Successful Smart Grid Implementation

Contents

Preface

Planning and implementing a smart grid project can be one of the most complex endeavors that a utility undertakes. The new technologies, integrations to legacy systems, business process transformation within the utility, and customer engagement aspects are multifaceted and interrelated in a way that most operational upgrades are not. The success of a smart grid project can be impacted and even derailed by lack of attention or competence in any one of the many areas involved in the project. The business and customer benefits, however, far outweigh the challenges to implementing and integrating these systems for most utilities, and therefore the risks are worth taking on. Not only is a wide range of operational benefits possible, but the systems that make up the smart grid will be capable of informing consumers of their day-to-day energy use, right down to the appliance level in the future. This sophisticated infrastructure also curbs greenhouse gas emissions, reduces consumers' energy bills, and enables a host of further operational business benefits as more systems are layered on. The U.S. Department of Energy undertook a study of four utilities involving 1,250 feeders and found that the System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) decreased 22% and 18%, respectively. These improvements in operations go hand in hand with better customer service.

A utility's definition of the smart grid depends on factors already in place at the utility, such as historic or current level of automation and technology investment and what perspective of the smart grid the utility wants to emphasize. For example, these could include customer, distribution, transmission, generation, production, or storage aspects. For most utilities, the business and consumer benefits of advanced metering form the logical starting point, because not only is it the norm to have a very positive business case, but it also serves as a foundation for more advanced elements of the smart grid. While the smart grid is often described as a revolution for utilities, it is more accurate to describe it as an evolution, though the pace of change has certainly increased. Common attributes of utility smart grid implementations include massive amounts of data, new stakeholders involved in energy system automation, and dependence on communications networks to facilitate interconnection of smart devices and systems.

Success in implementing smart grid projects throughout the industry has been mixed, and some major failures have spilled out of the trade news into the mainstream consciousness. The underlying complexity of the implementation itself coupled with a major change in business processes and active consumer engagement result in many challenges. Indeed, a typical smart grid project usually has components that would be considered large projects in their own right. This book endeavors to distill lessons learned and best practices from successful projects into an understandable guide and roadmap for those starting on their smart grid journey. The reader will be taken through the process from the very first planning steps through operational transition and next steps, though each stage is presented in a standalone manner so readers can jump to the most appropriate stage of the life cycle for their needs.

It is important to note that this book contains advice and guidelines, but it is fully expected that the readers will tailor these recommendations and approaches for their own unique considerations. Success in these projects can and has been achieved by utilities that approach the project with a clear-eyed appreciation of the risks and employ appropriate risk mitigation strategies. We all owe a debt to the first utilities that started smart grid initiatives for the valuable success factors and lessons learned that benefited the industry.

1

Elements of a Smart Grid Project

The term *smart grid* is generally understood to refer to technology and process updates to bring utility electric, water, and gas delivery systems into the modern age by using computer-based remote control and automation. These systems use two-way communication technology and computer processing techniques to enable a more accurate, responsive, and automated approach to delivering utility commodities to the customer. The term *smart metering* refers to a subset of a smart grid project, meaning just the metering component of the project without the more expansive elements such as distribution automation. Typical benefits of a smart grid project include the following:

- Improved meter reading accuracy: provides meter reading automatically, transmitted over a communication network.
- Faster response to outages: smart grid equipment helps pinpoint areas affected by an outage.
- Deterrence of power theft: benefits all customers by reducing the potential for costly power thefts and thereby protecting rates.
- Enhanced data communication: provides better information and therefore reliability to help manage system operations more effectively.

Smart grid projects are technology- and hardware-intensive, and because of this, there is much focus on new systems and their integration with existing or legacy systems at a utility. However, two other primary elements require equally intense thought, planning, and execution for the project to be successful. The business transformation element is necessary to develop new workflows, business processes, and ways of operating that unleash the power of the new systems; it also includes the organizational change and readiness component. The customer

Reducing Implementation Risk

Reduced acquisition costs can lure utilities into decreasing their attention to proper implementation services. So much of the cost is in hardware, proposals may offer project management, system engineering, or testing services for a small price or even at no apparent price. It is very important for utilities to perform their due diligence and ascertain the quality of the services that a technology provider has. If the utility does not have a proven track record of managing the details of successful implementations, it may want to consider hiring a consultant who specializes in assessing the maturity and capability of the services of the technology provider and system integration (SI) and/or helping implement the solution.

In summary, there are several ways for utilities to reduce their risk when implementing smart grid systems. These include verifying the service capabilities of the technology provider in depth at the proposal stage, teaming with the technology provider so that the utility can leverage in-house SI capabilities, obtaining consultants or implementers to monitor or supplement the team, and turning to third-party SI service providers.

Integration Success

Another challenging aspect of AMI projects involves the interfaces and integrations with other utility IT systems. Most implementations initially ignore the valuable integrations between smart grid and other utility IT systems. While the core AMI benefits of the meter reading and billing function are clearly critical, planning for other IT integrations early in the project life cycle facilitates ease of unlocking those benefits of an integrated utility IT suite.

Utilities need to independently, or with assistance from third parties, examine integrations because most technology providers have limited or no experience in this area. Integrations with the other utility IT systems—such as a customer information system (CIS), geographic information system (GIS), outage management system (OMS), work management system (WMS), and mobile workforce management (MWM)—have valuable operational benefits.

SIR success factors

Ultimately, SIR success will hinge on teamwork, a clear-eyed vision of the future, solid grounding in the utility starting point, and the ability to merge process and technology into an operational workflow. Technology development without consideration of the humans using it is ineffectual and will not be adopted within an organization. Therefore, an approach to technology planning and development with a focus on the processes will yield better results. Using business process–modeling techniques that incorporate technology into business process flow diagrams will help bridge the gap. It also assists in determining where benefits arise by improving the users interaction with the technology, not just the fact the technology is in place. An SIR is not a "once and done" document; rather it should be reviewed and adjusted as the technology and regulatory climates change, as illustrated in figure 3–3.

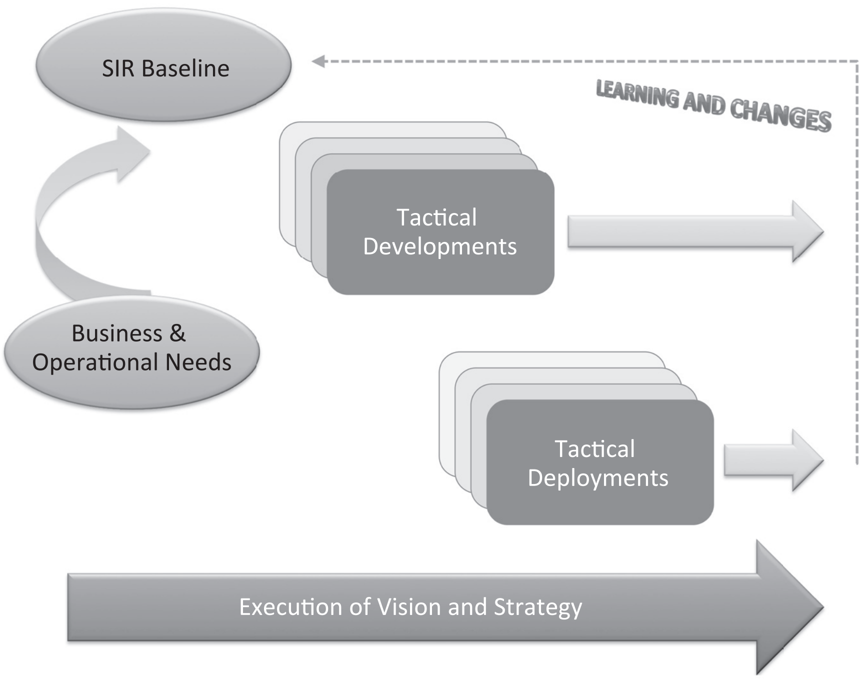

Fig. 3–3. SIR evolution

The first factor is weighting of the requirement; a five-level structure is recommended. An example of this weighting structure is shown in table 5–1. Note that a weighting factor of 5 is the minimum gate criterion, so in practice only weights 1 through 4 are used.

The other factor is the score for a requirement. The utility should have a rule that any functionality or service must be commercially available to be scored, so any requirement that the vendor notes has future availability gets a zero score (table 5–2).

Table 5–1. Weighting structure

Weight	Name	Definition
1	Desirable	Indicated as "optional" in RFP; considered optional to utility
2	Somewhat important	Required in RFP; work-around exists if requirement not met; minor impact to benefits, quality, and/or schedule occurs when implementing work-around
3	Important	System planning
4	Critical	Required in RFP; work-around exists if requirement not met; major impact to benefits, quality, and/or schedule occurs when implementing work-around
5	Must have	**Minimum Gate Criteria**: required in RFP; no work-around exists; unacceptable impact to benefits, quality and/or schedule; reject proposal if functionality/service not provided

Table 5–2. Scoring structure

Score	Definition
0	Does not comply or did not respond or will not meet any of the requirement by [required date]
1	Meets (or plans to meet) some part of the requirement by [required date]
2	Plans to meet all of the requirement by [required date]
3	Meets all of the requirement currently
4	Exceeds all of the requirement to benefit of utility

figure 7–1 and add more systems, we can see where the MDMS fits into the picture, as shown in figure 7–2. Note that in this diagram the utility integration bus, which uses technologies such as ESB, is not always present. The utility integration bus represents middleware technologies to ease the integration of multiple software systems.

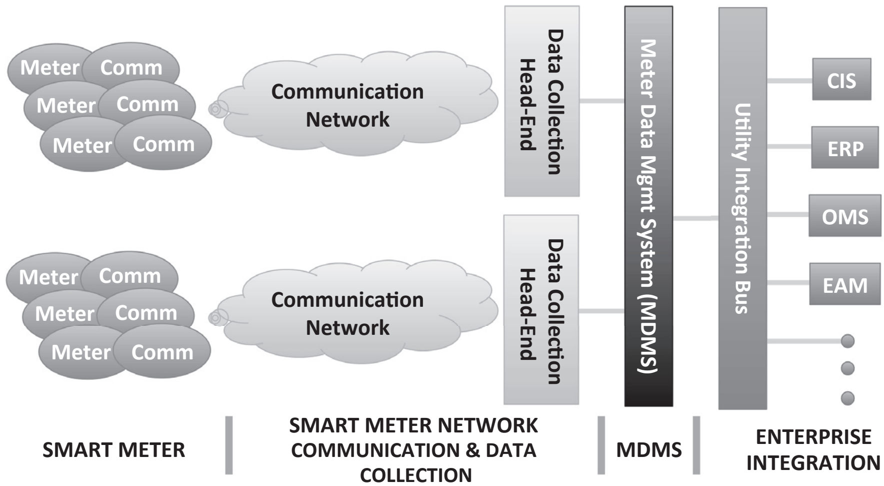

Fig. 7–2. MDMS position in the system

MDMS is central to achieving smart grid enterprise benefits while reducing the ongoing operation and support costs of IT. An MDMS is needed because the volume, frequency, resolution, and type of data (e.g., interval demand data, voltage, outage events, meter tempering indications, etc.) received from the utility meters in a smart grid system are much different from manual meter reads and AMR systems. Some utilities (though rare) may have selected multiple AMI technologies, such as phone-based system for C&I customers and a fixed network–based system for urban or suburban residential areas. Other stakeholders such as regulatory bodies, the customers, and the utility's own management may request more load data analysis and reports, as well as greater rate and billing flexibilities. As a result, the customer care and billing applications and other business and operational systems will need to process more meter data from multiple sources.

In addition, the utility often needs to make major enhancements to existing meter reading, customer information, and billing systems to handle the volume of data, to process from multiple meter reading sources, and to provide more advanced analytics for the load data. Last, it becomes