will be prosecuted to the fullest extent the law allows. Copper theft costs the utility money, decreases reliability, and may even put NPPD employees at risk.

Individuals who see any unusual activity around substations, transmission towers, utility poles, or storage sites should report information to local law enforcement at 911 immediately. The individual observing the activity should safely gather specific information on who, what, when, where, and any vehicle and personal descriptions, but should not attempt to stop the crime in progress.

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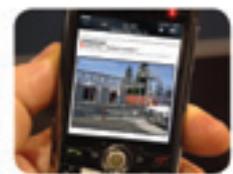
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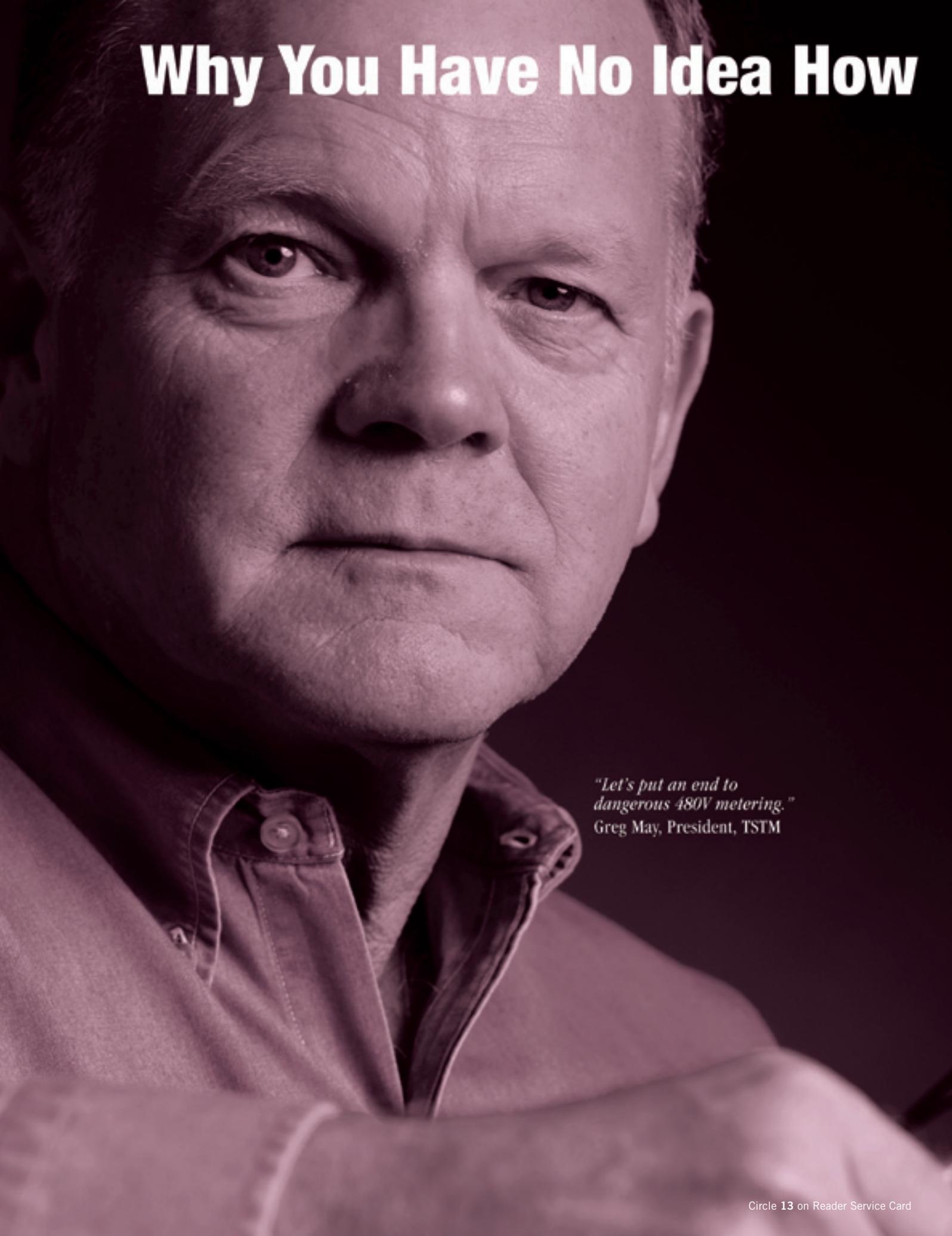
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# 2011 GreenWays Series

## Leadership for a Clean Energy Future



BRIDGE Energy Group, Boston, Massachusetts USA

By Colum Lundt, Founder & Chief Operating Officer and  
Tony Giroti, Chairman & Chief Executive Officer

The core business of energy generation, transmission and distribution has been operated and managed by 'non-IT forces' for years, but with Smart Grid programs now rapidly evolving, that paradigm is changing. The short-term tactical IT solutions that worked well for companies in the past no longer fit the ambitious objectives of the Smart Grid. The mission of BRIDGE Energy Group is to guide power companies on their IT transformation journey. In this interview, the leadership of the firm shares some of their ideas and vision for the future of the Smart Grid, framed in a holistic perspective. – *Ed*.

**EET&D**: I know from our previous conversations that BRIDGE seems to have a markedly different view of the challenges associated with achieving Smart Grid objectives, and your approach to meeting them is also considerably different from that of most traditional suppliers and consultants. Maybe a good starting point would be to help our readers understand your views on this by explaining how you perceive the problem.

**Giroti**: Well, you definitely hit a nerve with that question since we agree that we start by framing the problem – or the challenge, as you put it – a bit differently than a lot of people see it. That's probably because they've been so close to it for so long, it's hard to develop and maintain an objective view. You and I have discussed this before, and I think we agree that most

companies – utilities and suppliers alike – are extensively focused on deploying a tool or a piece of technology, such as Advanced Metering Infrastructure or Meter Data Management as the focal points of their objectives.

Our approach is to start by developing a strategy that takes into account a holistic approach based upon the business drivers and objectives for the program. This approach must include investment in the back office so that enterprise IT and integration architecture has the capacity to handle the data and the capability to integrate disparate systems and applications to deliver new services and solutions – which after all is the real value to the consumer and the utility not just the investment in the hardware.



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Without the right back office, a tangible return on the investment in AMI and/or MDM cannot be realized. An enterprise architecture and enterprise integration strategy is the necessary pre-requisite that will help utilities realize the real benefits of their investments in AMI and MDM. A contemporary architecture that provides a foundation for integration and interoperability within and across domains is the real need. This is where we believe the real challenges reside.

**EET&D** : Are you still seeing examples of this behavior in the marketplace?

**Giroti** : Yes, of over 25 pilots that we evaluated, most included Smart Meters and AMI/AMR, but none of them included implementation of back-office integration. Those that do include integration have point-to-point integration that will not, and cannot, scale beyond the pilot. Back office integration and Enterprise Architecture is integral to Smart Meter and AMI/AMR deployment. Without a holistic strategic IT integration architecture, achieving the true vision of Smart Grid is simply not possible.

**EET&D** : So why do you think it is that these kinds of considerations are being overlooked?

**Lundt** : Probably the main reason is that for a lot of folks, IT has long been an afterthought, especially around application integration. As Tony mentioned, this continues to be the norm for a majority of the Smart Grid pilots across North America. Right now, most utilities are focused exclusively on deploying smart meters, the technology behind the meter, communications infrastructure and MDM in their pilot phases. Some have included MDM integration with CIS, but very few have included developing a strategic integration architecture that ties MDM data with other enterprise applications such as their Outage Management System (OMS), Customer Information System (CIS), Interactive Voice Response (IVR), Geographical Information System (GIS), Workforce Management (WFM), Distribution Management System (DMS), or Supervisory Control and Data Acquisition (SCADA) systems. All these systems need data that will be pouring in from the AMI head-end.

Additionally, the popular approach of connecting MDM with CIS is in a point-to-point manner. That might work for low data volumes and low transaction rates, but it may not scale to accommodate full deployment volumes and bi-directional communications models.

**Giroti** : Moreover, if the CIS is ever to be replaced, MDM integration with the CIS will require redesign and rework. In the absence of a strategic IT approach, current integration practices provide little value to achieving larger scale Smart Grid & Demand Response objectives from an IT perspective.

**EET&D** : Are there any other issues that are contributing to the scenario you've laid out here?

**Lundt** : Yes, another big problem is that a lot of these projects are being done on a "one-off" basis. In many cases, that's because of the way these projects are being planned and budgeted on a compartmentalized basis. But overall, an enterprise vision and strategy are often missing. Without a holistic approach that views IT and OT integration as critical, an investment in AMI/AMR may actually shortchange future benefits in other areas of distribution automation. A holistic enterprise level approach is really the only way to optimally reduce cost and risk.

**EET&D** : Why do you think that is so prevalent?

**Lundt** : As it turns out, there's actually a very logical reason for it, and that is a fundamental lack of necessity. For decades, IT and power systems engineering applications have typically operated in silos due to the lack of any compelling need for integration across the enterprise, which is still an evolving concept. I'm talking about integration between business units, business processes, applications, and even the integration of databases. Until now, the industry has had minimal real-time integration capabilities built into IT systems because applications and data integration needs have been met tactically through the routine one-off and project-based approach. IT has never had the motivation, the business drivers or the budget to develop a strategic architecture or develop a standardized approach to integration.

**EET&D** : Clearly there has been a lot of progress made towards meeting the integration challenges, but there is still a long way to go, I suppose.



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**Giroti** : Yes, and there are many reasons that we still have a long road ahead. First, IT and OT integration is not a common practice. Second, application and data integration requirements have typically been met through a tactical approach based on just about any available technology or middleware offered by the application or system vendor. In most cases, available resources have placed limitations on these development efforts, usually restricting them to quick point-to-point interfaces between applications in order to achieve critical near-term objectives. I call this an “accidental architecture”, where each interface is non-standard and custom-coded. Many of these interfaces are batch rather than real-time, with database links and proprietary code that is customized by writing more code within the application.

**EET&D** : It seems that making the transition into this holistic approach has been a bit slow coming. What is impeding the progress?

**Giroti** : A lot of it really requires more of an IT philosophy adjustment than anything else. You can't let an MDM vendor modify your internal applications, and you can't let your application integration strategy be determined by whatever tool is being used by a particular MDM or AMI supplier. In the future, utilities will have to address – at a minimum – integration-related aspects of strategic enterprise architecture to address IT challenges related to many demands on the system. These include interoperability with applications and systems (within and outside the organization); Integration complexity, data volumes and real-time data needs; event processing, throughput, performance and security, just to name a few of the most essential considerations.

**Lundt** : And that's just the beginning. New operating models to accommodate electric vehicles, distributed renewable energy resources and new regulatory mandates, such as FERC Order 719 for load curtailment, impose even greater architectural demands around interoperability, application and data integration as well as IT governance, security and data management. There is enough empirical evidence from organizations implementing Smart Grid programs to support the concern that systemic problems within today's IT environment could seriously derail many Smart Grid programs before they get off the ground. Therefore, without a holistic strategic vision, planning, and an architectural approach,

some Smart Grid programs – Demand Response is one example – will pose formidable challenges that cannot be fully solved.

**EET&D** : What about the rapid growth of Service Oriented Architecture (SOA) that we've been hearing so much about lately?

**Giroti** : SOA is relatively new to the power industry, and there have been several false starts in adopting SOA. Many of the early adopters failed on their first try and are requiring a fresh start – primarily due to lack of SOA vision, strategy and experience. Some of these early adopters had wrongfully assumed that buying an SOA integration tool would be the silver bullet. This is not the correct assumption. Vision, strategy and technical leadership must precede the SOA tool procurement. The bottom line is that SOA is not really a technology or a product. SOA is a strategy and an approach. Rather than seeing IT as a set of applications, databases, storage and other resources, SOA is a strategy to create a true enterprise architecture that views IT as a set of services.

**EET&D** : Does SOA have any typical set of what I'd call rudiments, and if so, what are they?

**Lundt** : Yes, we know that enterprise architecture within an organization includes infrastructure, databases, applications and the business architecture. It is this business architecture that defines the business processes of an organization and provides the starting point for any application development. After all, IT exists to serve the business. SOA is rooted in the notion that business architecture drives the enterprise architecture. Based upon that premise, an IT that delivers services is equipped to handle the needs of the business as and when needed. In other words, rather than offering monolithic applications, IT builds a set of services that it threads together for the specific purposes of the business.

**Giroti** : The point is that these services can be easily added or removed from the business process, thereby making IT more responsive to the needs of the business. This is the holy grail of where all IT needs to arrive – that is, a set of service tools that bring agility to the organization. This top down approach is quite revolutionary in IT – not that the motivation was really ever missing – but now we have a strategy and approach that works.

This is remarkably different than the tool-driven approach or the bottom-up approach extant in prior distributed computing and architecture initiatives. Again, that's what SOA is – a new strategy for IT that delivers business agility as its principal benefit.

**EET&D** : As you have already mentioned, AMI/AMR/MDM are creating data volumes that are already significant – and growing. Existing IT systems are literally choking on these unprecedented data volumes, and although storage is relatively inexpensive these days, turning those enormous volumes of data into meaningful and useful information remains a huge challenge. How do you see that evolving?

**Lundt** : Back to an earlier point, much of the initial focus around Smart Grid has been on deploying Smart Meters and reading these through AMR and AMI. MDM products and applications are being employed to collect the data for various Smart Grid initiatives such as advanced billing, real-time pricing and managing grid reliability. These programs call for collecting huge volumes of meter data at 15-minute intervals. For a million meters, this amounts to more than 1,000 transactions per second; going to from one million to 2 or 3 million meters quickly gets you to 3,000 transactions per second. Receiving, sorting, storing and evaluating this data and collectively integrating the results with legacy applications make for a very challenging task. To put this into perspective, we worked with one utility whose system was already choking at 400 TPS, so this is by no means a trivial matter.

**EET&D** : Clearly, transactional data collected from customer meters can quickly reach staggering proportions that will require significant storage capacity and an information life cycle management approach to managing the data. If I'm running the utility IT department, what is best way for me to make that transition – or at least start preparing for it?

**Giroti** : Transaction performance is critical to the success of any system. Many Smart Grid & Demand Response projects are hitting performance bottlenecks due to architectural constraints. In addition to collecting the data, an organization will need to manage performance and storage challenges. A general practice is to add more CPU and hardware to solve a performance problem.

Although a short-term fix, performance problems will re-surface over and over again until the fundamental architecture is altered.

**EET&D** : With so much fundamental change going on, what's the best way to start down this path?

**Giroti** : To start making the transition, utilities will need to develop a real-time architecture where disparate applications can interoperate with one another to achieve objectives such as self-healing, load curtailment, air conditioning load management and other advanced applications. These capabilities require DMS, MDM, CIS, OMS, SCADA and other applications to interoperate without compromising their data integrity or their application performance. The first step in making this transformation is to take a holistic view of how all of these activities are tied together and develop a strategy and roadmap for the future “to-be” enterprise architecture that serves both the near-term tactical objectives as well as the long-term strategic vision of the utility.

**EET&D** : If future Smart Grid initiatives will require real-time integration of applications and systems to enable real-time communication and timely sharing of data across the enterprise to make informed decisions, that sounds like a fairly substantial effort, time and cost.

**Giroti** : Unfortunately, most utilities will grossly underestimate the IT Integration and Interoperability effort required to evolve to the next level. The core business of energy generation, transmission and distribution has been operated and managed by “non-IT forces” for years, and until recently, IT has only had a modest role in energy operations. With Smart Grid, that paradigm is about to change. The ambitious objectives of Smart Grid, when combined with some early warning signs from those who've embarked on the journey, indicate that IT is going to play a more prominent, if not dominant, role in making Smart Grid a reality. The utility industry needs to take a long and careful look at these indicators, make appropriate course corrections and reconcile with the role that IT will play in the future. IT will need to develop a strategic Smart Grid architecture to replace the accidental architecture previously mentioned.

**EET&D**: Meeting the broadest objectives of the Smart Grid initiative will require a consistent process and methodology that all stakeholders must conform to in order to be successful. But as we know, the electric utility industry has not in the past invested very aggressively in the IT organization and leveraging it. As a result, IT has often been working in a decidedly reactive mode. How is that going to change?

**Lundt**: As Tony implied, IT has historically been relied upon to merely deliver the bare minimum the business requires. Consequently, many IT departments are missing an organizational structure that is capable of leading a large initiative like Smart Grid, which requires strong technical leadership, discipline, standards, processes, methodologies and a governance framework. In some organizations, the role of Chief

Information Officer (CIO) or Chief Technology Officer (CTO) is either missing or its role diminished. Even in organizations with a CIO/CTO, IT management is not always represented at the executive level, and therefore, often does not get its 'fair share' of budget or resources. Simply stated, this will all have to change.

**EET&D**: What is the role of standards in all of this?

**Giroti**: Although it has a reputation for being stodgy in some areas, the electric power industry is one of the leaders in leveraging standards, not just in traditional power system engineering, but more recently there has been a significant effort to define specific Smart Grid-centric standards. For example, in the summer of 2009, the Electric Power Research Institute (EPRI)

delivered its Smart Grid Interoperability Standards Roadmap to the National Institute of Standards and Technology (NIST).

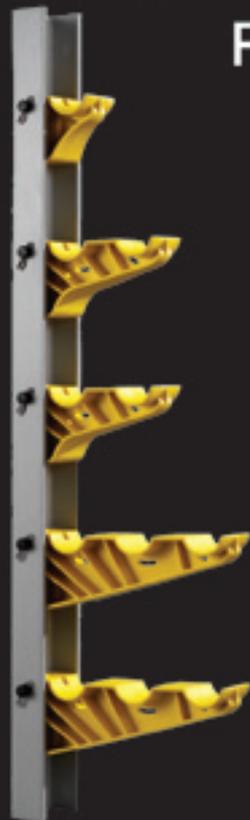
**EET&D**: What is the best way for utilities to prepare themselves appropriately to accommodate these extensive future changes and evolving standards?

**Lundt**: Organizations should also stay abreast of the work being done by FERC, which provides the overall policy, direction and market design; the North American Energy Standards Board (NAESB), which is accredited by American National Standards Institute (ANSI) that provides leadership on business practices; the North American Reliability Company (NERC), which provides guidance and standards for reliability. The GridWise® Architecture Council (GWAC), whose role is to help identify areas for standardization that allow significant levels of interoperation between system components, has developed the Gridwise Interoperability Context-Setting Framework to introduce interoperability groups, categories and a classification of interoperability issues.

**EET&D**: Tony, do you have any other advice for utilities preparing to make this transition?

**Giroti**: New demands being placed on the grid such as PHEVs, distributed renewable generation, new types of load curtailment programs will require new operating models to be developed to handle those demands, and the resulting new models will definitely tax the underlying IT systems over time. For example, EVs will need to be serviced, charged and appropriately billed for their power consumption – or generation – as the case may be. Preparing for these challenges will enable utilities to deliver new services gradually, over time, without making wholesale changes to their IT infrastructure. A strategic architecture that accommodates the business case of delivering yet-to-be-known business applications and services will be absolutely essential to success. ■

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# CHANGE OR DIE: Effective Utility Business Readiness Through Change Management

By Marisol Garza, Principal Consultant, Enspira Solutions, Inc. — A Black & Veatch Company

Change Management is not new to enterprises facing challenges, either elective or forced upon them. It has evolved in its perspective, sometimes being considered simply re-training, targeted internal communications, or implementation of new automated systems. However, as with all companies striving for success, utilities now realize that Change Management must become a deliberate process that assists their organizations to achieve useful business transformation. Also referred to as Organizational Readiness, real Change Management provides a systematic approach for participants to embrace new ways of doing business.

Successful change management results in a flexible organization that fully embraces new methods of executing key business activities, adopts more efficient and responsive methodologies, and can efficiently utilize new tools and enterprise systems. Change management strategies are most effective when they are tailored to the unique characteristics, drivers, and business models of each utility.

## Urgency for Change

Utilities have been traditionally characterized by a seasoned workforce and well established work processes. The industry has tended to be highly conservative, slow to change, and engineering oriented. They have operated with manual or quasi-automated processes for many years, relying on employees with specialized procedures, well-honed skill sets, and a deep reservoir of system knowledge in their heads.

The pressure of rapid technological evolution, coupled with an aging workforce, provides both challenges and opportunities for utilities. Utilities must capitalize on the potential of technological innovation to support the transitioning of the workforce pool, enhance customer services, and implement improvements in operational efficiencies.

Smart Utility implementations are providing data-rich systems for enhancing utility practices. Utilities are evolving to a proactive service model, equipping their workforce with information to restore outages faster, assessing data trends for optimizing

infrastructure changes, providing conservation consultation services to customers and offering pricing options and customer-behavior based plans.

As the utility industry transforms its business model, change management is becoming critical to realizing the immediate and long-term benefits of technology implementations. Internal change management is vital to the successful implementation of improved business practices, while external change management is critical to managing the expectations and communications with customers and external stakeholders.

## Unique Challenges

In tailoring organizational change for utilities, some of the unique challenges to consider are:

- Staging a complex implementation over a long period of time to sustain focus and complete all envisioned process improvements
- Managing the impact to Business Units and ensuring realization of the business benefits
- Developing an effective communication plan to manage expectations, prudently inform stakeholders, and sustain motivation
- Realizing and sustaining business transformation to impart permanent business process improvement

Many utilities are embarking on very large initiatives involving complex implementations over an extended period of time. Typically, these systems and technologies have significant impacts to employees and processes as well as customers. Utilities must design their implementation programs to address large service territories with diverse needs, as well as to communicate effectively across this diversity. It may also be especially challenging to execute a transition plan, which may include both old and new systems operating in parallel, as well as to stage these transitions across multiple regions.

And, while utilities have worked to centralize some activities (e.g., call centers and control centers), other activities are decentralized, such as execution of capital construction and O&M activities – making running old and new processes in parallel even more challenging. All of this program implementation complexity is compounded by the coordination required with multiple vendors and aggressive schedules.

Successful program implementation requires proactively managing the expected impacts to the utility's key Business Units. Complex implementations often bring significant process change and usually have a large impact to a significant number of employees in many departments. The utility may potentially need to coordinate with one or more collective bargaining units. Critical elements to managing impact include workforce transition and training, and consideration of workforce demographics.

Change management is dependent upon developing a comprehensive change plan. The plan must set forth approaches to manage change internally within the organization (executives, stakeholders, and employees) as well as to manage the changes externally to customers, unions, regulators, community groups and other third parties. It is vital that external change management communications embrace the utility's long-term strategies regarding rates and its vision for Smart Grid implementation.

Once an effective plan is in place, the challenge becomes realizing and sustaining business transformation. This is dependent on building internal ownership of the transformation initiatives and promoting adoption of the new business processes and methodology. Ultimately the realization of benefits is dependent on implementing the improved business processes.

Two examples of successful utility change management programs follow.



Securing and resealing the exchange meter for the SmartStar Lawrence program  
(Source: Westar Energy)

## Westar Energy – SmartStar Lawrence Program

**Westar Energy** is an investor owned electric utility (IOU) headquartered in Topeka, Kansas. It is the largest electric company in Kansas, employing approximately 2,400 employees and serves more than 687,000 residential, commercial and industrial customers in the eastern third of the state.

Westar Energy generates more than 7,100 megawatts of electricity, and operates and coordinates 35,000 miles of distribution lines. Their diverse energy mix includes wind, coal, nuclear energy, natural gas and landfill gas generation.

### Project/Technology Overview

The U.S. Department of Energy recently awarded a Smart Grid Investment Grant to Westar Energy to develop its Smart Grid project in the city of Lawrence, Kansas. The SmartStar Lawrence Program involves the implementation of Advanced Metering Infrastructure (AMI) and Meter Data Management (MDM) systems and will result in smart meters, interactive web access, technology enhancements and improved electric service in Lawrence.

### Business Transformation Challenges

Westar Energy is preparing to address expected people related impacts and issues of this transformation initiative by preparing their workforce, customers and the Lawrence community through their Organizational Readiness and Change Management effort.

Westar Energy has established the following key success factors for its transformation initiative:

- Active and visible sponsorship
- Establish leadership agreement on initiative direction and guidance
- Leverage strengths of individual leaders throughout the initiative
- Promote awareness, understanding and acceptance
- Equip workforce with knowledge, training and tools
- Facilitate transition and reinforcement for sustainability

### Implementation Highlights

Westar Energy is proactively building internal and external awareness of the SmartStar Lawrence Program. Extensive customer and community outreach initiatives have been executed. External initiatives implemented to date include community open houses, media announcements, social media interactions, and customer surveys. While the project is in its early stages, socializing the notion of having a new smart meter installed and introducing the benefits allows the customers and community to ask questions and engages them in the effort. Future plans include enhancing employee engagement with employees residing in the Lawrence community. Preparing them as community ambassadors will not only serve to assist in communications effort, but also return feedback from the community to improve future efforts.

## CPS Energy – GIS Migration Project

**CPS Energy (San Antonio, Texas)** is the nation's largest municipally owned energy utility, and provides both natural gas and electric service. CPS Energy serves 707,000 electric customers and 322,000 natural gas customers in and around the seventh-largest city in the nation. CPS Energy employs approximately 3650 employees.

CPS Energy customers' combined energy bills rank among the lowest of the nation's 20 largest cities. Their diverse mix of fuels includes nuclear energy which satisfies 34.6 % of greater San Antonio's electrical generation needs, followed by coal at 34.4 %. Natural gas and oil makes up 15% of the fuel generation mix while renewable energy, including wind, solar and landfill-generated methane gas, comprises the remaining 16%.

### Project/Technology Overview

CPS Energy's GIS project aimed at enhancing their GIS systems by migrating from AutoCAD to ArcFM Designer. This transition involved migrating from a static manually driven system and processes to a dynamic system with increased automated real-time transactions. Implementing a new interactive GIS system allows real-time changes of infrastructure and services, resulting in current and accurate maps for field personnel to perform their jobs and services safely and efficiently.

Benefits from current and accurate maps also supported other internal departments dependent on current maps, thereby enhancing customer service. This migration also served as a prerequisite for the AMI initiative, preparing the landscape of real-time accurate mapping data. Project changes included:

- A shorter As-Built lifecycle
- Designers acquired entire As-Built process and learned the new tool
  - Process takes longer because of the inherent ownership, but overall life cycle is shorter
  - Performance metrics were revised to reflect process time
  - Enhanced communications between designers & foremen
- New Quality Assurance (QA) department was formed and staffed
- QA Staff were trained on the new tool and processes
- Employees were trained for new roles within their department or trained for alternative positions throughout the organization

### Business Transformation Challenges

Introducing new technology where seasoned employees have worked their entire career in the same role creates

impacts and raises the challenge of how to best prepare them for a new way of doing business. The CPS Energy workforce possessed strong GIS capabilities and a strong work ethic. The transition from manual and paper-driven processes to automated and interactive processes required a varied and broad based training effort. Several roles and positions dissolved, due to reducing the backlog of modified maps needing to be entered into the system, while new positions with different roles and skill sets emerged to operate and maintain the new processes.

### Implementation Highlights

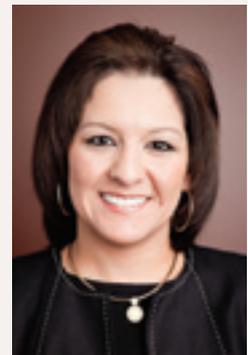
Change Management was recognized early as an essential component for success, particularly in light of anticipated workforce impact. The initiative included assessments of current employee skill sets and roadmaps for implementing the new technology in a robust and scalable environment. This process revealed the need for new business processes and changing and dissolving of existing employee roles. Impacted employees were identified and prepared for the impacts to their roles, the new technology and the new processes required.

CPS Energy was mindful of positioning visible and active sponsorship throughout the initiative. Sponsorship and leadership involvement included regular town hall meetings, frequent face-to-face interactions with the project team and impacted employees and an extensive training effort to equip employees for success.

Managers and supervisors played a key role in the success of the initiative. They recognized the need for adopting new tools and took ownership of their respective areas to promote awareness and to equip their employees, which ultimately enhanced the speed of adoption. ■

### ABOUT THE AUTHOR

**Marisol Garza** is a Principal Consultant with Enspira Solutions, Inc. – A Black & Veatch Company. Ms. Garza provides change management support to utilities in support of transformational projects and initiatives. She previously served as Change Management Manager for Human Resources at CPS Energy (San Antonio, TX). Prior to this role, she was an IT and integration manager and systems analyst for CPS Energy. Ms. Garza holds a BA in Computer Science/Application Systems and an MBA in Finance. Training includes Prosci Change Management Training.





# LightsOn

## South Carolina Utility Builds Citywide Broadband Network

By Jimmy Bagley, CIO  
City of Rock Hill,  
South Carolina

The City of Rock Hill, South Carolina's utility provides electric, water, and sewer service to approximately 95,000 residential and commercial customers within the city and surrounding suburbs. The utility developed goals to offer customers more choices and improve services. To achieve these, utility executives determined they needed to get more energy consumption data, manage it faster, and make it available to customers. This is how they did it...

The utility determined that to provide these new and improved services it would need to deploy several new systems.

First, an Automated Metering Infrastructure (AMI) system, including replacement of power and water meters with digital meters that could be centrally monitored, 24/7. With the ability to monitor meters centrally, outages could be quickly detected and the location pinpointed – rather than waiting for customers to call and report a problem. In addition, by understanding power usage, engineers would be able to perform real-time analysis of transformer loading and better manage power through the distribution system.

Another key system needed was a new customer interface to provide customers with easy access to their own utility usage information. The utility decided on a web-based portal that would allow customers to view their usage and make decisions on how to conserve usage resulting in a lower utility bill. In addition to usage information, the utility wanted to enable customers to submit service requests such as cut-off, which would automatically create a final bill.

Finally, the utility determined it needed a high-speed communications network that would provide reliable and secure communications between the utility and its customers.

Following a successful trial in downtown Rock Hill, Tropos Networks was awarded the contract and Rock Hill became the first city in the world to implement city-wide automated metering infrastructure (AMI) and a fixed water leak detection system.

## Now in Full Deployment

Today, the wireless broadband network covers 32 square miles with backhaul connections to the city's fiber ring. The utility has achieved both its goals of improving customer service and making energy consumption information available to customers. Utility customers are now able to view in real time their energy use and how making changes affects their consumption. For example, they can turn off their water heaters for a few hours, look at their meter data, and see the results immediately. Or, a customer can adjust his or her thermostat from work if he or she is coming home earlier or later than usual, just by logging into the Rock Hill utility portal and adjusting the temperature accordingly.

Remote monitoring is a huge advantage for the utility as well; utility executives estimate that they save approximately \$50 to \$60 per call by remotely reading the meters in the area, which also improves customer satisfaction. The process and time for change in service or name requests is now streamlined and utility representatives can access real-time reads without a truck roll.

In addition, mobile utility workers enjoy greater mobility and are able to work more efficiently. For instance, instead of waiting for calls from customers about a power failure, alerts are immediately detected centrally whenever a failure occurs. Outage location is immediately pinpointed using the Geographic Information System (GIS) and field workers can physically see where all the meters are located enabling problems to be addressed much faster.

Before a truck leaves a neighborhood following an outage, the utility can determine if all of the meters are up and working or if a few have been missed, rather than waiting to see if complaints come in. This has resulted in substantial savings on the cost of a truck roll while also increasing customer satisfaction.

## Expanding Use of the Network for Public Safety and Public Works

The Rock Hill City Council adopted the concept of using the wireless broadband network as a foundation in its strategic plan to improve a wide range of municipal services in the city.

Public safety was identified as a top priority – police and fire departments backed the technology and worked to get the police and fire departments on the wireless broadband network by implementing laptops in vehicles that provide real-time information in the field – from crime data to mug shots and building blueprints. Previously, the police

had not been able to access this information from the field due to limited network bandwidth. Now installed in police vehicles, mobile routers enable high-speed access to critical state (i.e. SLED – South Carolina State Law Enforcement Division) and federal databases, along with the ability to remotely view security surveillance cameras located in parks and other public places, in real-time.



The fire department also installed on-board mobile routers and uses the network, en route, to download a building's blueprint before arriving at the scene, so they know exactly what they're going to face in terms of the building structure – types of materials, storage, and locations. Instead of having a person relay the building layout over the phone or pulling out paper maps to identify locations of fire hydrants, fire officials have updated information at their fingertips, saving critical time in emergency situations.



The city's building inspection and code inspection departments also benefit from being able to 'virtually' extend their offices into the field. Inspectors can sign off on paperwork from their vehicles as soon as they finish inspections rather than waiting until the end of the day, speeding up the reporting process for builders and contractors. A contractor can access the paperwork online after an inspection to see whether their project was approved or rejected and why, usually within minutes of the inspection.



The sanitation department has received an efficiency boost as well using the wireless broadband network with an application written by the city. Previously, sanitation workers had no way of knowing which homeowners had paid for or dropped service; the city estimated that approximately one thousand homes were getting free garbage pickup each month.

Now, using GIS and GPS, sanitation trucks go out into the community and they have an onboard computer that shows them their location using the GPS data. The worker just has to click on a house on a map screen and the system automatically issues a bill for the location – no commands, no typing, just a touch screen.



Another application developed by the city that uses the wireless broadband network enables mobile city workers to send a work order to the appropriate city department when there are problems such as potholes, streetlights that are out, or other hazards. Instead of taking time to call in the problem – the GPS pinpoints where the workers are and records the GPS location of the utility vehicle. This single application has improved the efficiencies of taking work orders and enabled faster response to problems.

## Public Access Hot Zones

Rock Hill citizens and visitors are also provided free Internet access at various hot zones around town such as City Hall, as well as other city facilities and parks. At outdoor sporting events, officials can post game information and scores for people monitoring the game remotely as well as research rules and regulations; fans, and press in the stands can access the Internet and stay connected as they watch games.

## Conclusion

Rock Hill's success is largely because the City Council was very supportive and willing to go out on a limb to do something that nobody else was doing, at the time. Once the momentum got going and the utility started showing some of the benefits, people came on board and came up with ideas of their own on how to use the broadband network to improve quality of life in the community – and that's when it really took off.

Most cities and governments don't know exactly what they want out of a communications network because they don't know what's possible. Rock Hill is an example of a forward-looking city that created a broadband future benefiting the entire community that started with needs identified by the utility – control meter reading costs, improve billing accuracy and encourage resource conservation. The utility took the lead, backed by the City Council, in creating a citywide broadband network foundation that has led to improved efficiencies and reduced operational costs for many city services. ■



**Jimmy Bagley**, is currently employed with the City of Rock Hill as the Public Services Administrator/CIO, where he has responsibility for the Utilities Department, Public Works Department and the Information Technology Services Department.

He previously served as the Utilities Director for the City of Rock Hill with responsibilities in water, sewer, electric, and storm water.

Mr. Bagley is a past president of the South Carolina Society of Professional Engineers, Catawba Chapter, where he was voted young engineer of the year in 1993. Mr. Bagley has also presided over the South Carolina Association of Municipal Power Systems Board and is a member of the American Public Power Association's Transmission & Distribution Committee. He has been a member of the IEEE-Power & Energy Society since 1989.

# Powering an Effective Workforce Management Strategy

By Charles Coy, Director of Product Strategy  
Cornerstone OnDemand

Although improved technology in the electric energy industry will pay off with lower costs and higher returns, the people side of the industry is an area ripe for a more strategic approach. People make a company. Increased competition due to deregulation has put on the pressure to hire the best, while at the same time, energy organizations are looking to increase worker productivity and competency. As a result, human resources (HR) operations throughout the industry are fighting to recruit top employees from competing firms – and struggling to retain their best people.

There's a generational brain drain coming, due to the retirement in the next 10 years of 53 percent of the electric energy industry workforce, who are now 45 years of age or older.<sup>1</sup> Training and developing up-and-coming worker – whose average age is 24 to 35 – will become critical for electric energy organizations.

Generation technology also plays a role, as it evolves and changes, creating the need for more complex training and development. It's already being seen as companies bring new, more efficient facilities online that require more highly complex skills from operators.

These waves of change are creating a significant “talent void” that, when combined with other HR management issues such as globalization and identifying and developing future leaders, may snowball into a huge strategic business issue for electric energy organizations. In order to course correct their talent management strategies in the face of these human capital management issues, HR executives must shift from an administrative to a more strategic function, aligning people management initiatives with the overall goals of the organization.

## Integrating Talent Management Processes

Strategic HR starts with a holistic approach to talent management processes which, by definition, help companies attract, develop and retain employees, ensure a pipeline of qualified people, and build a culture of engagement and productivity. Too often, these processes are disconnected across an organization and frequently

are incomplete, making it harder for leaders to get a clear picture of their workforce. Their strategic power is realized when they are integrated – and supported by the right technology solution – allowing an organization to more quickly respond to changing business needs and employee demands.

There's a bottom-line advantage for highly competitive industries such as electric energy companies. According to the analyst firm Bersin & Associates, companies with intermediate to advanced levels of talent management processes performed better financially during the recession, as well as generated higher employee performance and lower overall voluntary turnover.<sup>2</sup> With increased pressure to reduce costs as deregulation spurs competition, it makes good business sense for electric energy organizations to take a broader view of the strategic role HR operations can play.

Comprehensive talent management should encompass training and development, employee performance management, and succession planning, all of which can be intertwined using an integrated talent management system.

## Raising Performance Levels Via Coaching and Development

Training and development is the best way for any organization to raise the performance levels of its people and achieve better business results. It's not news that the Bureau of Labor Statistics predicts that because on-the-job training is very intensive in many utilities industry occupations, preparing a new workforce will be one of the industry's highest priorities during the next decade.

Employee performance management should go beyond simply identifying areas where an employee needs to improve. People need tools to increase their knowledge and improve their skills. This is especially critical for energy organizations, whose business has become more technology-driven, with generating plants that require fewer but more highly skilled workers as more experienced Baby Boomers retire.

Mentoring younger workers and capturing the vast knowledge of the retiring workforce is made easier with technology tools in talent management systems. Managers can also develop high-quality learning plans that improve underperformers,

<sup>1</sup> Bureau of Labor Statistics, (<http://www.bls.gov/oco/cg/cgs018.htm#outlook>)

<sup>2</sup> Levensaler, Leighanne, and Laurano, Madeline. Talent Management Systems 2010, Bersin & Associates. September 2009.

# Powering an Effective Workforce Management Strategy

prepare high performers for leadership positions, and address competencies required for specific roles. This “coaching and development” style of performance management can result in increased productivity, higher employee engagement, and improved retention. For HR leaders, this also ensures that learning initiatives are not randomly assigned but actively address identified gaps.

The ability to manage performance can be challenging when it comes to roles where employee performance is best monitored in real time. Some talent management solutions offer a “performance observation checklist” feature, which allows organizations to assess and record an employee’s skills and competencies while directly observing activities in the field. Automating what was once an inefficient, paper-based process makes it easier for organizations to track and validate proficiencies or regulatory compliance with critical safety procedures. When integrated with training and development tools, managers can automatically assign training when additional support is needed. Capturing and tracking this information in a centralized system also helps HR leaders ensure that regulatory reporting is accurate and timely, an invaluable feature for the energy industry as a whole.

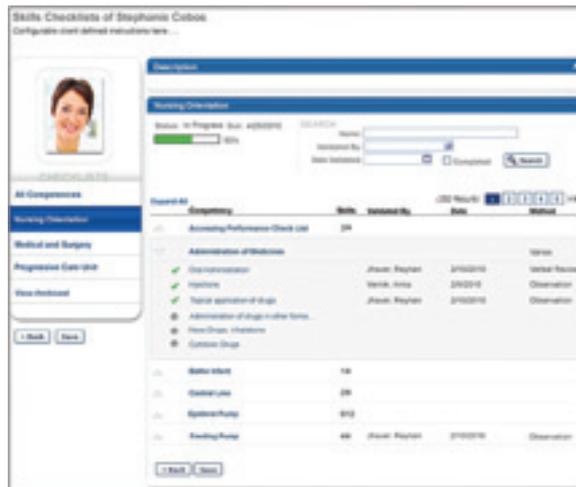
Blended learning is the most effective way of delivering consistent, cost-friendly training to global, geographically dispersed workforces. Utilizing the combination of in-classroom training with e-learning, virtual classrooms and mobile learning options allows learning initiatives to be more closely aligned to the needs of busy employees, who now have more options for accessing self-service training – as well as follow up, refresher, or extension materials – anytime, anywhere.

Good planning, engaging content, and a robust, user-friendly learning management system bolster a successful blended learning strategy. Some blended learning programs fail because they don’t take into account the actual learning needs of employees or the organization’s learning culture. Programs need to be developed based on what, how, why, and when employees need to learn. It also requires that employees become more engaged and take more responsibility for their own training and development.

## Succession Management 2.0

The third strategic leg is succession management, which can be so much more than just a top-down process that focuses on a few key executives. The right technology and processes can not only expand succession planning deep into the ranks of the organization, but also let a company engage employees directly in career management. Technology can facilitate the collaboration between managers and employees that supports both the needs of the business (bench strength, talent

mobility) and the needs of the individual (professional growth, career management, career path).



Career management and career pathing tools are new to the succession discussion. They empower employees to take ownership of their careers, helping to improve engagement and retention. These tools allow employees to create an online profile to market their skills, competencies, and fluency in certain languages, as well as career preferences, such as the willingness to relocate, specific geographical preferences, and long-term career goals. For HR, this provides a searchable database for internal recruiting and introduces a strategic way to connect employees with projects and departments outside of their immediate sphere.

When integrated with learning management, HR leaders can assign targeted leadership courses for employees in the succession pipeline or allow people to identify skill and knowledge gaps based on their career aspirations within the organization and then access courses to close the gap.

## Fostering Collaboration and Capturing Knowledge with Social Tools

Some talent management systems can also take advantage of social networking as an emerging powerful business strategy, especially for younger workers who have been practically raised on technology. Tools like workplace communities, wikis (Web-based knowledge repositories that any employee can contribute to), blogs and rich user profiles should be viewed as information resources that can help organizations increase productivity and drive innovation. It's not about entertainment – it's about connecting employees with knowledge and people across an organization, and, most importantly, bridging the generational technology divide by providing a strategic purpose for social networking.

## Better Workforce Insight

Strategic, comprehensive talent management strategies supported by the right technology solution can provide HR leaders with better and deeper insight into their workforce – the kind necessary to make smarter workforce decisions. Businesses are able to identify high performers and future leaders, track and evaluate employee performance, isolate and address skill gaps with targeted training and development, and ensure that the right people are in the right roles and at the right time – all within a centralized system.

It also can create organizational efficiencies, automating key processes so that HR leaders can spend less time mired in paperwork and tactics and more time developing HR strategies that can support current and future business needs. Even better, valuable workforce data collected in the system can now be tracked and shared.

Making the transition to a holistic workforce management strategy may seem time-consuming and expensive. The best approach is to phase in initiatives for training and development, performance management, succession planning, and enterprise social networking. Consider that field-based employees may not have a culture of remote or self-service learning and performance management, which will require change management initiatives to persuade those employees to access and use these tools.

Energy companies with responsibilities to public and private stakeholders should choose a technology solution that is flexible, scalable, and configurable enough to support business needs, that can be implemented quickly and easily, and that won't require added IT resources or constant version upgrades. But a technology solution is only as good as the strategy it supports. HR leaders must ensure that talent processes are in line with business needs and that they make sense for the company as a whole. ■



Implementing social media and collaboration tools doesn't have to be daunting tasks. The easiest and most practical way to introduce these tools is to start small and focus on wrapping social technologies around existing programs, such as training and development. It has been observed that while 80 percent of training budgets are spent on formal learning programs, 80 percent of what people actually learn is informal, whether it is overheard at the water cooler, passed down by a mentor, or shared in an email. Building an online community around an existing training course helps to centralize and capture this informal learning experience. Participants have a means of connecting with one another before, during, and after the course to find commonalities and share knowledge. Employees are better able to connect with their mentors and foster a richer relationship.

Another practical application for social tools is the creation of employee alumni networks. Aging workers leaving the workforce possess large amounts of institutional knowledge that is difficult or impossible to capture and share. Alumni networks provide a social channel to engage retirees so the business can continue to benefit from their expertise even after they are no longer employees, easing the brain drain.

Rich user profiles also can help the company and other employees quickly and easily identify subject matter experts, no matter where they are in the organization. Overall, companies will benefit from the knowledge capture that occurs through this process, allowing them to better manage and collect it in a centralized and searchable system.

### ABOUT THE AUTHOR

**Charles Coy** is director of product strategy and a corporate social networking expert for Cornerstone OnDemand, a learning, performance, and talent management software provider.



# Embracing New Project Management Trends Can Boost Operational Efficiency & Competitive Advantage

By J. LeRoy Ward  
Executive Vice President, Product Strategy & Management, ESI International

After traveling the globe and speaking with clients across the energy industry, I have come to see that significant project management trends coming “down the pike” in 2011 will have long-lasting impact on both project management and the electric utility businesses that rely on the discipline to take strategies from ideas to reality. Are you ready? –

*LeRoy Ward*

Major industry projects, such as transitioning to smart grids and deploying smart meters, present challenges for project managers due to the complexity of the technology, coupled with addressing community concerns and regulatory requirements. These and other industry transforming projects set the stage for 2011.

## First A Solid Foundation

Regardless of the trends, it's important to remember that all good project management starts with a solid foundation. This means following the golden edict of ‘people, process and tools.’ In practice, this means teaching your people the skills and knowledge they need; putting in place consistent processes for them to follow; and then providing the tools for them to effectively apply their knowledge and follow the processes efficiently and effectively.

In addition to skill development, strong team development is essential to the ‘people’ portion of building a solid foundation to improve project outcomes. Rather than fixating on hiring or technology as the cornerstones, organizations need to invest in creating a team-oriented culture that actively breaks through the outdated approach of project managers working in silos, each handling their own piece of the project management pie.

While learning is an essential element, gone are the days when training and certification were “good enough”. Today learning must be approached as a long-term, integrated effort to improve performance, rather than a one-time event. Successful learning programs help teams work in alignment – with each other and with the organization's goals – not just deliver information, which may or may not be absorbed and applied on-the-job.

Knowing that you have a strong foundation in place will help you and your organization be ready to gain value from the project management trends of 2011. In some cases this will mean taking defensive action, but for most of these trends, the real value is in using them to implement a strong offense and leap ahead of the competition.

As you'll see, several key themes emerge from my 2011 PM trends, such as the need to continue to build on the project manager's organizational influence; an acceleration in the demand for PMs with outstanding leadership and communication skills; and the use of more informal learning modalities such as social media and experiential training – also known as action learning – for professionals and their organizations to realize the full benefits of strong project management.

## Leadership Skills Will Be the PM's Critical Success Factor

Only eight percent of utilities around the world have completed their smart grid technology implementations while 37 percent have projects underway and more than half haven't yet started, according to a 2010 Microsoft Corporation survey.

Leadership skills, such as critical thinking, crucial communication and organizational change management, will be strategically imperative project management competencies essential to successful smart technology rollouts.

In 2011's project management landscape – featuring more complex projects and greater use of virtual teams – being on time and on budget will require not just a laser-like focus on the triple constraints, but on the requisite leadership skills necessary for an individual PM's success. The challenge for utility businesses will be to clearly define what “leadership” means in the project and program management context.

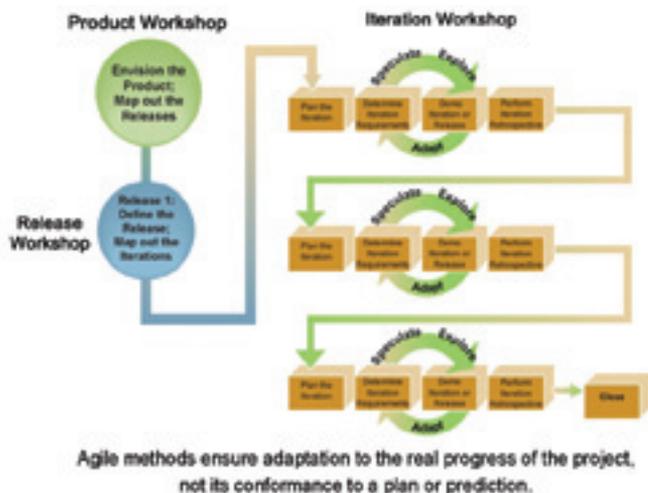
## No Industry Will Be Spared from the War for PM Talent

Aside from transitioning from older technology systems, utilities are also balancing the realities of an aging workforce coupled with the challenges of recruiting and retaining younger, more ‘smart technology’ proficient managers. Common wisdom dictates that the smart grid will rely on a highly skilled human network.

Savvy talent management and retention strategies will be essential to ward off poaching in 2011. Although economic recovery has been uneven worldwide, PMs with the greatest mobility and experience will have the best opportunities for career growth through “overseas” assignments. In particular, India and China will continue to be plagued by a dearth of competent and experienced PMs to manage large and complex infrastructure and IT projects.

## Agile Will Be Seen for What It Is... and Isn't

Project management organizations embracing Agile software and product development approaches will continue to grow while being faced with the challenge of demonstrating ROI through Agile adoption. In addition, they will need to disabuse their stakeholders and executives of the expectations set by IT consultants, the media and the vendor community that Agile is the next “silver bullet”. Organizations that do it right – including selecting the right projects for Agile – will reap significant rewards.



## Competency Models

As project management gains greater acceptance as a discipline, the hiring, assignment, promotion and professional development of PMs will be based on comprehensive competency models. In order for these models to be effective, they must be company-specific. Competency models illuminate the behaviors required for a PM to be successful and take on larger and more complex projects. Accordingly, the CLO (or senior HR executive), business unit heads and the enterprise project management office (EPMO) need to work shoulder-to-shoulder to identify and codify organization-specific competencies, thereby building a framework for talent management success.

## Experiential Learning: The Norm – Not the Exception

The professional development of PMs will increasingly focus on reality-based learning and on-the-job training, an approach certain organizations in Asia have taken for many years. Learning providers will be required to send PMs back to the job from such sessions with the ability to immediately apply what they learned to their current projects. Even the many universities that offer project management degrees will face the challenge of making their courses and programs relevant, practical and pragmatic based on participants' real projects. The lecture mode is dead, and any training provider or university who ignores it does so at its peril.

What is also commonly referred to in training as the synthesize stage, creating communities of practice, centers of excellences, and identifying coaches and mentors helps the individual make the leap from recognition of when and how to use the competencies learned in class to actually absorbing the competency and executing based on the current work situation at hand. At this stage, applying learning is as easy as the natural act of breathing. It is done without conscious effort; one knows how to do it without thinking about it.

## Informal Learning for PMs Will Gain Momentum

Organizations will continue to develop and exploit informal learning approaches such as communities of practice (CoP), various forms of social media, as well as coaching and mentoring. With millennials joining the workforce in greater numbers, we will witness more effective use of social learning technologies and approaches, such as wikis, blogs, videos, podcasts and other methods of communication. With four generations now in the workplace, it is not only the millennials who will benefit by such relatively new forms of learning. However, the great Zen kōan question of the day is, “If informal learning becomes formal, does it become formal learning?” If the answer is yes, do we search for more informal learning to formalize?

## Outsourcing Will Remain a Risky Business

According to the *Fourth Annual Strategic Directions in the Electric Utility Industry Survey* (2009/2010, Conducted by Energy Central's Sierra Energy Group), utilities remain a relatively difficult market for outsourcers of all types. However, the survey shows that information technology, engineering and vehicle maintenance are the three areas utilities say they are most likely to outsource.

## Embracing New Project Management Trends Can Boost Operational Efficiency & Competitive Advantage

The continued growth of outsourcing will force organizations to pay more heed to its associated risks and conduct better due diligence. According to an ESI outsourcing survey, *Risky Business: Organizational Effectiveness at Managing Risk of Outsourced Projects*, 45 percent of organizations report that they lack a strong risk management culture. It's not surprising that more than half of organizations believe their organization is only somewhat or not very effective at risk assessment and risk management of outsourced projects. Further, two-thirds of organizations lack a well-defined or structured risk management process.

As a response, organizations will strengthen their risk management cultures and recognize the value of best practices in contract management. More than a euphemism, the word "sourcing" will replace the term "outsourcing" as it more accurately describes the resource allocation approach, both internally and externally for many organizations.

### Change Partners and Structured Methods to Facilitate Adoption

Projects initiate change and PMs are change agents. Yet, they have been ill-equipped to facilitate the type of change required to adopt the product or service the project delivers, especially when faced with the implementation of a smart grid or advanced meter infrastructures that demands a complete redesign of customer and departmental interactions.

And the statistics are undeniable – most organizations fail at change management. According to the Wharton School of the University of Pennsylvania Executive Education Program on Leading Organizational Change, "Researchers estimate that only about 20 to 50 percent of major corporate reengineering projects at Fortune 1000 companies have been successful. Without understanding the dynamics of the human transition in organizational change, change initiatives have a slim chance of success. If organizations cannot change and adapt, they will not thrive – or worse, they may not survive – in today's dynamic environment."

With that in mind, in 2011 we will see more organizations developing and assigning "change partners," also known as change management experts, to projects to assist in such adoption. Moreover, project teams will slowly, but steadily, increase their use of change management methods, which will be packaged as methodologies.

### PMP: The Credential of Choice... for Now

With 400,000+ holders, the PMP (Project Management Professional) will continue to be the most popular project management credential in the world, outpacing every one of its rivals as the "credential of choice" among practitioners. While most organizations will continue to support their PMs in earning the credential, the value of proven experience and demonstrated competency will take on even more relevance beyond having the certification itself.

No doubt project management will continue to play an increasing critical role in driving operational efficiencies, and rightly so, savvy electric industry leaders are putting more stead in project management to fine tune their competitive advantage. This year, alongside technical savvy, other skills such as negotiation, communication, critical thinking, change management and leadership are taking on new importance for project managers. Your most successful project managers will need influence and organizational agility to keep performance improvement moving forward. ■

#### ABOUT THE AUTHOR

**J. LeRoy Ward, PMP, PgMP** is Executive Vice President, Product Strategy & Management for ESI International, where he brings more than 35



years of expertise in project and program management to the refinement of learning programs. He works closely with ESI clients worldwide to guide the assessment, implementation and reinforcement of knowledge and skills that allow for the effective measurement and successful adoption of learning program objectives.

## PART 2: How can the Renewable Energy industry sustain growth?

Developers, Regulators and Investors need to meet in the middle!

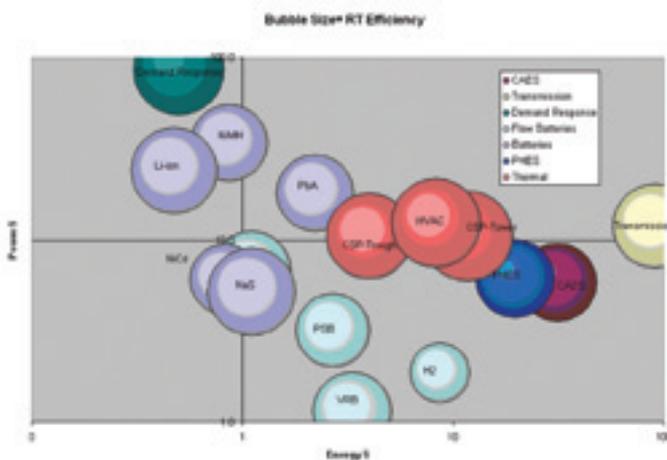
By Koustuv Ghoshal, Managing Partner, Inspirra Energy



Conventional forms of power generation have a proven and established value chain and easily identifiable (and more importantly, finite) set of levers to determine the technical viability and financial profitability of projects – whether in the generation or in the T&D domain. Renewable forms of generation, however, pose a different set of challenges, given that as yet, there is no ‘well-baked’ set of business rules other than those established for more conventional energy sources such as hydroelectric and nuclear. In this second part of our look at the future of renewables growth, we explore the intricate relationships between developers, regulators and investors and how those relationships affect the outcomes of proposed projects – and their success or failure.

If we look at the overall energy demand and supply relationship<sup>1</sup>, it is clear today that no single entity calls all the shots - this is especially true in the Renewable Energy sector. This new model has, however, evolved somewhat in the aftermath of the economic meltdown with two primary levers emerging:

- 1) Cost of Technology (controlled by the major suppliers, especially true in the case of solar and wind suppliers); and,
- 2) Expected Return on Investment (ROI) – in the form of project IRR (Internal Rate of Return) – by the investors.

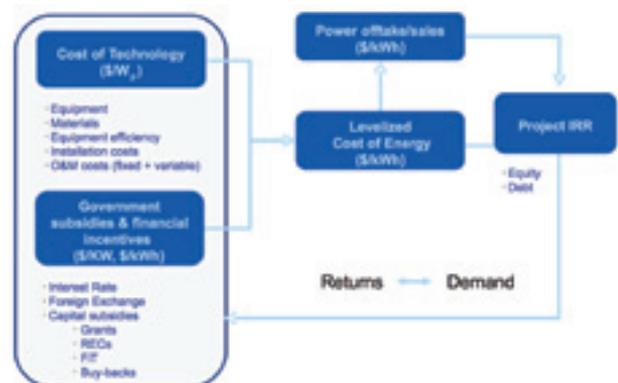


The rest of the value chain (above) had to align with the key drivers. However, the falling price of technology (consider the drop of nearly 30% in solar modules alone!) together with a major reset in investor expectations (project IRR threshold for a PE fund is 18%) have refocused attention on other levers. Today, a promoter of renewable projects has an

array of opportunities where it can be effective – from acting as a pure-play project developer (i.e., selling the project to a third party after development) to acting only as an EPC (Engineering, Procurement & Construction) contractor, to being the complete asset owner/operator. Somewhere in between is the notion of a Systems Integrator.

### Integration of Storage Solutions

A key toward combating intermittency and capacity concerns of renewable sources of generation – primarily solar and wind – is to integrate storage devices into the overall generation schema. Battery back-ups in small-to-micro solar applications have been around for a long time. However, there are very few commercially viable solutions that are truly dispatchable. Integration of storage helps to improve grid optimization of bulk power generation from renewable sources in addition to improving plant capacity factors. For example, there have been solar thermal projects where molten salt has been used as the storage medium, but economic feasibility usually makes such solutions prohibitively expensive.<sup>2</sup>



<sup>1</sup> Adapted from Linx•AEI Consulting (Sep 2010). – <sup>2</sup> Pumped hydroelectric and CAES technologies are proven market solutions in the hydro power domain.

## PART 2: How can the Renewable Energy industry sustain growth?

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GUEST EDITORIAL

As a first step toward determining the amount of energy storage that should be added to a grid with intermittent resources is to ascertain the marginal cost of generation. The brief analysis illustrated here offers a snapshot of various options available today. Another option that is rapidly gaining momentum among generation planners is the integration of base load generation – mostly gas – with a large wind project.

### Moving Down the T&D Food Chain

One of the ways to demonstrate near-term positive impact of renewables – in the form of energy efficiency – within the T&D grid infrastructure is in its penetration at the Distribution level. Such integration can be part of a wider Demand Response and Demand Side Management program. A great example of such an implementation is PSE&G's program, announced in 2010 to integrate solar PV modules at the distribution pole level. The assumption in such implementations is that the incumbent utility's distribution system is equipped to handle spikes (and troughs) of intermittency during peak hours. An additional benefit of distribution-level "behind the fence" application (i.e., with a net-metering option) is not having to deal with transmission-level ISO issues which will help in quicker execution of projects.

### The 'Catch-22' Loop

It's the classic Catch-22 situation in the renewable sector today between investors and developers. Investors are looking for projects that are "shovel ready". However, for a project to be ready for construction, a developer has to spend an average of \$200-\$250K/MW – which most investors are simply not willing to put up. This is a logjam that needs to be broken. Another aspect that developers need to be mindful of is the fact that most investors are not interested in one or two small (e.g., <500KW in solar PV) projects. A portfolio of 5-10MW (minimum) is a much wiser approach toward developing a portfolio of projects – at least in case of solar.

### Dependence on Government Subsidies

Finally, the renewable energy sector has to eventually wean off government subsidies. The independence from state handouts (of one form or another) will not happen immediately and will require a concerted effort between:

- **Regulators...** who will help lay out long-term clear market rules to facilitate growth;
- **Developers...** who will have to reset their ROI expectations;
- **Suppliers...** who will be forced to improve technology efficiencies constantly to drive manufacturing costs down. (Even a 15-20% reduction in 'per MW' capital cost increases the project IRR by nearly a full 1%, in the case of a solar project); and,

- **Investors...** who will need to rethink their IRR thresholds and consider a more collaborative approach with project developers right from the project development stage.

### Potential Solutions in Solar PV Project Development

The nature of renewable project development is such that no single model can fit every proposed project. Here the author illustrates<sup>3</sup> a scenario of a Public Private Venture (PPV) for a solar PV project that may offer each of the key stakeholders in the value chain various options to consider. PPV participants are the developers, the energy off-takers, local authorities, suppliers and investors. Typically solar PV projects may be categorized under two principal categories:

- 1) Ground-mount systems, and
- 2) Rooftop projects.

The "off-takers" – that is, the entity (or entities) buying the energy – which may be a utility (e.g., a local distribution company); a commercial establishment, such as large warehouse, hospital, parking garage, etc.; or a local government owned and operated facility (e.g., state-/county-owned buildings, schools, etc.). The example given here is a unique, but proven, model for a large rooftop project at a county-owned facility.

It is important to note specific traits of the PPV model – mostly how the funding resources were optimized to make a project financially meaningful to the investor/s. At the same time, it is critical to appreciate how a project can leverage and optimize the two big incentives the US Treasury and the USDOE offer today as investment incentives:

- 1) The 1603 Treasury Refund for renewable projects, and
- 2) Application of the accelerated depreciation benefits.

### Large Rooftop<sup>4</sup> System: A Low Project Cash Flow Challenge

Let's consider the role of various participants in this project to better appreciate how each party worked through various challenges by optimizing the resources at hand.

**The Developer:** Was presented with a classic example of what most solar project developers struggle with today – a PPA which has a low starting tariff (below \$0.08/kWh) on top of being in a region that does not offer Solar Renewable Energy Credits (SRECs) that could have provided the added "kicker" to energy sales. Thus, the pro forma presented a low project cash flow situation – and yet the need to create a model that attracted equity investors was imperative. One positive aspect of the PPA was the fact that the off-taker (the County) had a AAA credit rating – a vital statistic to any investor!

<sup>3</sup> Based on actual business models for large solar PV projects in the US that the author has been associated with recently, representing the developer and the investor components of the value chain - <sup>4</sup> By this author's definition, any solar PV rooftop project of more than 2.0MW is a large project. However, there are not many projects of that size in the US today.

## PART 2: How can the Renewable Energy industry sustain growth?

Developers, Regulators and Investors need to meet in the middle!

# GUEST EDITORIAL

**The Investor:** This is where leveraging tax equity benefits kicks in. With corporations sitting on record amount of cash and profits today, the classic tax equity investor is starting to emerge again (which had been mostly in a state of hibernation the past two years).

**The Off-taker:** The project was envisioned as a “crown jewel” in this particular county’s push toward a leadership role in the country in owning renewable energy assets in its portfolio of facilities. However, the opportunity didn’t come without dilemmas! The retail energy rates were low enough in this state that it posed a challenge to justify paying a higher tariff to the solar energy provider – JUST to have a showcase project. Moreover, in anticipation of this monumental project, the County had already started down the path of reinforcing the roof to make it ready for the solar PV infrastructure. Needless to say, a lot was at stake.

**The Supplier/EPC:** The equipment supplier and the EPC partner had to be in close concert to constantly improve upon the cost/Watt factor in order to compensate for the challenging economics of the project.

**The Utility:** Project completion is incumbent upon successful interconnection with the local utility for net-metering purposes. Here was a situation where the local distribution company had never tried to integrate intermittency of this magnitude (i.e., 2MW or more of solar PV) into its grid.

### The Solution – Optimization of Stakeholder Expectations

After several rounds of discussions regarding making the project financially viable, here’s where the County stepped in to not only provide some incentives and guidance, but also to take a leadership role – primarily to make sure specific risk parameters were adequately addressed and the project became attractive to all parties concerned:

- The County issued a bond to cover debt (approximately 15% of the total project cost), a process that was fast tracked by the county;
- The County applied for and received significant DOE and ARRA grants (for approximately another 15% of total project costs, which could be applied toward capital procurements);
- The County was also instrumental in lobbying to the National Development Council (NDC) for an allocation of New Market Tax Credit (NMTC) that accounted for almost 20% of the project cost;
- The PPA allowed a flip-structure – where the equity investor could sell the project after a pre-determined number of years for the County to own the asset for the rest of its useful life;
- The County worked hard with the developer to make sure it qualified for the 1603 refund; and,
- Topping it all, the County as the off-taker became the key facilitator between the developer/EPC team and

the distribution utility to ensure adequate management sponsorship at all levels to move the process forward.

This meant the equity investor only needed to put up less than 50% of the total project cost after accounting for the 30% refund from 1603 after production started. Historically, private equity funds have expected a minimum IRR of 18-20%. In this case, to compensate for the lower IRR of the project, the equity investor re-modeled its return expectations by leveraging the up-front tax equity benefits and the ability to depreciate the eligible asset base a full 100% in Year-1 to gain a fairly healthy return on equity.

Rather than accounting for a large upfront development fee, which would have made the project even more difficult to justify, the developer formed a joint venture with the investor. In this arrangement the developer continued to have a carried interest in the cash flow throughout the life of the project in return for a lower expectation on the development fee.

In the end, rather than each stakeholder maintaining a rigid set of expectations, each party came to the table to work toward a common goal by being a creative in structuring the transaction so that no one party would be left feeling short-changed as a result of its willingness to compromise and participate – and it worked! (The PPV Model is depicted in the illustration below.)



### ABOUT THE AUTHOR

**Koustuv Ghoshal** is Managing Partner at Inspirra Energy, an independent investment banking and industry advisory firm focused on the mid-market renewable project development and energy efficiency sectors globally. Each of its principals has deep industry experience in energy industry market research, power project development, and project funding advisory. Koustuv can be reached by phone at +1-469-361-2120 or via email to [kghoshal@inspirra.com](mailto:kghoshal@inspirra.com).

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With William T. (Tim) Shaw  
PhD, CISSP

# SECURITY SESSIONS

It seems as if you can't pick up a magazine on automation or read an article about automation without running across an ad for or reference about some wireless instrument or device. Wireless is the new "hot" technology. Just a couple of years ago every vendor was rushing to bolt an Ethernet port onto their devices, but today they are all gluing antennas to their equipment. On its surface wireless seems to be a wonderful enabling technology. You save a bundle on wiring costs, you can just stick equipment anywhere you want and move it if you need, everything interoperates in one big happy wireless network and it even automatically fixes problems if there are failures. Oh, and it's totally secure because it uses all sorts of high-tech encryption. Maybe I should point out that this list of sunny observations was enumerated to me by a control system engineer who was planning to "go wireless" on his next (and I believe first, but possibly last) major automation project. Maybe you have heard the same good things? – *Tim*.

## Wires? We don't need no stinking wires!

I have no issue with wireless technologies. A good bit of my earlier career was spent designing, building and commissioning SCADA systems. Wireless communications was (and still is) an essential component of such systems for the practical reason that it was not possible to run wires across the countryside in order to communicate with dozens of outstations that could be tens to hundreds of miles distant. Of course the wireless technology used years ago was analog and "dumb" and operated on fixed/licensed frequencies at high levels of transmission power.

Mostly it was voice-grade radio equipment to which we attached a MODEM and then send our message traffic out over the airwaves at the blindingly fast rate of 300 to 1200 bits per second. Because of the low data rates we were forced to use we devised or adopted highly efficient protocols (like Modbus RTU©) that required minimal communications overhead to

successfully deliver our messages. Of course today that strategy is one of the reasons that such systems are highly susceptible to a cyber attack. We didn't incorporate any defensive or protective mechanisms into those old protocols and now we are scrambling to find a quick and easy bolt-on solution to protect and secure those communications.

Wireless technology has evolved quite a bit in the past two decades. Today a typical 'digital' radio has an embedded microprocessor, uses digital encoding schemes and may hop around over a number of frequencies while transmitting. The presence of an embedded microprocessor was a major game-changer for wireless. A basic radio has no identity, but a computer can be programmed to understand ID numbers and addresses.

A radio has no storage, but a computer can buffer messages in memory. A radio doesn't listen to the messages it is receiving, but a computer can do that and determine if the message is corrupted. A modern digital radio that only costs a few hundred dollars can automatically detect the presence of other similar radios, exchange messages with those radios to determine the presence of radios that are too distant for direct communications and establish message-forwarding agreements to provide a means for communicating with even the most distant radio. The radios can even identify alternative routes in the event of a radio failure.

All of these things are possible only because the radios contain a microcomputer, and of course, the applicable program logic. That message-passing scheme is what is popularly called a Wireless Mesh Network. Since these radios have computer memory they can keep a copy of a message in case the intended recipient is momentarily out of communications and then send it later when communications are restored, often called Store-and-Forward.) Radios can request that the recipient of a message send a return verification message confirming successful receipt. If necessary the initiating radio can attempt to resend the message several times until delivery is successful.

# SECURITY SESSIONS

Years back you could not operate a radio transmitter unless you were granted a license (and assigned a specific operating frequency) by the F.C.C. That became a cumbersome burden and eventually the F.C.C. allocated a range of frequencies (a 'band') in the 900 Mhz, 2.4 Ghz and 4.8 Ghz frequency range. Each of these bands was further subdivided into some number of channels (specific frequencies) and you were allowed to operate low-power radio equipment within these bands without getting a license (i.e., unlicensed operation).

These frequency bands are collectively called the industrial, scientific and medical (ISM) band. A large number of devices share these bands including RFID scanners, cell phones, microwave ovens, cordless phones, some airport radar systems and all of your wireless Ethernet (WiFi) equipment. It is actually quite a busy and crowded place. One of the reasons for developing frequency-hopping radios was to address the problem of having lots of other equipment in the same physical proximity trying to share the same band. By "hopping" around to different channels while sending each bit in a message, the hope is that one of the channels would be clear and the data would make it through. The embedded microcomputers in all of the participating radios would agree on a pseudo-random number sequence and switch their operating frequencies among the available channels at the same time and in the same pseudo-random order.

Of course, all of those capabilities and features deal with reliability and availability, not with security, although many people mistakenly believe that frequency-hopping is a security mechanism. Radio as a transmission medium has the general problem that unless blocked or focused in some manner a radio signal will propagate outward in all directions. Hackers have an annual competition wherein they attempt to see how far away from a WiFi (IEEE 802.11) 'access point' they can be and still establish a wireless connection. The current record is about 30 miles or so, which is quite a bit further than the functional specifications for that technology would suggest. But the hackers use special high-gain antennas and amplifiers to achieve those stunning results. Sure, that's cheating, but they are HACKERS after all! The point being that hoping that no one hears your wireless communications because your plant is geographically large is probably pushing your luck.

Today, the developers of wireless technology understand the need for security mechanisms and most modern wireless technologies at least offer reasonable security features as an option, if not as an integral and mandatory function.

Yes, I said that 'today' wireless technology developers offer reasonable security features. This is a direct result of the debacle that ensued when the original IEEE 802.11 ("WiFi") was introduced and include an optional security feature set called (WEP – wired equivalent privacy.) It turned out that WEP had a number of security weaknesses and hacker tools for 'breaking' the encryption and obtaining unauthorized access into WEP-protected wireless networks were popping-up in a matter of months after WEP's introduction. So today, with any number of readily available utility programs (like 'aircrack'), it only takes a few minutes to break into a WEP-protected wireless network.

Because of the unfortunate security weakness of WEP and the rapidity with which hackers made Swiss cheese out of it, the successors in the wireless arena all made sure that they could offer a much better level of security. Even WiFi has supplanted WEP with a series of security technology improvements include WPA, WPA2 and finally IEEE 802.11i. The current wireless technology offerings – from Bluetooth and its 'personal area network' (PAN) technology all the way up to WiMAX and its 'municipal area network' (MAN) technology – all of these technologies support advanced and cryptographically 'strong' encryption algorithms, large 'key' sizes (at least 128 bits) and some level of end-point authentication. But then, for these techniques to provide protection, you DO have to enable the security features! (NOTE: For several wireless technologies, the default mode is: *No Security Features Enabled.*)

All of this information is factually accurate, and it sounds great, doesn't it? It sort of makes you wonder why anyone would use wired communications when wireless is so flexible, powerful and secure. The problem is that when you get into actual implementation of most wireless technologies you run into surprises. Also, there are number of wireless technologies to consider and, unlike men, they are not all created equal. The most popular wireless technologies being used in industrial applications and/or automation products include:

- IEEE 802.11 (often called "WiFi®") either a, b, g or now n
- IEEE 802.16 (also called "WiMAX®")
- Cellular (with three competing, incompatible underlying technologies)
- Bluetooth®
- ZigBee®
- WirelessHART®

# SECURITY SESSIONS

Each of these technologies has different implementation requirements and issues, they vary quite a bit in their officially specified usable range, and they also differ with respect to use in fixed, portable and mobile applications. A good starting point for comparison is the basic requirement for wiring. Elimination – or at least a major reduction – of wiring is often touted as a major justification for using wireless technologies. Radios (digital and otherwise) are electrical machines and they require power to operate. So do the associated sensory electronics of the wireless instrument. It is possible to have battery powered devices, but running on battery power means you can't be transmitting all the time or the battery will die. Your cell phone is battery powered, but if you make heavy use of it on a regular basis, your battery will probably only last a couple of days, at most.

Battery technology also imposes environmental limits on the wireless device applications. A battery can freeze or bake and die an early death. ZigBee allows for end devices that can be battery powered. But you should only poll them for measurements every few minutes – or even less frequently if you want adequate battery life. Even though these end devices can be wireless, they depend on powered routers to be nearby. Basically most wireless technologies still require power wiring even if they can eliminate signal wiring.

Many wireless technologies give you the best range and most reliable connectivity in high noise environments (or in situations where signal reflections, called 'multi-path distortion', are created due to lots of structural metal) when you implement them using high-gain, directional antennas. Unfortunately, directional antennas create a problem with mobile wireless applications and don't work for point-to-multipoint applications. The higher frequency signals used in unlicensed radios also mean that the cable distance allowed between the radio and the antenna is quite limited – often as short as only a few inches.

All of this means that radios usually have to be mounted with the antenna, and you need to run wire to a power source. Antennas can be mounted with vertical or horizontal polarization to improve performance, but this can also create problems for any node that can physically be mounted to accommodate that orientation. Some wireless technologies can deal with mobile operation – cellular technologies were specifically designed for this – but others don't handle this or produce unexpected results. For example, walking around with a WiFi device can automatically re-associate with other access points (AP) if they are generating a stronger signal.

This may have undesirable consequences if that AP doesn't have a path to the systems with which you were previously communicating via the prior AP. Radio equipment can also be effected by weather – including solar events – when used out of doors. When used inside a facility momentary outages can occur when equipment movement or repositioning (e.g., vehicles, cranes, etc.) blocks the signal path.

As far as interoperability and compatibility go, wireless doesn't actually fulfill that promise any better than the numerous Ethernet variations created by the conversion of proprietary serial standards into proprietary Ethernet standards. If two wireless Ethernet devices have a "WiFi" sticker then they are likely to interoperate. But each of the wireless technologies listed previously are incompatible with each other, and in fact, here in the USA we have three incompatible cellular systems, as noted previously. (Therefore, choose your carrier carefully!)

The main point here is that wireless technologies sound great on paper, but you are not going to implement them on paper; you must be able to make them actually work in your plant. People who buy a WiFi router and get it up and running often think that a similar level of effort will be needed to apply wireless technologies in an industrial setting. That rarely (okay, never in my personal experience!) ends up being the case.

Then there is still the basic argument about the actual reliability and security of using wireless communications. Wires have fewer failure modes than do electronic circuitry... but that will be the subject matter for a future column. – *Tim*.

## ABOUT THE AUTHOR

**Dr. Shaw** is a Certified Information Systems Security Professional (CISSP) and has been active in industrial automation for more than 30 years. He is the author of Computer Control of BATCH Processes and CYBERSECURITY for SCADA Systems. Shaw is a prolific writer of papers and articles on a wide range of technical topics and has also contributed to several other books. He is currently Principal & Senior Consultant for Cyber SECURITY Consulting, a consultancy practice focused on industrial automation security and technologies. Inquiries, comments or questions regarding the contents of this column and/or other security-related topics can be emailed to [timshaw4@verizon.net](mailto:timshaw4@verizon.net).

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