Why Requirements Development is Critical to Making the Smart Grid Smart

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If the Smart Grid is going to live up to its name it must be able to support the functions and applications that many people are now envisioning. The process of identifying these functions and capabilities is known as “requirements” development.

Why Are Requirements So Important?

Requirements specify what the system must do for end users. End users include not only those individuals wanting to execute applications but must also include systems administrators and cyber security personnel that must manage the systems deployed. Without a robust set of requirements systems may be designed that fall short of end user needs and necessary systems administration support functions. A “complete” requirements specification is particularly important for small, resource-constrained field equipment such as meters. This equipment can number in the millions and will require significant efforts to initially install. Errors or omissions in requirements can be costly to fix if they are discovered after systems are designed and even more costly if caught following implementation or deployment.

Types of Requirements

Requirements come in a few different general categories of “functional” and “non-functional,” and both are needed to specify systems adequately. Functional requirements specify the functions and identify what the completed system is to do for the end users. Non-functional requirements specify the supporting capabilities that are also necessary to adequately administer and secure the systems. Non functional requirements specify the levels of performance and underlying management features needed to support the functional requirements.

Good Requirements Are Not Easy

Good requirements take significant work to be as complete as possible. Studies have shown that creating good requirements are worth the effort. Recommended practices for requirements development include the creation of “use cases” that articulate functions as well as defining the equipment and personnel involved with a given application. Presently a template is proposed for industry use and is available for download from the **NIST Smart Grid Twiki website**. The template includes not only sections for the narrative description of

functions but also includes detail of the individual steps of an application including necessary constraints.

Requirements Are at the Heart of Robust Standards for Advanced Systems

Good requirements are at the heart of successful **standards**. Virtually all standards in use are based on some initial set of functional requirements. These requirements may not be documented in the forms that are now in use by the industry; however they have become embedded within the standards documentation. Successful standards will reflect these requirements in that they are able to support a wide variety of devices from different vendors and meet user needs.

EPRI's initial work on the Utility Communications Architecture (UCA), for example, started from requirements development. These requirements in turn were used to assess existing standards. This process led to the initial selection and development of several standards that are now in use and available from the **International Electrotechnical Commission** (IEC). It should be noted that the standards were further developed based on what was learned from a series of EPRI projects to implement the standards. These projects identified requirements that needed to be supported by the standards. This resulted in a maturing of the standards to the point where they are in use today. Subsequent projects have focused on meeting requirements that span across different standards, thus driving the need for the harmonization or integration of standards.

An example of where requirements influenced the development of a standard is perhaps best represented by an IEC standard for advanced automation equipment. When developing a standard to integrate substation equipment, power engineers realized the complexity of the equipment involved and that it may be necessary to communicate to different functions within different physical devices that are complex. This requirement led to the development of an advanced application level language that included a way to model communications to remote equipment. The resulting standardized "hierarchical" set of communication instructions and data provided a robust and successful approach to communications with equipment that can vary widely in complexity. The IEC 61850 standard for automation equipment has this capability today and is foreseen as a strategic approach to future advanced communications for field equipment.

Plan Requirements Development into Your Projects

Though not easy to do well, requirements are critical to successful projects. Help is available from emerging technical disciplines. The disciplines of systems engineering, complex systems engineering and system architecture development can help direct the details of requirements development. Planning for requirements development is one of the most important tasks to get right for your project.