Technology Planning to Maximize your Investment

By: Rick A. Schmidt
and Candice M. Roth

Contact:
Rick A. Schmidt
Power System Engineering, Inc.
Phone: 608-268-3502 E-mail: schmidtr@powersystem.org
www.powersystem.org

This paper addresses techniques for utilities to drive greater benefits out of their automation-related technology deployments.

One of the first steps in deciding to deploy new technology is to start with a good plan for which automation programs to deploy first, second, third, etc. Sometimes utilities have elected to deploy a given technology because of the industry hype, board mandates, or from good sales pitches from vendors. There is, of course, a better approach.

Power System Engineering, Inc. (PSE) (www.powersystem.org) developed a planning process called a Technology Work Plan (TWP). The goal of a TWP is to identify the applications and technologies that will provide the best value and to develop an implementation plan that ensures success.

It does not take much of a miscue on a technology project (e.g., less than optimal design, wrong choice of technology or vendor, or ineffective contracting) to quickly waste substantial dollars, time, and resources. With a TWP in place, utilities can rest assured that their decisions are backed by a conscientiously examined strategy.

The TWP should:

1. Review the utility's existing strategic plan.

2. Identify objectives, needs, and requirements.

3. Create conceptual designs: an overall automation plan and multi-year strategy, a high-level view of what any new "system" will look like, an application integration approach, and an evaluation of fit with daily operations.

4. Generate feasibility-level business cases for a variety of applications.

5. Establish priorities.

6. Determine implementation methods: tasks, schedule, possible suppliers, staffing, and key performance measures.

Electric and water utilities use many applications and technologies, and they typically work each year to improve their capabilities in one or more areas. A TWP will typically first cover the "big picture" (showing many applications at a high level) and then cover priority applications and technologies in more detail.

The Smart Grid

TWPs integrate the "smart grid," a concept of ever-increasing popularity. Generally speaking, the term "smart grid" refers to an advanced state of utility system infrastructure, operation, and processes. Discussion of the subject ranges from advanced metering infrastructure (AMI), Demand Response, Feeder Automation, and advanced grid optimization. The smart grid advances the level of intelligence in a utility's operation to include not only traditional "grid" aspects of the field, but also enterprise systems and processes such as CIS, work management, rates, and other future applications.

Smart grids vary in their level of sophistication and intelligence, and are accordingly often referred to in terms of "smart," "smarter," and "smartest." Highly automated, integrated systems, capable of self-healing, are ideal; nonetheless, more basic smart grids may be possible and within reach of some smaller utilities. Thus, the definition of smart grid is somewhat dependent on the utility's present infrastructure, application needs, and vision.

What are the Common Themes of the Smart Grid?

The common themes of any smart grid design include:

1. The need for automatic collection of data from multiple applications throughout the utility network, including end user premises. While the *smartest* grids will include end-user premises, this is not a prerequisite for a *smarter* grid.

2. New investments in the core electric distribution facilities to take on more load and to provide bi-directional back-feeding between switching points.

3. The need for adaptive integrated communication mediums that can handle data from multiple applications located throughout the utility infrastructure.

4. The need for integration of application software suites so they share collected data in common dynamic databases.

5. An incremental improvement approach versus the "big-bang" approach.

Figures 1 and 2 illustrate the key concepts of a smart grid approach to utility infrastructure.

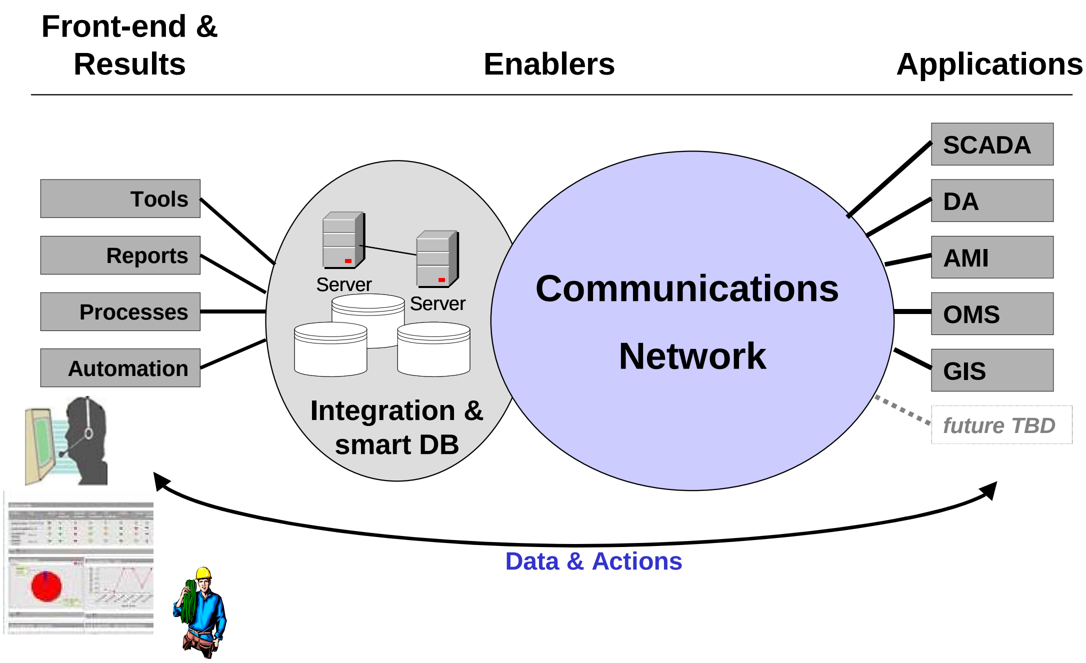

Figure 1 – Overview of Smart Grid Orientation

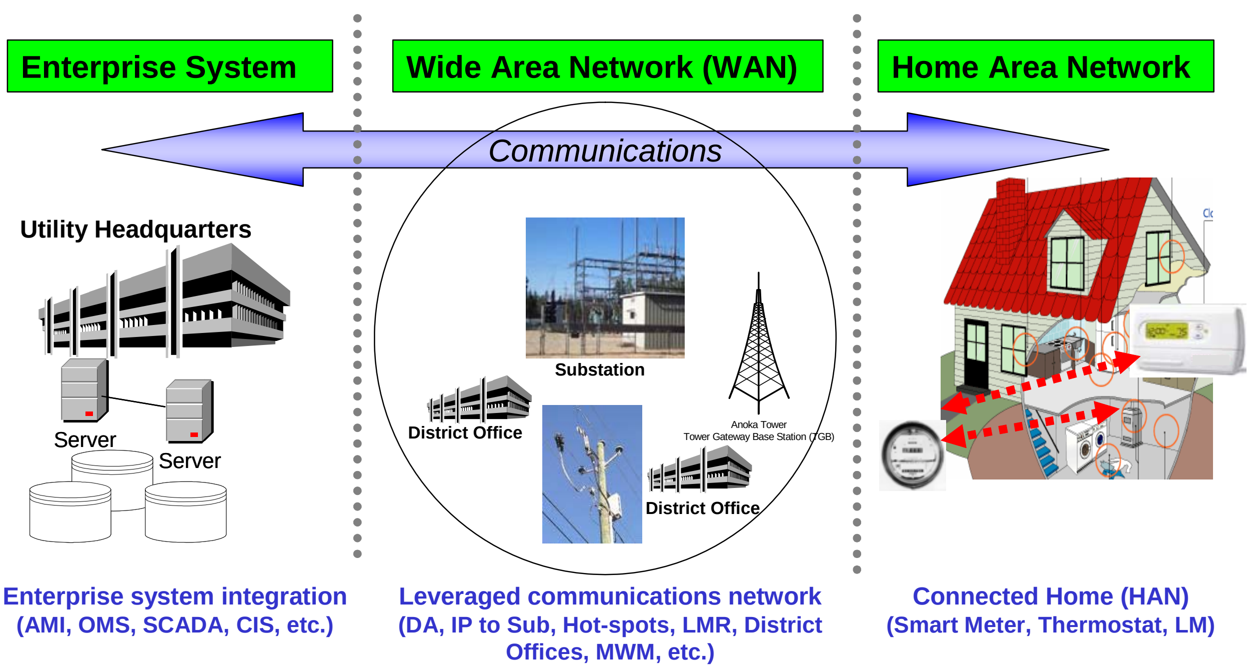

Figure 2 – Overview of Smart Grid

Getting Started with Smart Grid/TWP: How Does one Create a Roadmap and Prioritize?

1. Establish the Precedent & Stakeholder Buy-in

It starts with a strategic desire, shared by all functional stakeholders, to shift from the past. In the past, utility system plans developed a unique infrastructure for each application that was implemented. Given the Wide Area Networking communication challenges and proprietary protocols of the past, this approach was understandable. New applications typically benefited one of the utility's functional groups more than others. This approach creates silos in the organization, which means that each functional group has its own isolated information storage area.

However, although the system was designed with the expectation that only one functional group would need a particular type of information, often multiple functional groups end up gathering that same information on their own, and storing it in their own isolated "silo."

Shifting the utility culture from a functional or "silo" organization to a shared infrastructure is the first step in implementing a smart grid. This step is probably the most challenging; however, it is the key to leveraging both the infrastructure and operational data. This step may need to be driven by the Board of Directors and the Executive staff at the utility. Figure 2 (shown above) illustrates the change in strategy and culture that will help to develop a smart grid approach.

2. Conduct Needs Analysis & Develop a Strategic Plan

The next step is to perform a needs analysis that identifies the applications that will drive the utility toward its operational excellence goal. The needs analysis should be developed by all stakeholders, and can include regulatory boards, engineering, operations, IT, accounting, customer service, generation, and even the retail customers. A rolling 5-10 year strategic plan, updated annually, will keep the strategic plan current and also will help keep stakeholders focused on implementing the plan. Figure 3 below illustrates this process, as well as the follow-on steps.

Developing a Strategic Technology Plan

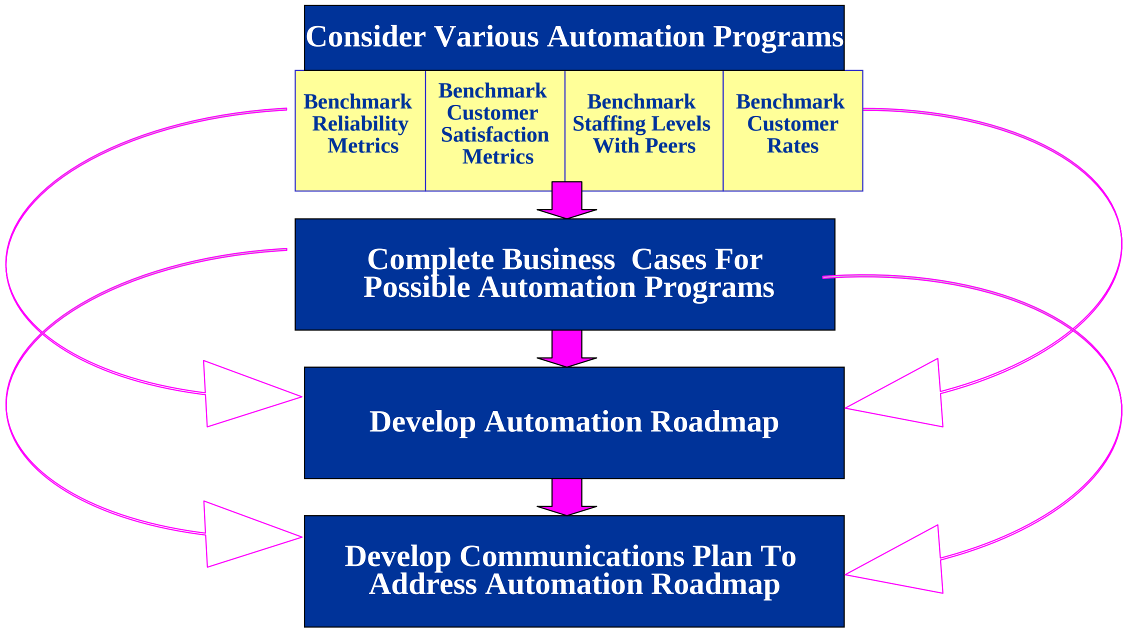

Figure 3: Next Steps for Smart Grid

3. Develop a Technology Work Plan

Implementing the strategic plan typically requires changes to the present applications and systems used at the utility. The best tool for a structured implementation of this new application and system technology is a TWP.

The TWP reviews the utility's existing strategic plan, identifies possible technology gaps, inventories the current technology, evaluates the utility's plans for future technology, and develops budgets and deployment schedules based on justified business cases for the new applications. The TWP also validates that all the utility's stakeholders' requirements are being addressed.

The utility should identify priorities during the first phase of the project. It is useful to gather information on applications including benefits, typical costs, alternatives, pros/cons, resource needs, and risks. Below is a list of the possible applications to investigate in your TWP:

- Supervisory Control and Data Acquisition (SCADA)
- Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI)
- Load Management and new Demand Response opportunities
- Geographic Information Systems (GIS)
- Automated Staking
- Outage Management Systems (OMS)
- Interactive Voice Response (IVR)

- Mobile Workforce Management (MWM)
- Automatic Vehicle Location (AVL)
- Work Management
- Distribution Automation (DA)
- Substation Automation
- Mobile Voice and/or Mobile Data Communications
- Fixed Data Communications (e.g., wireless solutions, fiber optic, satellite, power line carrier, BPL)
- Wind Generation opportunities

Some of the benefits of a TWP include:

1. **Saving money**: Substantial savings can be realized and losses prevented by avoiding costly mistakes.

2. **Saving resources**: Looking at the big picture in the beginning can save time and resources in the end.

3. **Setting Priorities:** At the conclusion of the TWP, you will have an understanding of the order in which you should implement different technologies. For example, the TWP illustrates the pros and cons of deploying an OMS prior to AMI or GIS.

4. **A Yearly Plan:** Determine the best mix of technologies to deploy during each calendar year based on a high-level feasibility assessment. This combines a review of the costs, cost savings, areas of improvement, resources required to deploy, and other factors.

5. **Budget Breakdown:** The TWP will create a budget breakdown for each application, which will help your utility prepare for year-end budgeting.

It is recommended to update the TWP annually to address details for the next budget year. In a sense, you plan "just in time" design. With this approach, technology planning, design, and budgeting is not a one-time large effort but rather a way of doing business.

Typical tasks involved in completing a TWP during the first year include:

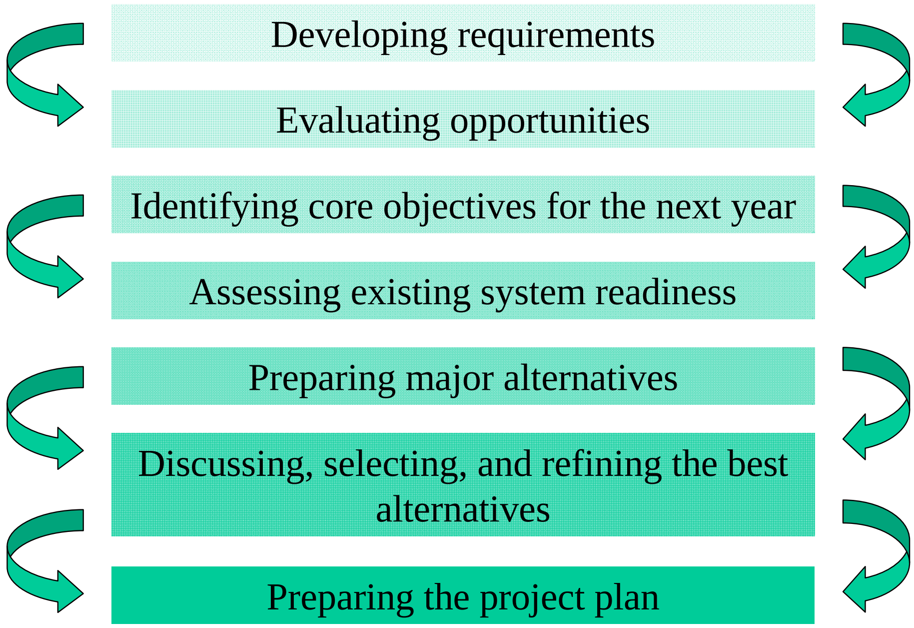

Figure 4: TWP Tasks

4. Develop a Strategic Communications Plan

The next and final step is a Strategic Communications Plan (SCP). The SCP focuses on integrating communications to leverage the utility's communications infrastructure for present and future applications. This final planning stage is crucial to implementing a smart grid; the communications infrastructure is in fact the very foundation of a smart grid.

Electric utilities experience communications challenges due to large geographic territories, the need for extremely reliable communications at the most inopportune times (during and after major storms or disasters), and idiosyncratic challenges based on local terrain and frequency availability, for example. Unfortunately, an SCP is often an afterthought once the application technology has been procured or even deployed. However, utilities that create an SCP upfront have greater success in deploying planned (and even unplanned) applications. These utilities have also been able justify more dynamic communications infrastructure (and associated process improvements) because they are able to spread the communications capital expenditure across multiple applications. Similarly, utilities may be able to reduce overall recurring communications costs by, for example, flowing multiple applications through the same communications pipe versus paying monthly telco costs for separate AMR lines, SCADA lines, and LMR backbone lines.

5. Develop an Integration Plan

Developing an application-level integration plan upfront as part of the TWP/Smart Grid plan for both existing and future applications will make it much easier to select the most appropriate products for the various applications. Some of the products are so called "more open" or "more compatible" with other products for integration, and this is uncovered as the plan is developed.

There are several approaches for integrating various applications and there are dozens of vendors to choose from. Some vendors have a single product line such as a Staking and Design or Outage Management software suite. Some large vendors offer many different software suites, e.g. OMS, GIS, MWM, AVL, etc.

Some utilities elect to pursue a "Best in Class" vendor for each application; some choose to pursue one primary vendor for many applications. The choice depends on each utility's unique situation. It is critical to have a clear roadmap for how the future applications will be integrated prior to selecting a vendor and buying those future applications. For example, one has to have a plan for how an OMS would be integrated with the AMI prior to selecting the OMS, IVR, GIS vendor, etc.

6. Understand your Roadmap & Move Forward

Documented, successful smart grid programs all start with a technology roadmap. The planning steps described above will guide your utility through the development of that roadmap.

Once the technology roadmap is in place, procurement, deployment, and integration of the applications become fairly straightforward. Creating a smart grid is not extremely mysterious. It all comes down to deploying the technology that best leverages the communications, data, and applications across all functional groups within the utility.

The key is to plan upfront for the future and to realize that the process is always evolving. As a concluding thought, the TWP could be considered planning for a "smart*er* grid," since any smart grid can always become smarter.

Examples of Maximizing Technology Deployments

AMR/AMI: Most utilities that have deployed two-way AMI technology in the last two years have done so with the intention of deploying many programs beyond basic meter reading. We are now starting to see the applications beyond meter reading starting to materialize.

The utilities that have deployed one-way drive by technology have limited potential to add advanced two-way functionality. It does not mean that the one-way drive-by technology is poor, but the technology may need to depreciate prior to advancing to AMI. For example, the business case for two-way AMI is much stronger for utilities without a present drive-by program. Many other automation opportunities exist in the near term for the utilities that have one-way drive-by AMR such as SCADA, GIS, OMS, and new mobile data technology.

The chart below lists some of the applications that are now being deployed with two-way AMI technology.

	Reduce Costs	Improve Cust. Service	Productivity Improvements
Capturing individual load contribution during system peak conditions	X	X	X
Evaluate transformer loading	X		
Developing load shapes for customer classes		X	X
Voltage monitoring	X	X	
Identifying system blinks & power quality	X	X	
Monitor system conditions during load transfers	X	X	
Track phase changes and phase verification	X		
Critical Peak Pricing (CPP)		X	X
DG & Net Metering	X	X	X
Reduce theft of service	X	X	X
Distribution Automation (DA)	X	X	
Time of Use rates (TOU)	X	X	X
Remote disconnect/reconnect	X	X	X
Load Management (LM)	X	X	X

Figure 5: AMI Benefits Beyond Basic Metering

In an AMI business case, the overall benefits of AMI beyond meter reading are forecasted over a 15-year period for areas such as service representative cost savings, benefits relating to meter accuracy, etc. The results will vary utility-to-utility, but the chart below reflects the weighting of benefits by type. We omitted the benefits tied to demand response and load management due to the large variance utility-to-utility.

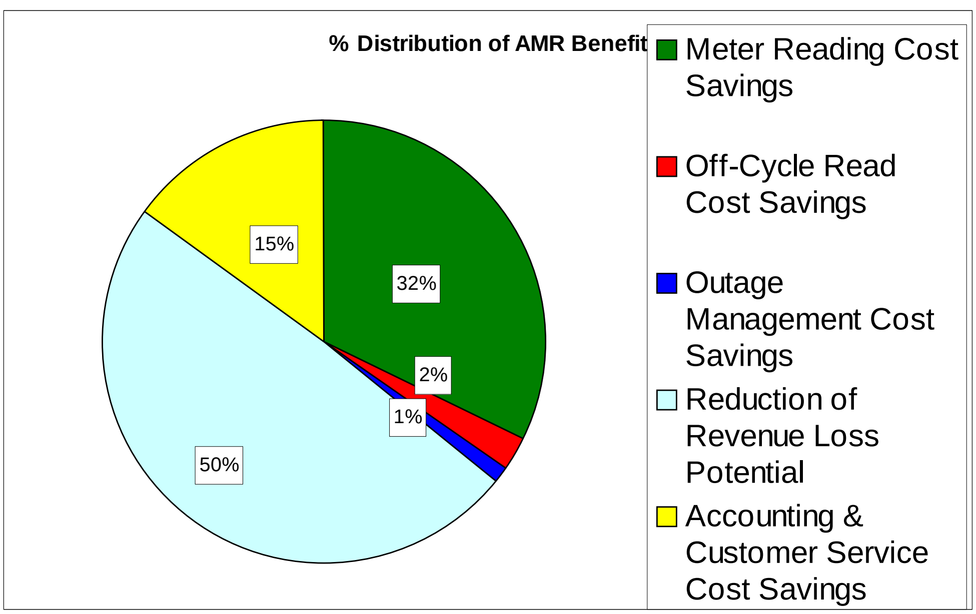

Figure 6: Distribution of AMI Benefits

GIS/OMS/IVR: A GIS is much more than an electronic map of the service territory. It has become the wheel, and many other systems/applications become the spokes. The GIS has become the repository of many applications and can be integrated with the following systems and common work practices:

1. Financial Information System (FIS) –assembly units.
2. Staking – mapping extension information.
3. Map Viewer – web based.
4. Map Viewer – vehicle based.
5. Engineering analysis software.
6. Outage analysis software.
7. Automated metering – showing transformer loading, blinks, outages, etc.
8. Work management and AVL systems.

One of the best ways to drive the most benefits of many of the new automation technology investments is to develop a clear vision and roadmap for how best to leverage the GIS across many applications. For every extra system that the GIS touches, the benefits just keep on multiplying.

GIS Benefits

In a recent business case for GIS, PSE included the following as benefits and future programs planned for the GIS:

1. Reducing cost of printing electronic maps.
2. Creating new service estimates.
3. Performing outage analysis.
4. Changing or updating tax district information in member records.
5. Continuing property record maintenance.
6. Handling paper updates, files research, responding to public requests for information, etc.
7. Finding UG cable location (past and present).
8. Updating maps and making corrections.

9. Staking.

10. Integrating and exporting to the Milsoft model.

11. Verifying CPR records.

12. Completing facility-aging studies.

13. Tracking annual line patrol repairs and history.

14. Generating an immediate material list for large segments of line during emergency situations.

15. Generating an immediate cost estimates for large segments of line during emergencies for FEMA.

16. Improving asset management.

What does an OMS do? An OMS is a system for analyzing outage notification data and distribution system connectivity data to determine the cause and location of outages.

There are benefits of deploying an OMS without a GIS but the benefits are multiplied when adding a GIS with the OMS. Without the GIS, the dispatcher or technician views a tabular screen with predicted outage information. With a GIS, the utility service territory map is lit up with graphical information as indicated below. The diagram below reflects the OMS searching for the common open point based on outage information entered into the OMS.

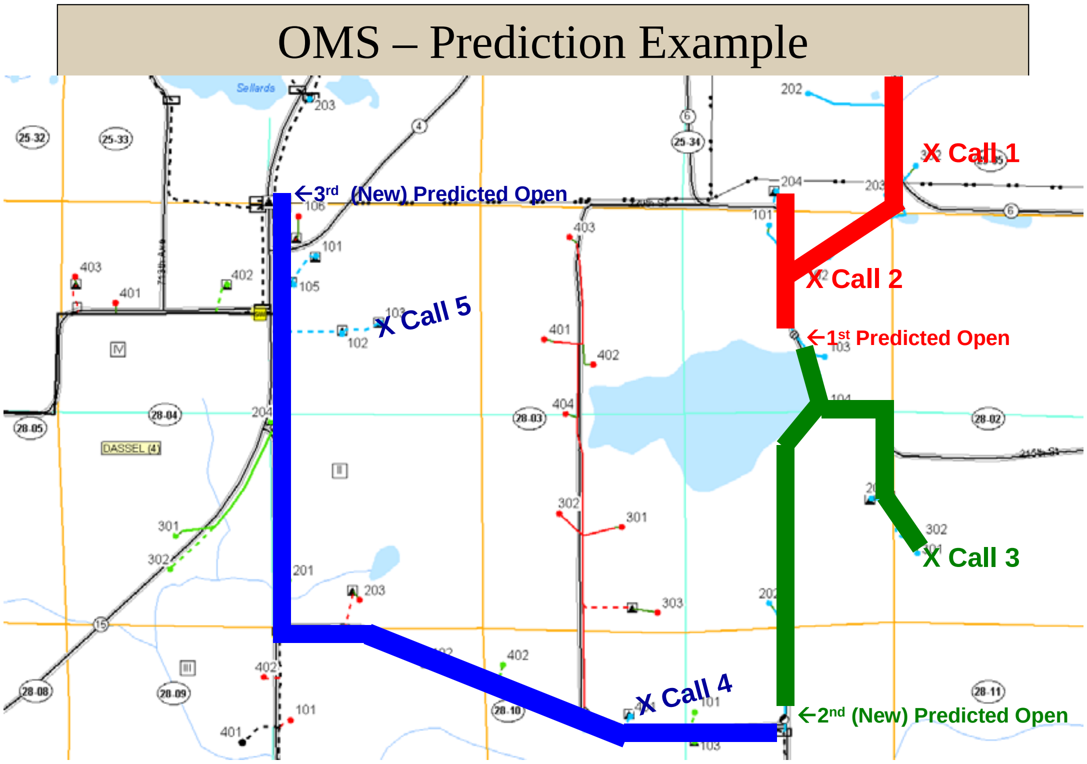

Figure 7: OMS Prediction Model

What happens when the IVR is added to the OMS and GIS?

Most utilities build a database with the home and cell phone numbers of their customers. When customers call in to report an outage, the GIS database is populated to reflect the locations of outages on the GIS map. The OMS then begins to predict the location of the open point. The figure below reflects what happens when a customer calls the utility to report an outage.

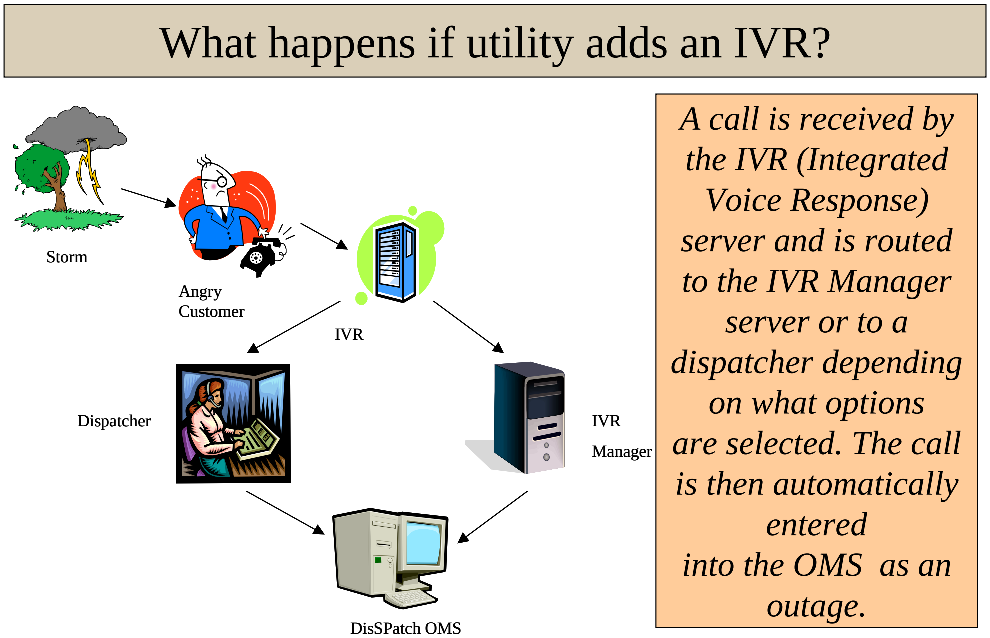

Figure 8: Adding an IVR to OMS

AMI, OMS, GIS, and IVR

Further benefits can be maximized when adding AMI to the OMS, GIS, and IVR. This is being done on a regular basis, even for small- and mid-sized utilities, through the integration capabilities of the MultiSpeak integration standard. With these systems integrated, the dispatcher can:

1. Look at a screen that reflects outages of the metering points with outages based on the call-in records from the IVR.

2. Predict the source of the open point with the use of the OMS.

3. Ping the meters to verify where the outages are.

4. Ping the meter area again, after the outage appears to be resolved, to make sure the outages have been resolved prior to leaving the area.

This process flow is highlighted below.

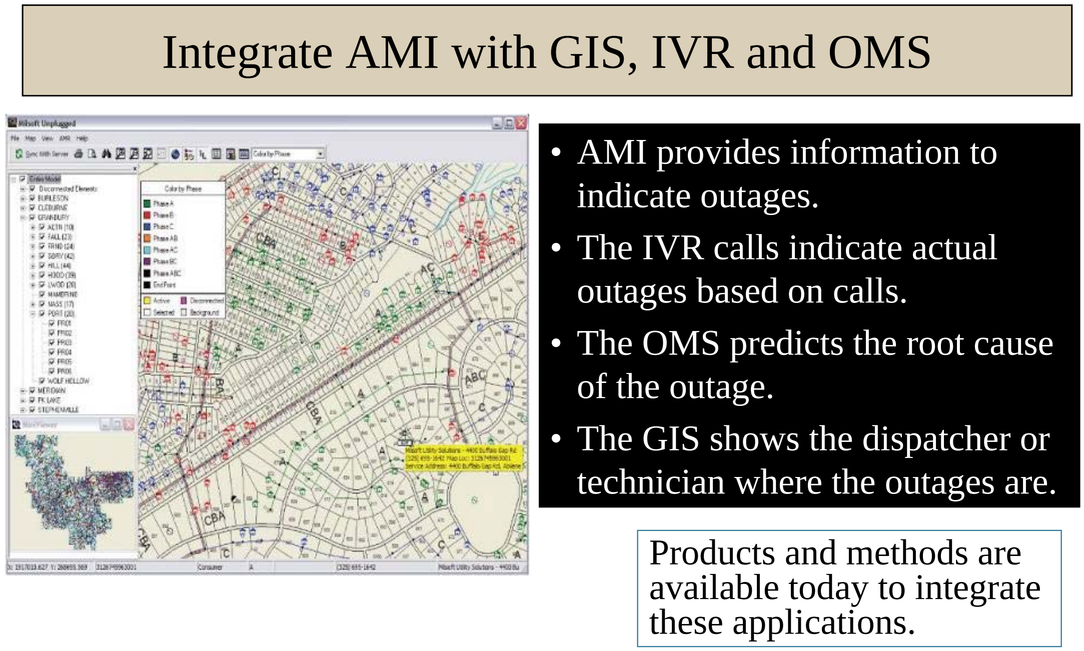

Figure 9: Combining AMI with IVR, OMS, and GIS

MWM and AVL services are additional programs that can be added to the GIS to extend benefits to other applications.

Shared Communications Infrastructure: Many utilities are starting to see the benefits of building a communications infrastructure that can be shared with many programs and applications. We are now seeing a need to have several applications at substations requiring communications from SCADA, AMI, direct connect to IEDs, relay protection, and mobile data hotspots. There are new needs for mobile voice systems and mobile data systems. Therefore, the technology plan will define what type of communications infrastructure, backbone, and other media is required in the future. It is much more cost-effective to share the communications infrastructure for many applications. The diagram below reflects this opportunity.

Approach for Communication Projects

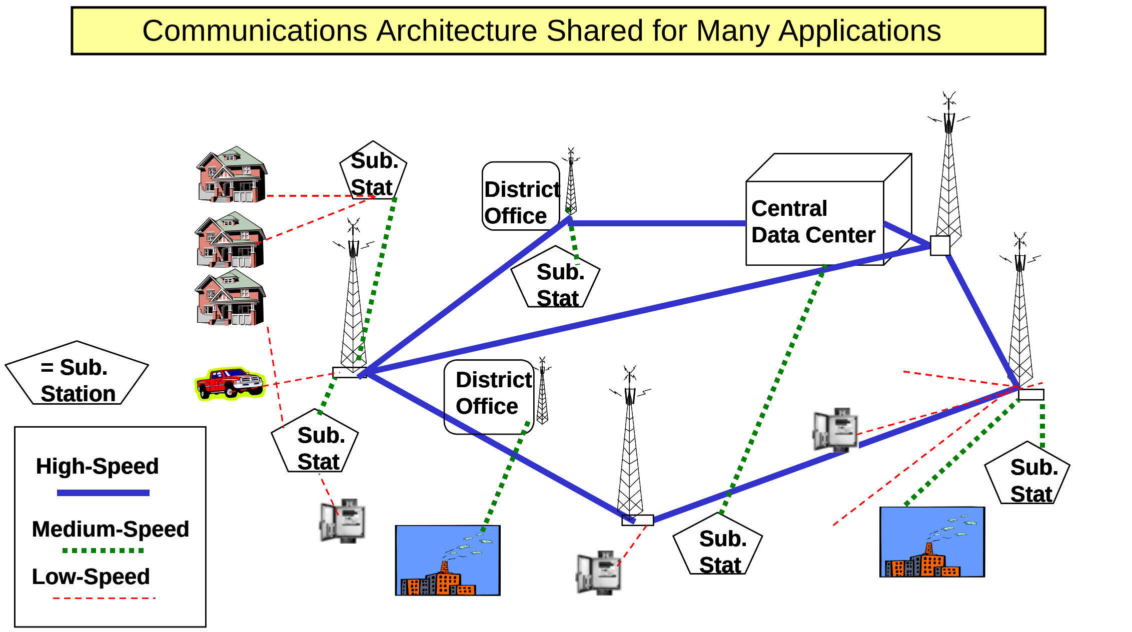

Figure 10: A Smart Grid Communications Plan

Summary of Opportunities

Much can be done to extend benefits and get the most out of your technology investments. It all starts with a vision from senior management, a good plan, a roadmap, and a lot of hard work. It won't be easy, but it can be done with a step-by-step process.

Caribbean Client Experience

Rick has provided consulting for technology planning, procurement and deployment projects for the US Virgin Islands Water and Power Authority. Rick has completed business planning for AMI, SCADA, DA, and communication related initiatives. Presently, PSE is supporting the USVI WAPA with their SCADA deployment.

About Power System Engineering

Power System Engineering, Inc. (PSE) is a full-service, independent consulting firm for electric utilities. Our clients include distribution cooperatives, generation and transmission cooperatives, investor-owned utilities, municipal utilities, public utility districts, and industry associations. The professionals at PSE include engineers, IT and communication experts, economists, and financial analysts. The PSE team has extensive experience in all facets of the utility industry. PSE is employee-owned and 100% vendor independent, with offices in Minneapolis, MN; Madison, WI; Indianapolis, IN; and Marietta, OH.

Lead Author Biography:

Rick A. Schmidt: Rick leads the System Design and Communications Department at Power System Engineering. Rick and his staff provide automation and communication consulting and engineering services to utilities, including: Technology Work Plans, strategic communications plans, procurement, design and project management of SCADA, DA, substation automation and design, AMI, demand response, GIS, MWM, AVL, OMS, IVR, and a variety of communication areas, including Land Mobile Radio, fiber and microwave backbones, mobile data, etc. Rick has over 25 years of professional experience and has an MBA from Cardinal Stritch University in Milwaukee, WI.

