STANDARD-BASED OUTAGE MANAGEMENT PROCESS MODELLING

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ABSTRACT

Currently there is much standardization activities going on in the field of IT for power systems Based on the functional and process descriptions included in some of these standards, models of outage management processes were created in co-operation with a large Swedish Distribution System Operator (DSO). This helped to verify that the standards were helpful to create process models for power system operation and control. Another case study also shows the use of process maps to evaluate business-IT alignment of the outage management functions of a Distribution Management System.

INTRODUCTION

The deregulation of the power industry introduced a competitive pressure on utilities to conduct their business operations more efficiently. As a consequence, the industry has witnessed a large number of mergers and acquisitions, creating larger electrical utilities. The business logic behind this development was that utilities of a sufficient size would be more profitable, due to synergy effects. [3] The larger the utilities are, the more complex they become, which calls for an increased and improved use of IT-technologies. To be able to reap any benefits out of information systems, they need to be aligned with the business processes, i.e. tailored to support the business processes. Specifically, much is to be gained from integrating systems with one another and thereby share and reuse data and functionality across the enterprise. [13] Integration is facilitated by having systems speak the same "language", i.e. use the same information models. One way of achieving a common language is to standardize and precisely define the meaning of commonly used terms, such as "substation", "pole" or "transformer". [13][7] Such standardization work is currently underway within primarily the IEC. EPRI is also running parallel project called Intelligrid, which objective it is to define an integrated power system control architecture based on among other things the standards created by the IEC. [6]

The standardized information objects from the IEC, and the common architecture proposed by EPRI are both derived based on more or less explicit assumptions regarding business process for power system operation and control. To be of any use in a standard, these business process models must be generic, i.e. similar to business processes implemented at most electrical utilities. Consequently, the business process descriptions and the employed terminology are useful as a basis when creating business process models for electrical utilities. This has been shown with respect to asset management in [9], [10] and [11]. Business process models have many uses, one of which is to evaluate information system suitability, i.e. the degree to which the systems meet the requirements of the users. [4]

This paper proposes using process descriptions found in the IEC 61968 standard and the Intelligrid Architecture, as a base for creating business process models of the power system operation and control processes. Moreover, this paper elaborates on the use of such business process models for evaluating the business-IT alignment of a Distribution Management System (DMS). The remainder of this paper is outlined as follows: the next chapter describes some standards from the IEC Technical Committee 57, and the Intelligrid architecture. After that follows a chapter describing a case study in which business process models of the outage management process were created, followed by a section where the developed process maps are used to assess business-IT alignment of the Outage Management process and a DMS, and a concluding chapter.

STANDARDS

This chapter describes the standardization activity of IEC Technical Committe 57 and EPRI's Intelligrid Architecture.

IEC Technical Committe 57

Technical committee 57 (TC 57) of the International Electrotechnical Commission (IEC) is concerned with issues related to Power Systems Management and Associated Information Exchange. The TC 57 standard of interest for this particular study turned out to be the IEC 61968 standard facilitating interapplication integration in DMS. [5] The output of the 61968 standard series is a common data model for distribution management systems. Having a common data model will make it possible to define standardized application interfaces, thereby allowing data and services to be exchanged between applications from different vendors.

IEC 61968 – the Interface Reference Model

The development of the data objects defined in the IEC 61968 are based on a functional description of the area of DMS; the Interface Reference Model (IRM). The content of the IRM is divided into 14 *Business Functions*, see Figure 1. A business function roughly comprises the activities or functions, normally performed within a specific organizational unit at a power company. Some examples of relevant business functions are [5]:

- Network Operation
- Records and Asset Management
- Maintenance and Construction

The business functions are in turn broken down into smaller functional units to provide a more detailed view.

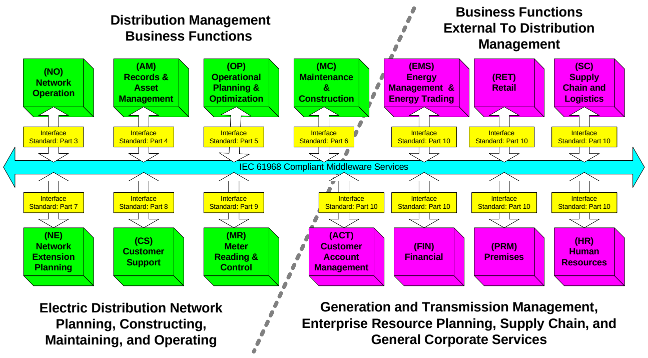

Figure 1: The business functions of the IEC 61968 standard. [5]

EPRI's Intelligrid Architecture

The Electric Power Research Institute, EPRI, is an American independent center for energy and environmental research. The basic idea with EPRI's Intelligrid project is to define an architecture for highly automated 'self healing' transmission and distribution systems, thus supporting efficient and reliable supply of power. Intelligrid prescribes the use of standards, among which are those of the IEC TC 57, to integrate and automate power and communication systems. [8]

Intelligrid - Architecture

The Intelligrid development approach is outlined in Figure 2 below. The project had two objectives. First, the identification of business needs. Second, the development of the architecture itself, using the business needs as the basis for the information requirements necessary to support the desired power system characteristics. The strategic vision defines high-level requirements and visions for information systems used in power system control and operation. The tactical approach operationalizes the strategic vision into more specific recommendations on technology and environments for power systems management systems. [8]

Based on standards and industry best practice, e.g. the IEC 61968, Intelligrid gives normative recommendations regarding which technologies to employ in an Intelligrid compliant architecture. For the purpose of this article, it is the business needs, or business functions that are of interest, as they illustrate operations and business processes that are generic, i.e. commonly used in industry. An example of an Intelligrid business function is the Advanced Distribution Automation function, containing sub-functions including Fault Location, Isolation and Restoration. [8]

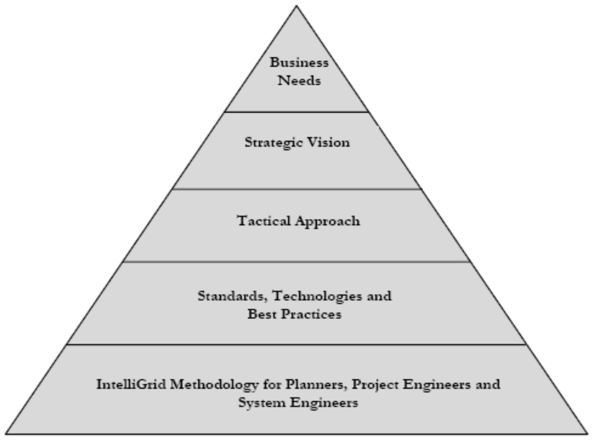

Figure 2: The Intelligrid approach towards defining a more automated power system operation and control architecture. [8]

CASE STUDY 1 : PROCESS MODELS

The functional descriptions of the IEC 61968 and Intelligrid were tested in a case study at one of the largest Swedish DSOs. The case study created business process models of how the DSO performed Outage Management, i.e. the identification, isolation and restoration of outages in the distribution network. As there are no or very few automated sensors in the low-voltage parts of a distribution network, efficient outage management is based on having a customer support organization, capable of efficient customer trouble call management.

Table 1: Sample questions from the used standards

Source	Functional area	Question
IEC 61968	Network operation	Is there a standard way to spread customer incident information?
IEC 61968	Operational planning and optimization	How is prioritization done between planned outages?
IEC 61968	Maintenance and Construction	Is it possible to track what takes place in the field, e.g. work crew movements etc.?
IEC 61968	Customer Support	Who is responsible for distribution of customer information for planned outage notifications?
Intelligrid	Fault Location and Fault Isolation (FLIR):	Who determines which the faulted sections are, and on which basis?

Case study method

The business functions of the IEC 61968 IRM were not all relevant to outage management, and were discarded from further investigation. Those chosen for a closer scrutiny were Network Operation, dealing with operation of the network, i.e. Control Center-related systems and processes, Operational Planning and Optimization, concerned with optimizing the control center processes with respect to economic aspects. Also relevant were the business functions

Maintenance and Construction and Customer Support. The former deals with e.g. the dispatch and scheduling of work crews, and the latter with how to manage customer contacts, especially with respect to trouble calls related to power outages. The review of the IEC 61968 and Intelligrid resulted in a number of interview questions, which served as input in the data collection part of the case study. Examples of such questions are shown in Table 1.

During the interviews, the respondents were asked to describe their work tasks. The iterative nature of the data collection consisted of starting to build a model of the entire process, with its constituent sub-processes. Thereafter, the investigation focused on the sub-processes and identified activities and actors and IT-systems related to the activities. 18 respondents were interviewed, starting with those having knowledge of the entire process and then moving on to people with more detailed knowledge of sub-processes and their activities. The former category of people included control centre managers and control system owners, as well as control center operators. The latter included staff from the customer service center, service personnel and field crews. In addition to the interviews, a number of direct observations of the outage management process were performed. These observations served to validate the process models that were developed using interviews. The business process models were documented using swim-lane diagrams, and activity descriptions, cf. Figure 3.

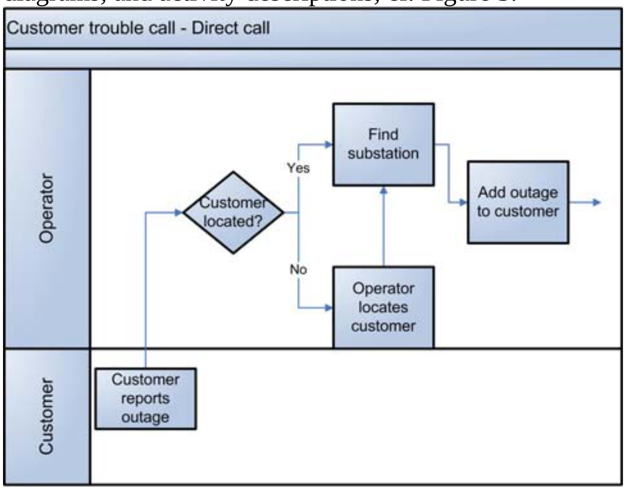

Figure 3: Example of process model using swim-lane diagrams. The process model describes some activities related to outage management and customer trouble calls.

The aforementioned questions based on the functional descriptions in IEC 61968 and Intelligrid, were used as a checklist to make sure that all vital parts of the outage management process were covered during the interviews.

Applicability of standards

One conclusion regarding the applicability of the functional descriptions in the standards, was that the Intelligrid functions were less useful than its IEC counterparts. This mainly due to Intelligrid's focus on control center functionality rather than general business functions in the area of electrical distribution. The IEC-standard provided useful input in the sense that it provided background information about what is done in different activities in the outage management process. Its focus on system functionality and interface descriptions slightly reduces its usefulness when it comes to defining process models but it is still complete in the sense that all major process steps of the distrubution management process is at least mentioned.

CASE STUDY 2 : USING THE PROCESS MAPS

Another case study has been conducted in cooperation with a large-scale DMS vendor and the DSO from case study 1. The aim of the study was to investigate the functional suitability of the vendor's DMS and the outage management process of the DSO. Suitability is one aspect of business-IT-alignment dealing with whether the functions of information systems support the intended work tasks or not. [4] The study's method was to gather a complete and structured view of the functions available in the DMS by interviewing system experts and reading system documentation provided by the system vendor. These functions served as input to the functional evaluation together with the process maps and its activity descriptions from the other case study.

The functional content of a DMS varies greatly between installations, and as a consequence, a distinction was made between functions that can be part of the vendor's DMS, but were not purchased by the DSO and those functions that were part of the DSO's installation. The activity descriptions and the functional descriptions were compared one by one in order to analyse the suitability by answering the questions 1-2 below. The mapping between activities and functions was inspired by requirements engineering [1]; activities were seen as business requirements.

1. *Is/are there any installed function(s), which fully supports the activity step?*
2. *Is/are there any installed function(s), which partly supports the activity step?*

The use of this method is illustrated in an example below.

Activity description*: When an outage has been verified, the normal action of the DMS operator is to contact a field crew to restore the outage.*

Requirement: *The operator shall be able to inform a suitable field crew about the outage location, probable outage cause, comments etc.*

Example of a functional fit: *The DMS has an "assign crew function", which is integrated with the field crew's information system. The function" list crew" provides the operator with a list of suitable crews (right geographical area etc.).The" assign crew" function enables the operator* *to send an electronic message to the crew's information system with some message information predefined.*

Example of a partly functional fit: *The DSO has an "assign crew function"; separate from the crew's information system. The operator uses the "list crew function" to find a suitable crew in order to contact the crew by phone. The operator can update the record of crew assignments by using the "assign crew function".*

Example of a functional gap*: Previously mentioned functions are not installed. The operator uses the phone to contact a crew that the operator finds appropriate.*

When questions 1-2 were answered (for every activity), a picture of the present situation appeared. Since the purpose of a system evaluation often is to come up with improvements the result of the above analysis could serve as an input to a change management process starting with a presentation of the current situation in order to analyse relevant change suggestions [2]. The questions 3-4 below can be applied to every identified functional gap and are instrumental when having discussions whether certain improvements should be considered or not.

3. *Is/are there any non-purchased function(s) in the DMS which fully or partly support the activity step?*
4. *Is/are there any third party application(s) (an application not developed by the DMS vendor), which fully or partly supports the activity step?*

Question 5 identifies functions with low user acceptance.

5. *Is/are there any purchased function(s), which supports an activity step but is/are not used?*

Experience from the case study shows that process gaps rather easily could be identified in situations where the actor uses another activity support than the DMS (question 1-2). The electric power company can get information about suitable functions that have not been purchased, and the DMS vendor of functionality that needs to be developed to make the DMS more competitive (question 3). The need of integration with third party systems could also be addressed by answering question 4. Rarely used functions are also identified, which enables a discussion of why the functions are not being used (question 5).

CONCLUSION

This paper has shown that it is possible to use the IEC 61968 standard as a basis for creating business process models of the outage management process at a DSO. The usefulness of such process models are illustrated in a case study in which the functional suitability of a distribution management system was evaluated through mapping of process model activities and system functionality

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