OPTIMIZED ASSET MANAGEMENT – AN INTEGRATED APPROACH

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ABSTRACT

Optimizing the management of its assets is one of the most important – indeed vital – responsibilities of a power delivery business. It is through asset management that the enterprise is able to deliver shareholder value while at the same time providing service with the quality expected by its customers and demanded by its regulators. This paper provides details about the principles for the development and implementation of an integrated asset management program, including information about the tools required to (a) develop the numerous complex inputs that inform and enrich the decision-making process, and (b) aid in the implementation of the asset management programs.

INTRODUCTION

Traditional utility thinking places significant restraints on the way asset management is approached. This paper recommends a number of ways for distribution utilities to transform their asset management process and as a result to maximize the value extracted from their assets, all within the applicable technical, economic, and regulatory boundaries imposed by the environment in which they operate.

INTEGRATED APPROACH DESCRIPTION

The integrated approach herewith presented is based on the Asset Management Program (AMP) concept as shown in Figure 1.

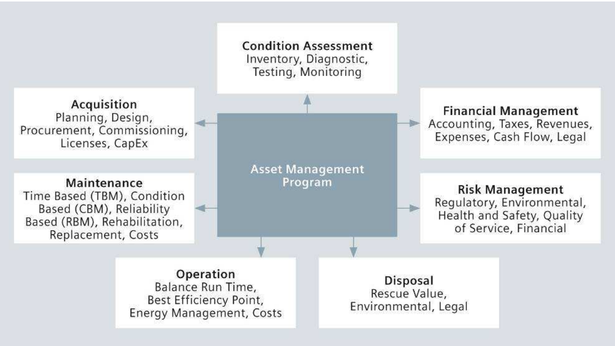

Figure 1. Elements of an Asset Management Program.

However, where this integrated approach innovates relative to traditional asset management thinking is in the principles and procedures used to develop and implement the various components of the AMP. These principles are illustrated in Figure 2 below.

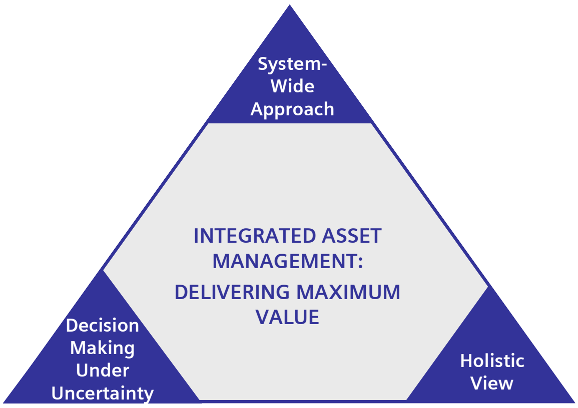

Figure 2. Principles of an Optimized Asset Management Program.

The three principles proposed here for the development of an optimized Asset Management Plan (OAMP) are:

1. Taking a **system-wide approach** instead of the individual asset (or asset class)-based approach adopted in the development of many asset management programs today. In this recommended integrated approach, the management of assets on an individual basis gives way to the management of the asset based on an overall grid (or network) basis.
2. Implementing rigorous **decision making under uncertainty** concepts and methods. At its core, asset management is a complex and continuous decision making process subject to multiple conflicting objectives and significant uncertainty.
3. Adopting a **holistic view** of the asset management process. For instance, it should be recognized that every asset management decision has technical, economic, and regulatory implications; e.g., there is a clear correlation between technical decisions and their business implications on network cost and service quality. Another instance is to recognize that the asset management function cuts across all facets of the operation of the power delivery business, from network management services to customer and market management services to information technology services and up to corporate services.

The above principles enable and support the vision of the asset management process as a:

- **Value Maximizer,** by taking a global and coordinated system-wide view of the impact of every decision, thus enabling the extraction of maximum value from the assets.
- **Smart Grid Enabler,** for instance, by enabling the optimal integration of every asset with all other assets to maximize function while reducing cost.
- **Multi-Faceted Core Business Function** considering key utility management processes such as: grid management (covering network structure, commercial assets, geographical and topological assets), asset monitoring and analysis, asset management strategy, asset condition assessment, asset planning & simulation, maintenance planning & simulation, and network planning & simulation.

MAIN PRINCIPLES OF AN OAMP

This section provides further details about the three main principles for the development and implementation of an optimized asset management program (OAMP). We also discuss a sample of proprietary tools and solutions that can be leveraged to: (a) develop the numerous complex inputs (in hierarchical information layers shown in Figure 3) that inform and enrich the decision-making process, and (b) aid in the implementation of the asset management programs, including the asset portfolio strategy and the management plan of a complex network that is subject to continuous expansion, adaptation and refurbishment processes.

Principle 1. Taking a System-Wide Approach to the Development of the Program

In contrast to the individual asset (or asset class)-based methodologies adopted in the development of many asset management programs today, here is recommended an approach where the management of assets on an individual basis gives way to the management of the asset-base on an overall grid (or network) basis. One of the main advantages of this paradigm shift is that it enables the evaluation of the business value brought about by reaching solutions that balance or trade-off ,for instance, technical necessity and overall system economical feasibility.

An example of the application of this principle is to perform the asset management recommendations on the tenet that decisions need to be based on three very **important dimensions**: (a) technical condition of the assets, (b) importance of every asset to the functioning of the system, and (c) the relative impact of every asset to the overall financial/economic performance of the system.

The system-wide approach can be implemented by means of the following sample tools (or combinations thereof).

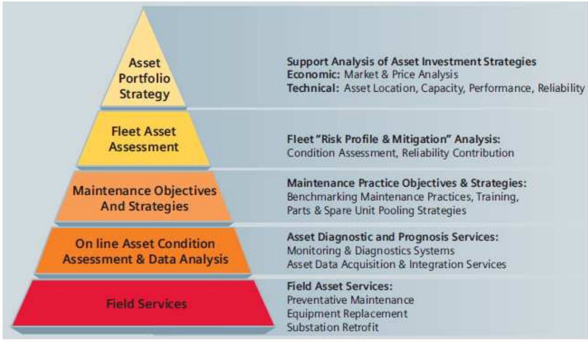

Figure 3. Asset Management Solutions.

Reliability Centered Asset Management (RCAM™). The special focus of the RCAM™ process is to analyze and forecast system reliability performance taking into consideration the strategies for preventive maintenance and replacement of components. Different sets of strategies can be evaluated for high-level indices of economical and supply reliability performance over a future study period.

System supply reliability performance is evaluated by means of probabilistic reliability calculations [1]. In contrast with contingency analyses, all relevant contingency states are modeled based on a stochastic description of component failures. In case of supply interruptions, the supply restoration process is also evaluated.

Asset Risk Mitigation Analysis (ARMA™). The ARMA™ process focuses on detailed investigations into both the conditions of certain asset classes and their impacts on overall network reliability performance. Using different sets of customer data gathered during field inspections and power industry surveys or continuous monitoring of assets [2], this tool calculates asset condition and reliability impact indices and develops a risk profile for each asset. The risk analysis can also include economic measures, such as equipment and reliability costs. From the risk profile a recommended strategy for each asset is derived (see Figure 4).

Asset Performance Management System (APMS) enables utilities to get the most out of their existing assets while providing options to improve power delivery reliability. It supports more informed decision making for activities (e.g., replace, repair or upgrade) that significantly affect the asset management bottom line. The APMS integrated product suite not only monitors and analyzes the assets and related environmental information, but it also helps to protect the assets from theft and damage [2].

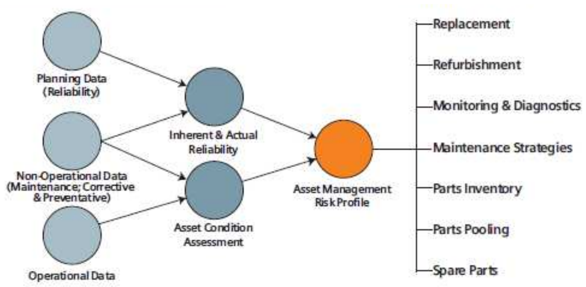

Figure 4. Asset Management Strategies.

Principle 2. Implementing a Rigorous Decision Making under Uncertainty. Concepts and Methods

At its core, asset management is a complex and continuous decision making process subject to multiple conflicting objectives and significant uncertainty. With multiple conflicting objectives the traditional concept of optimization is of limited use since there is usually no plan which is ‘‘best’’ in terms of all of the objectives or attributes of concern. When a problem has multiple objectives or attributes there is usually no single solution which simultaneously optimizes all of them. The best that can be hoped for is a compromise which represents a reasonable tradeoff among the attributes. Examples of the relevant uncertainties include the “true” condition of the various assets, and the rate at which load demand will grow. The decision making approach discussed in this section is illustrated graphically in Figure 5 below. This approach is generally described in [3], [4], [5], and [6], and has been applied successfully by the authors in a number of asset management engagements (for example, see [6]).

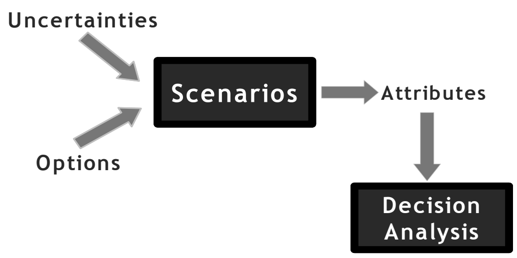

Figure 5. Decision Making under Uncertainty.

Key to the successful application of the approach (known in the literature as Trade-Off Risk or TOR) is the correct definition of options, uncertainties, and attributes (see Figure 5). Options are alternatives that the asset manager can control (i.e., actions or decisions that can be taken, such as replacing or refurbishing an asset). Sets of specific options are called Plans. Uncertainties, on the other hand, are variables over which the asset manager has no control. Scenarios combine specific options with given materializations of the uncertainties. The latter can be modeled either by means of unknown-but-bounded or probabilistic representations. Unknown-but-bounded representations account for the limits on the modeled uncertainties, with no assumptions about their underlying probability distributions. Unknown- but-bounded models do not introduce biases on the part of the asset manager relative to the likelihood or not of a certain uncertainty materializing at a certain level or with a certain probability or probability distribution.

Attributes are measures of the quality of options or plans, i.e., costs or benefits. The evaluation of alternatives in the asset management process involves postulating credible and relevant scenarios (i.e., assuming that uncertainties materialize at a given level), and testing how such alternatives would perform in that context. This yields tradeoffs in the attribute space.

A hedge is an action (or set of actions) that could be taken to mitigate or reduce the risk associated with a given decision. Hedges seek to add robustness to a plan, usually at the expense of some level of sub-optimality (e.g., hedges generally command a premium).

Since it is not often possible to "optimize a plan" in terms of each attribute simultaneously, decision-making involves assessing conflicting factors to find the best trade-off between desirable and undesirable effects. The methodology can aid the final decision-makers (board of directors, chief executive officer, top management, etc.) in choosing a plan and can integrate a wide variety of options. In other words, the Trade-Off Risk approach is an organized way of eliminating many possible plans that are dominated or inferior. What is left is in the end is a small set of plans (the decision set) which represent reasonable compromises.

The above notwithstanding, the asset manager ultimately has to make a decision (i.e., develop an asset management plan). We assume that decision makers act rationally, in the sense that they compare the costs and benefits of a given option/plan and then decide to engage in this option/plan if it maximizes their perceived return relative to cost and the resulting exposure to risk is acceptable.

An example of a proxy tool that can be used to arrive at a decision is that of Minimum Regret. This method seeks to maximize the benefits derived from a given decision, while minimizing the potential adverse consequences of such a decision.

Principle 3. Adopting a Holistic View of the Asset Management Process

At its core, the holistic view recognizes that the asset management function cuts across all facets of the operation of the power delivery business, from network management services to customer and market management services, including also information technology services, and corporate services. Further, this principle prescribes that it's a key issue to recognize that every asset management decision has technical, economic, and regulatory implications. For example, there is a clear correlation between technical decisions and their business implications (e.g., on network cost and service quality).

The Strategic Grid Management approach [7] fulfills requirements for both asset and maintenance management from a strategic view. One of the main tasks of Strategic Grid Management is the optimization of operational as well as capital expenditures (OpEx and CapEx). The approach itself does not directly reduce one type of cost or the other, but it establishes a 360 degree transparency related to the grid and its structure based budgets. This approach provides a tool to quantify and localize costs, risks, budgets to any kind of grid asset, grid hierarchy and grid structure (defined by business value, customer value, region, time, among others) allowing further optimization through strategies and measures.

Other additional functionalities that represent capabilities of Strategic Grid Management lead to an efficient measure based management of grid operations which also has an impact on reduction of losses.

CONCLUSION

Asset management is a complex and continuous exercise of decision making, made the more difficult by the fact that many of the key inputs to the decision making process are subject to significant uncertainty.

The integrated asset management concepts presented in this article have been successfully applied in several operation and maintenance projects as well as asset management engagements for transmission and distribution networks around the world. For example, reference [5] describes a recent practical application of the RCAM^{TM} tool to a transmission company and two distribution companies in a country in Europe.

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BIOGRAPHIES

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