Information Is Power: The Intelligent Utility Network

The intelligent utility network addresses the challenges of rising energy costs, aging infrastructure and increased demand for reliability by leveraging all of the benefits of automation and digitization.

In the United States, utility industry forces are driving substantial changes in strategy for T&D businesses. The U.S. Energy Policy Act of 2005 mandates improved infrastructure and reliability. Energy costs are rising. Higher energy prices overall reduce consumer energy demand and potentially pull down utility revenue. Smart metering and demand-response programs are expanding to satisfy customer demands for conservation opportunities. Rate cases to cover increases in nonenergy-related costs are becoming more difficult to push through, making operational cost reductions more important.

The lack of investment in aging T&D assets over the past 30-plus years has resulted in major reliability and capacity problems in certain regions. Significant staff retirements over the next 10 years will remove critical knowledge and experience from utilities if not addressed.

The utility industry seeks new ways to overcome these challenges. Investments are being made by utilities in automation, remote monitoring and control systems, metering, analytics, communications and IT infrastructures, and the digitization of many of their processes. A better level of connectivity and observability across the electricity supply chain is being sought.

To achieve this, one must have common standards. Industry standards promoting connectivity continue to gain well deserved attention. There are many industry groups actively working on data model standards and communications standards such as found in the ICA, IEEE and IEC.

Industry bodies such as the IntelliGrid Consortium are moving ahead with fast simulation and modeling, distributed energy resources and consumer portal projects. The GridWise™ Alliance is progressing with grid-friendly appliances/price-sensitive control systems. Other efforts are emerging, boosted by the Energy Policy Act of 2005.

All of these factors and more are driving the era of the digital utility. Many in the industry are seeing the need and the value for these investments. The utility industry is starting to embrace its digital age and learn from the successes and failures of other industries that have digitized and automated before them. After all, information is power, which has always been the case.

RECENT DEVELOPMENTS

Intelligent grid or smart grid strategies are emerging in the electrical utility industry. These strategies are used to align and optimize grid-related investments across the utility within a common framework.

They are aimed at the development of an intelligent utility information network (IUN), which enables more real-time operational intelligence, connectivity and observability further down into the grid and across the electricity supply chain. This allows the utility to achieve greater reliability and efficiency from their assets and operations and provide a better quality of service to their customers.

Figure 1 gives an overview of some utilities and their respective investments in their modernization. There are a growing number of utilities investing in the development of an enterprise strategy. Within the context of the strategy, investments in one major functional area can be incrementally increased to gain further return for other functional areas in the utility. For example, utilities investing in AMI are taking a hard look at their communications infrastructure strategy. They assess whether there could be an incremental

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Utility	Asset	Grid Ops	Customer	IT & Comms	IUN
NSTAR	X	X		X	X
Austin Energy	X	X	X	X	X
Edison International (Southern California Edison)	X	X	X	X	X
Entergy	X	X		X	X
United Illuminating	X			X	X
Xcel Energy	X	X	X	X	X
*CenterPoint Energy	X	X	X	X	X

*Sources: Energy Central's Sierra Energy Group, CIO Report 2007 and *Market Wire, April 11, 2007*

FIGURE 1 Some Utilities Currently Working on Intelligent Utility Networks

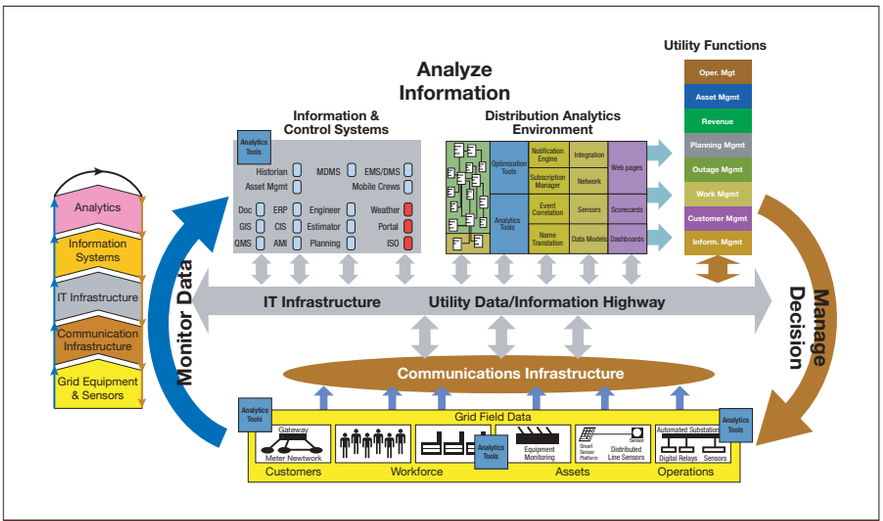

FIGURE 2 Major Blocks of an Intelligent Utility Network

investment made in communications that might benefit other functional needs.

A well-designed and well-built intelligent utility network can produce a broad range of strategic and operational benefits for the utility and its customers, depending on its focus and the business priorities of each utility. An IUN will benefit different utilities in different ways. It is not a one-size-fits-all solution.

Some common characteristics of an intelligent utility network are listed below:

- Increased use of automation and digital technologies to continue to improve reliability, efficiency and service;
- Functional area process and technology investments made as part of common interlocked utility IUN strategy;
- Common information architecture, IT and communications infrastructures, common processes and common standards across the utility;
- Common governance models required to manage IUN investments;
- More real-time grid observability smart sensors, monitors and meters;
- Tighter linkage between customers, assets and grid operations with increased customer control, services and options; and
- Increased use of analytics for decision support and automation.

An intelligent utility network can be broken down into five major blocks, as shown in Figure 2. These blocks are: grid equipment and sensors; communications infrastructure; IT infrastructure; information systems; and analytics.

An IUN is the network through which the monitoring, analysis, control and management of many of the functions of a utility will occur. It is the network through which the flood of field monitoring data streams are channeled, stored, combined, analyzed and transformed into actionable information streams and then channeled to the appropriate person or application in order to support timely decision making.

An intelligent utility network enables the ability to supply the right information, to the right person, at the right place, at the right time – in a more standard, common, cost-effective and organized fashion and can provide a higher level of observability over the entire electricity delivery supply chain system.

RETURN ON THE INTELLIGENT UTILITY NETWORK INVESTMENT

The most important element to manage in a utility is information. It is this information that is used to manage the grid, the assets and service to the customer. All this has to be done in a manner that meets the requirements of the utility leadership, the regulators and the shareholders. It is used to achieve improvements in operations, efficiency, reliability and service.

It is critical to be able to access, analyze and control information, within time frames that are required for a utility to manage and operate a real-time electrical grid. This level of challenge and coordination can only be achieved through a common intelligent utility network that connects to all parts of the utility.

If each utility function were allowed to automate and digitize independently and make investments in technologies and process improvements as it saw fit, a utility would end up with its next generation of functional silos with some vertical benefits achieved but little benefit across the utility as a whole. A major benefit of an IUN is the ability to reuse and leverage these investments across all the functional areas, as they will be based on common rules, governance, standards and infrastructures.

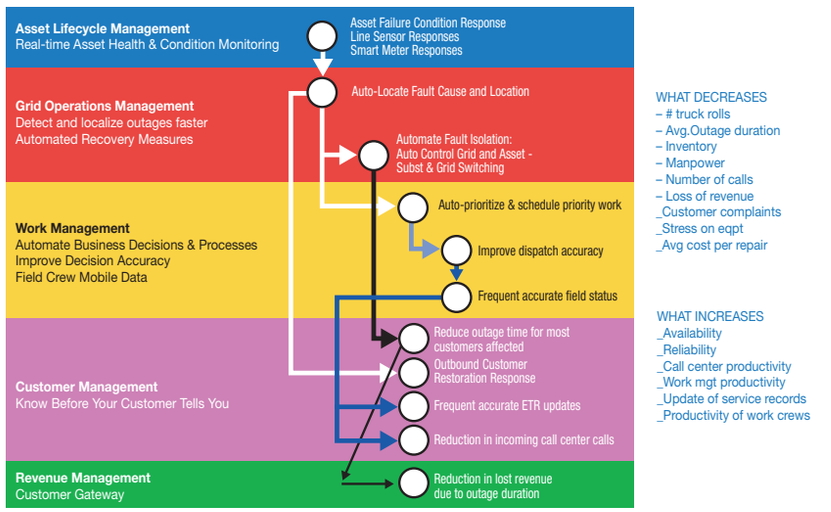

FIGURE 3 IUN Outage Restoration Example

There are many examples of IUN benefits and the value of how information can be used across a utility. Figure 3 depicts a scenario relating to an outage, real-time asset monitoring and how the initial data from the field is used by the various utility functions and the actions taken and benefits gained.

The IUN allows the utility to relate real-time asset health to grid operations through the development of equipment condition monitoring. Real-time knowledge of asset health allows the ability to sweat the assets while controlling operating risks. Strategies can be employed to increase asset life through better management and maintenance. With better information regarding risk and return, capital and O&M spending can be optimized.

From a workforce management perspective, one obvious benefit is reduction in frequency and duration of site visits through remote monitoring and configuration. When crews must be dispatched, as in the case of an outage, sensing data helps to pinpoint the location and cause, allowing crews to be better prepared and informed. With a common infrastructure for utility applications and communications, functionalities are common, data is input one time and re-used many times.

Access to accurate historical operations and asset data improves grid planning. Capital expenditures can better be optimized across the grid, allowing the utility, in many cases, to defer or minimize capital investments. More accurate design and sizing decisions for equipment to meet demand growth can be made.

The operator has fewer system blind spots, thanks to intelligent devices, sensors and meters. Faster detection, determination of cause and localization of outages is possible utilizing sensing data and analytics. Load can be better balanced and stability maintained. Power quality, reliability and fault issues can be located before they impact customers.

The intelligent meter is a portal to the consumer. It provides a profile of customer usage. Connect-and-disconnect as well as load control can be accomplished remotely. Time-based rates are enabled. The operator has another intelligent sensor on the grid. For the customer, this means more choices about price and service, less intrusion and more information with which to manage consumption, cost and other decisions. This is certain to make regulators happy.

PLANNING AND DEVELOPMENT

A strategic focus should be applied. A comprehensive approach to the development, support and validation can yield a blueprint for the development of the IUN.

Stage 1: Launch

The strategy is the end state – not the next step. Pursuing incremental steps without the benefit of the bigger picture can lead to fragmented, suboptimal solutions. Conversely, utilities often are overwhelmed by the enormity of the transformation and abandon it. Implementation can be incremental and spread over time, as long as each step is a part of the larger strategy.

The key to strategy development is to focus on how the intelligent utility network can enable your T&D strategy; then determine which capabilities will be required to achieve the strategy. Considering these required capabilities, what are your capability gaps? Finally, what are the enablers for addressing these gaps and establishing the required capabilities? With these insights, the utility can establish strategic goals, along with process or investment strategies.

A road map development is an iterative process with four steps:

- Road map development starts with consideration of the "as is" state of the utility, with respect to the five blocks of the IUN as previously discussed, as well as organizational structure, utility constraints, data flow models, current/planned projects, current standards and governance models in effect;
- A development of the "to be" state and the gap from the "as is" state determine the high-level applications, timeline, architecture and design specifications, based on technical requirements, resource availability, constraints and desired benefit timing;
- Costs and benefits are then estimated based on equipment/labor costs and the timing of benefits realization; and
- Finally, costs and benefits drive the business cases for the implementation options to build out.

The portfolio of business cases needed to support the realization of a strategy should meet the needs of four key stakeholders, and can take several months to complete. Senior management and Wall Street will focus on ROI and financial risks. Internal utility functions need to see how the IUN will provide them with benefits so each can

be convinced to provide an appropriate share of the funding. Customers should understand how it might provide them with improved service, increased reliability and new products and services options. Regulators will focus on increased reliability, capabilities for time-of-use pricing and other new pricing options, and higher customer satisfaction.

Stage 2: Pilot and Validate

Pilot projects are used to validate and mitigate technological, system and project risks associated with the development of an intelligent utility network. Pilot projects are also used to better validate costs. The pilot projects can reach from a single proof point to the implementation of part of an IUN to a limited small-scale deployment, for example, in a neighborhood. The types of piloting required depend on the flavor of the intelligent utility network being planned by the utility. It could be asset-centric, customer-centric, operations-centric or all three. These types of projects are also a very good means for demonstrating benefits to employees, management, customers and regulators.

The utility should establish a formal benefits realization framework and governance structure in the pilot-and-validate stage and keep it in place throughout execution, to provide the governance, processes and reporting needed to drive the business case benefits.

Stage 3: Align

It is imperative to selectively transform your processes and organization to align with and take the maximum advantage of the availability of an intelligent utility information network while it is being built out across the organization. Do not underestimate the planning and efforts required to manage such change in the organization. Change management is a very significant part of developing a strategy. When employees are made part of the design of the intelligent utility network and embrace its information riches, then it will be a success.

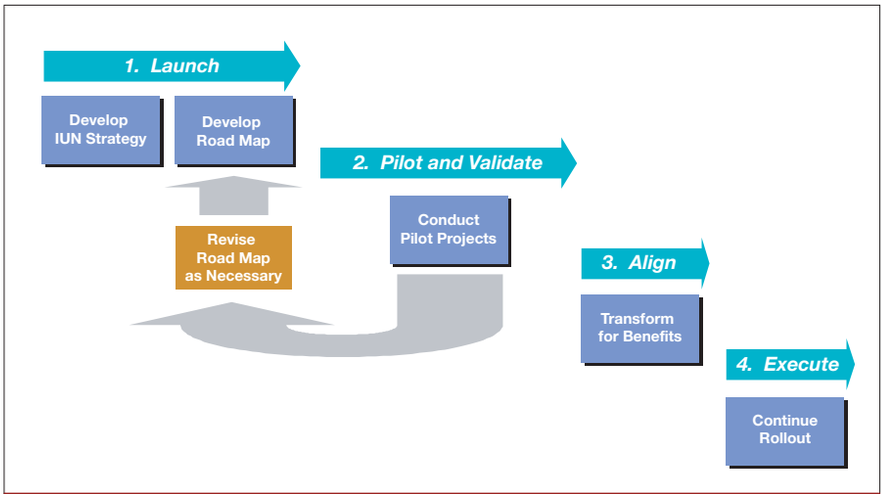

FIGURE 4 Stages of an IUN

Stage 4: Execute

Execution builds on the pilots with a series of projects that are carefully planned, sequenced and coordinated based on the road map. Figure 4 illustrates the complete process from launch through execution. The big-bang approach will not work; this is evolution, not revolution. Careful road map development and project management is essential. Pilots will resolve uncertainties and doubts. Benefits realization will ensure that business case commitments are attained. Change management will assist in driving the necessary transformation.

CONCLUSION

The intelligent utility network is now becoming a reality. More and more utilities are developing and implementing modernization strategies. Government and regulatory entities are embracing the IUN as a means to mitigate growing energy costs. Soon the intelligent utility network will be the standard model for all operators to meet.

The change will be transformational and essential. To address the imminent challenges of rising energy costs, aging infrastructure and increased demand for reliability, the electrical utility industry, like other industries before, will adopt automation and digitization in order to continue to improve reliability, efficiency and service to its customers. ■