Life Cycle Planning for Smart Grid Technologies

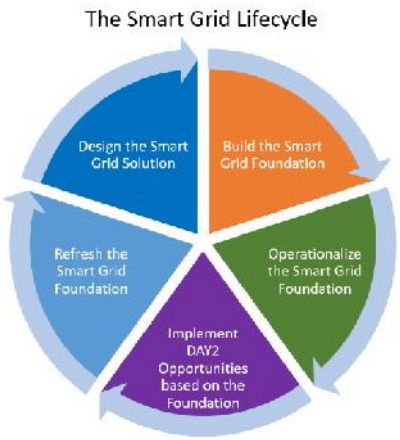
Introduction

Utilities continue to make significant investments in Advanced Metering Infrastructure (AMI), Outage Management Systems (OMS), Outage Communication Systems (OCS), Meter Data Management Systems (MDMS), Customer Data Presentment (a.k.a. Customer Web Portals), Supervisory Control and Data Acquisition (SCADA) and related intelligent grid infrastructure systems and projects. The implementation of these smart grid projects typically represents a significant, focused effort that results in a functional system that is "completed" and becomes "operational". Yet the story doesn't stop there, it's just getting started. In fact, the effort to maintain, sustain and successfully operate these systems is often as significant an endeavor as was the initial implementation. Life cycle planning provides the process to help ensure sustaining success.

Initial Project Implementation

The sheer size, complexity, duration and risks associated with initial implementation of smart grid projects typically results in a very high degree of corporate focus and attention to the classic parameters of cost, resource, schedule, benefits measurement or realization, and risk management. A range of sophisticated metrics and measures to monitor these, and many other parameters, are established and accounted for throughout the implementation process. And, upon completion of some or all of the "phases" of implementation, the solution is deemed "operational". At such junctures, it is not uncommon that responsibility for daily care, feeding and operation begins transitioning to the operating organizations which derive key benefits from the solution, or to a smaller team within those organizations who acquire the unique skills needed to do so.

So, the project is now deemed successful and implementation is "over". Key sponsors and stakeholders have met the business, customer and performance metrics associated with the project. The implementation team moves on to other activities. The company is ready to turn its attention to other projects and pressing issues, and the "big spend" is over, theoretically freeing time, attention, resources and funding for other priorities. The solution is "operational". The "big money" and effort has been expended. It's time to move on to the next priority – or is it?



Let's explore the next stage of the smart grid life cycle, the planning effort associated with these investments, and perhaps redefine the definition of what success will continue to mean for the organization.

Life After Project Implementation: Re-defining Success

Let's use an Advanced Metering Infrastructure (AMI) project as the baseline for this discussion.

The AMI solution, along with the supporting distribution communications and information technologies, consists of hardware, software and programmatic interfaces that typically includes:

- Electric, gas and/or water meters

- Electric and gas AMI communications modules
- Water encoder/registers and AMI communications modules
- AMI network equipment
- AMI communications and backhaul technologies
- A vendor provided AMI "head end" solution, consisting of multiple applications from system operation, data collection, events and alarm monitoring, network management, end point device management, software/firmware management, etc.
- Middleware and/or application program interfaces (APIs) to other systems including OMS, MDMS, customer data presentment, etc.
- AMI disaster recovery architecture

The ongoing sustaining operation, care and feeding of these components and the integrated solution they form outlives the initial project implementation and declaration of success. However, the highly focused effort that was previously mobilized for the project implementation has moved on. Left on its own to fend for success, the supporting and operating teams to whom operational responsibility has been designated must now gear up for the long haul.

Success is now redefined as how well the AMI solution is able to function in an integrated, seamless, consistent and error free manner in support of the way that business is now conducted. The field forces, for example, that once performed manual disconnects for non-pay and re-connects for new service – are now a shadow of their former selves – it's the AMI system's job, and the operations team behind it, to see that these activities are successfully performed.

The Goals of Life Cycle Planning

Let's continue to use the AMI solution for illustration.

Implementation of the initial AMI system necessitated the adoption of a number of structured approaches, including:

- The decision to contract with one or more providers for the provision of hardware, software and application components.
- The decision to adopt "in-house", "hosted", or "cloud based" solutions, or perhaps a hybrid of these.
- The decision to utilize in-house technical and field personnel, contract personnel, or perhaps a hybrid of both.

Furthermore, the implementation may have been contractually performed by the utility itself, or perhaps under a "turnkey" contract arrangement, a "Managed Services" approach, and/or some hybrid of these.

Together, these decisions created the structure needed to complete the delivery of the AMI enterprise solution – which has now been deemed "operational".

Now that the AMI system has now been transitioned to operations, new questions need to be asked:

- Which of these structures will remain the same?
- Which of these structures will require change?

- Which hybrid combinations of these will be utilized going forward to assure successful, sustaining operations?
- Which of these can be "retired" since they no longer contribute to the sustaining operation?
- What business processes are required for success?
- What level of staffing and training is required for success?
- What level of funding is required to sustain whatever combination of people, contracts and solutions that are selected for long term operation?

Life cycle planning is now accelerated to the forefront to provide a mechanism for the utility to prepare and plan for the life cycle financial forecasts, resources, people and processes necessary to support the sustaining management of its AMI or smart grid investment.

Understanding Your Solution

Transition to sustaining operations is approached in a similar manner as project implementation, albeit with a different expected outcome. Let's explore five key areas required for operational success.

Understanding Your Assets. Identification and understanding of both the fixed and dynamic elements of the solution that will need to be actively managed throughout their expected life cycle is necessary. This ensures high quality, cost effective, and best in class smart grid solution delivery that meets or exceeds the utility's contractual, operational and business requirements. What elements are static? What elements will change or evolve? This information will assist in determining what elements of the solutions will need to be actively managed over the lifespan of the integrated smart grid solution.

Life Expectancy. The utility must determine the expected lifespan of key components (assets) of the solution. Such determination will require not only working with internal subject matter experts, but may also require the utility to work with other utilities and key vendors, manufacturers and partners. Knowledge of the certification processes used by vendors and manufacturers, for example, is a key component to assist in such determination. Examination of documented or expected device failures, including returned product to manufacturer (a.k.a. RMA) documentation and failure analyses, yields additional valuable information. Industry expertise to understand the role that obsolescence plays may also aid in such determinations.

The Solution Roadmap. The utility will need to examine the smart grid solution providers' roadmaps to understand the impacts of the evolution of the vendor technologies as they progresses through various generations or maturation of its technology. Of particular interest, for example, would be a clear understanding of the impact of future generations of the AMI vendor's technology and how such future generations will impact the long term operability, backward compatibility, and migration therein of the current generations of technology installed at the utility.

Partnerships. The utility will need to carefully evaluate its contracts, its in house service providers, the potential for renewal of existing contracts or execution of new contracts, and/or the decision to pull in-house some services which may have been previously out-sourced, or vice-versa. A clear understanding of vendor contracts, Service Level Agreements (SLAs), and other relevant working arrangements are important inputs to this process.

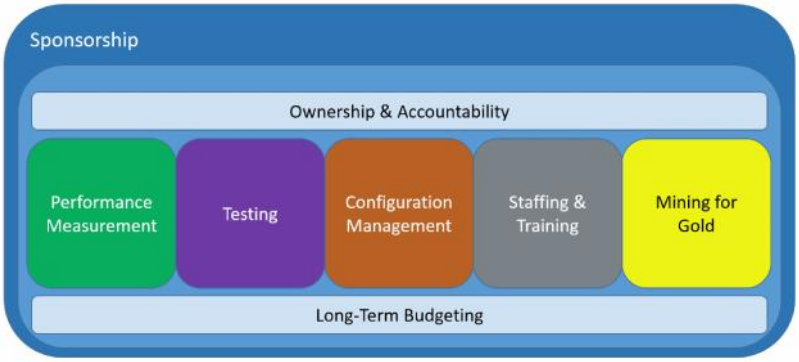
Teamwork and Collaboration. The team will need to work collaboratively with its vendor solution partners and conduct its activities in close collaboration with key utility personnel. Depending on the smart grid solution, collaboration with organizations might include:

- Electric, gas and/or water meter and field operations
- Distribution Engineering and Operations
- Field Services
- Billing and Customer Services
- System (distribution, transmission) operations
- Information Technology (IT)
- Telecommunications & Network Operations
- Controller/Finance
- Asset Management
- Security Team
- Former project implementation team members (if available)

The knowledge gained through these efforts serves as key inputs to the life cycle framework.

Implementing the Smart Grid Life Cycle Framework: Putting the Pieces Together

Armed with a firm understanding of its solution and a clearer understanding of its operational direction, the team can now utilize the smart grid life cycle framework to articulate the people, process and funding needed for long term operational success.



1) Sponsorship. Engage your sponsor. With the transition to sustaining operations, your sponsor may come from a different part of the business than the original implementation effort. Your sponsor is key to helping tell the story throughout the utility and securing the resources (budgets, people) needed to assure sustaining success using the new smart grid investments.

2) Ownership & Accountability. As is apparent above, smart grid solutions are complex systems whose success relies on support that spans multiple organizations. But, the buck has to stop somewhere, and someone or some organization needs to "own" the solution. Establishing this ownership and accountability is essential to assure sustaining success.

   - Clear roles and responsibilities must be defined for all aspects of smart grid solutions.

   - Business processes that define how work is accomplished and how problems are to be resolved in the smart grid-enabled world must be in place.

- Systematic processes for managing and operating the end-to-end smart grid solutions must be developed, documented and implemented.

- Well defined Disaster Recovery plans need to be in place in the event that the production system, or portions therein, incur a failure that impairs the smart grid system's ability to meet its prescribed objectives.

- A fundamental philosophy of maintaining secure systems and end-to-end solutions must be adopted and embedded in the day-to-day culture as a way of life.

3) Performance Measurement. Internal stakeholders' (users) and enterprise operations teams (operators) require information to know how well the end-to-end solution is performing. This knowledge is essential to manage both internal-to-the-utility resources, as well as external customer expectations.

   - Service Level Agreements (SLAs) that truly define the outputs of the end-to-end smart grid solutions, and accurately measure the expectations of the internal smart grid solution users, must be implemented.

   - Well defined reporting of SLAs, key performance indicators (KPIs) and metrics throughout the smart grid solution enterprise are mandatory. Educated guesses, based on the way business may have been done in the past, are no substitute for accurate and timely information.

4) Testing and configuration management must become an established discipline.

   - Smart grid solutions represent a complex system of end point and communications network devices. Application servers and software act as the heart and brains of the system, enabling all to function as an integrated organism. All of these involve various versions of hardware, firmware, software and proprietary applications that must operate in a seamless, integrated fashion.

   - Changes to hardware, firmware, software and proprietary applications are never ending. Electronic components reach end-of-life. Software is constantly updated. Proprietary smart grid applications are constantly evolving to enhance the use of data from devices, and to position for future capabilities.

   - With change comes responsibility. That responsibility must be embodied in a set of disciplined processes designed to understand, test, manage and implement these changes in a responsible, controlled manner that assures the underlying smart grid system integrity that is needed for sustaining operation. The development and implementation of well-defined testing and configuration management protocols is a critical key for sustaining operation success.

- Configuring, enabling and testing of security capabilities becomes a relentless and never ending duty. New threats and vulnerabilities, some of which could be self-induced, others which may be a result of passive design built into the solution, or some which lay dormant in embedded software, require ongoing vigilance and testing to defeat and maintain a secure end-to-end solution.

5) Staffing and Training. Smart grid solutions enable sweeping transformation in the business. Such transformation requires that:

   - The utility team be retrained to use the new business processes enabled by the new smart grid solutions.

   - New skills and competencies be attained by the personnel assigned to manage and operate the new solution in a consistent, repeatable, reliable and safe fashion.

   - Organizational change management practices be used to plan for the structured evolution of the impacted organizations and people as you transition to the sustaining operational phase of the smart grid solution.

6) Mining for Gold. Smart grid solutions provide an incredible volume of data to the utility on its customers, on their usage, and on the performance of utility systems – data that was previously not available. Consistent processes for mining this data for information (nuggets of gold) should be implemented.

   - "Controlled curiosity" should be allowed to flourish. The immense volume of data is a prime feeding ground for business and operational personnel to identify solutions to problems, and this should be encouraged.

   - The development of a structured Data Analytics practice should be established. Personnel who understand the business, operations, customer and the data should be groomed as data scientists that obtain the information and parse it out to the organization, enabling such data to be processed, understood and applied in new and meaningful ways.

7) Long term Budgeting. Understanding the correct costs and establishing a multi-year budget are critical to sustaining smart grid success. Unlike some projects, which in theory might be able to be started or suspended based on annual appropriations, the sustaining success of the smart grid solutions requires multi-year budgeting. Long term budgeting involves a number of key steps:

   - Identify, understand and financially quantify your smart grid asset life cycle and supporting ancillary utility asset life cycle. Considerations include: contractual vs. typical industry useful life, relevant industry technology life cycle, industry observed life cycle, and expected replacement life.

- Analyze, understand and quantify smart grid hardware, software and services warranties and obligations so that you can adopt the appropriate maintenance, operating and replacement practices, and budgetary investments that are required for successful life cycle maintenance and operations. The operating life of batteries in devices such as AMI gas communications devices, for example, is significantly influenced by the type and frequency of data transmission, and the amount of data transacted. By understanding these tradeoffs as part of the design and implementation process, and by carefully managing these throughout the lifespan of the technology, the organization may be better able to stretch out the life of the batteries or even avoid a change out of batteries altogether – providing significant improved operability as well as budgetary savings.

- Identify and qualify potential gaps or enhancements to the current smart grid supporting technologies, integrated systems, and smart grid services that could impact the life cycle costs necessary to ensure delivery of cost effective, high quality sustained smart grid operations post-deployment implementation. For example, if your AMI system is capable of supporting in-home customer Demand Response (DR) programs, and such a program is contemplated, evaluate the potential performance impacts of latency and throughput of the AMI data, and examine the costs need to potentially enhance or expand the network capabilities to absorb the DR program.

- Understand and qualify industry best practice recommendations for business processes and tools to maximize benefit and maintain a high degree of quality and efficiency for the sustained management of investments throughout the smart grid lifecycle. For example, the role of data analytics is increasingly being recognized as an emerging value-add effort to enhance customer satisfaction through the targeted implementation of new utility sponsored programs and services. What future resources and expenditures are needed to support such activities?

- Develop a smart grid configuration management framework which can be leveraged as a model for sustaining the endpoint, network, systems software, systems hardware, firmware, IT environments, and vendor services management lifecycles. This framework will become an important component that allows the utility to understand the life cycle costs necessary to achieve the benefits expected from successful management and operation of its smart grid investments.

- Identify required and recommended enhancements which might be anticipated during the smart grid lifecycle to support future capabilities within its smart grid roadmap. For example, the implementation of Volt/VAR Optimization (VVO) could require that the underlying AMI network be enhanced to reduce latency, or that the AMI head end system be upgraded to implement message prioritization and processing for selected new or existing end point devices. The execution of proper due diligence to understand which underlying smart grid systems may need to be enhanced in order to support these future services and capabilities is an important element of long term smart grid financial planning.

Conclusion

Successful, sustaining operation of intelligent distribution technologies is a predictable, repeatable process. But, the effort to assure sustaining operational success is often as significant as the initial smart grid implementation effort.

Life cycle planning provides a repeatable process that helps guide the utility to sustaining intelligent distribution technology operational success.

About VASS Solutions

VASS Solutions is an agile smart grid consulting company that focuses on Electric, Gas and Water Utilities. VASS Solutions listens to your specific drivers, needs and risks, and provides a lifecycle of customized services for smart grid projects. VASS Solutions develops and implements strategic plans; facilitates vendor/partner contract negotiations and management; enables justification, design, integration and implementation of core operational and strategic technologies and business processes; enhances customer interactions and satisfaction; and ensures the most valued benefits of smart grid technologies for the Utility and its customers. VASS Solutions tackles the tough situations. VASS Solutions' consultants "git-er-done".

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