GRID ASSET MANAGEMENT SUITE (GAMS)
- REFERENCE FRAMEWORK FOR STRATEGIC GRID MANAGEMENT -

Thomas GLÜCKSELIG, Siemens AG – Germany, thomas.glueckselig@siemens.com
Christian HEUER, Siemens AG – Germany, heuer.christian@siemens.com
Fin JENNRICH, Siemens AG – Germany, fin.jennrich@siemens.com
Michael SCHWAN, Siemens AG – Germany, michael.schwan@siemens.com

ABSTRACT

While the main goal of asset management methods has always been to balance technical necessity and economic feasibility, today's market trends, cost pressure and new technologies and concepts like Smart Grids require network operators to focus more on the strategic aspects of asset management. Siemens AG is currently developing a reference implementation for Strategic Grid Management based on end-to-end processes and with a continuous focus on business value. Innovations like grid structure orientation, systemic performance indicators and advanced analysis and simulation capabilities support mastering the changes in asset management within the next years.

INTRODUCTION

At present, electricity markets are driven by three trends:

- Resource limitation and environmental considerations enforce the necessity of sustainability,
- Need to cover the ever increasing energy demand, accompanied by increasing decentralized generation and generation from renewable energy sources,
- Ageing infrastructure, generating a massive need for investments into the electricity system.

These market trends are the reason for a major paradigm shift in electricity markets: While generation always followed the load up to now, the requirements on future electricity systems will force load to follow generation, at least to a certain extent.

Transferring the current configuration of the electricity system into a Smart Gird is a basic prerequisite to achieve this change. Four functional domains have to be considered in this move, each covering different aspects and addressing different business models:

- Grid Automation
- Customer Management
- Load Control
- Strategic Grid Management

REQUIREMENTS FOR STRATEGIC GRID MANAGEMENT

The core requirement relating to asset management activities is, of course, to support the planning, execution, analysis and control of maintenance, operation and replacement measures on the system's assets – considering both economical and technical aspects and performance indicators [1]. While this poses a tough challenge on its own, additional aspects need to be considered in strategic grid management:

- **Complex decisions** – Utilities need transparency and comprehensive decision support for supporting the balancing of technical necessity and economic feasibility in the ever more complex environment.
- **Value orientation** – Facing constant cost pressure and limited budgets, utilities have to optimize and prioritize investments with respect to business value.
- **Performance measurement** – Utilities need systemic performance indicators to be able to manage their grid adequately. In addition, performance-oriented views on the assets are required, rather than the mere topological or hierarchical views.
- **End-to-End processes** – Both continuous processes and a strict process orientation in general are required for systematic and objective asset management.
- **Individual history** – While all these challenges are more or less relevant for most utilities worldwide, understanding the individual mix in the actual situation of each separate utility and the individual history and situation of the separate existing systems is a key prerequisite to successfully manage and develop the electricity supply systems.

STRATEGIC GRID MANAGEMENT

The domain *Strategic Grid Management* completes operational management of power grids through capabilities and functions enabling strategic, business value oriented analysis and decisions. Four key strategies play a major role for Strategic Grid Management:

- The first strategy is the joining of technical, commercial and geographical information to provide a consistent 360° view on assets.
- The second strategy is the utilization of the topology together with performance-based classifications to build up hierarchical and business value oriented grid structures.
- The third strategy is strategic decision support based on systemic Key Performance Indicators (KPIs). Such KPIs can be created by leveraging physical properties of grid structures.
- The last strategy is the active controlling of OpEx, CapEx and risk exposure for grid structures based on business relevance.

New and complex analyzing capabilities utilizing those strategies also have an important role within Strategic Grid Management. The overall target of Strategic Grid Management is to build a new foundation for asset management strictly focused on business values such as:

- Optimized resource allocation in asset management,
- Control of technical and economic risk,
- Support for regulatory compliance (analyses, documentation, …),
- Long-term protection of knowledge about decisions taken and their impact on the system's technical and economic performance including their correlations,
- Simplified growth.

Strategic Grid Management is embedded in a business concept consisting of

- A specific set of capabilities in the areas:
  - Optimized transparency
  - Value Management
  - Grid Management

  Each of those areas comprises specific capabilities that are essential for Strategic Grid Management, for example the 360° view on assets to improve transparency.
- A set of business levers in the categories:
  - Cost
  - Regulation
  - Revenue

  Each of those categories contains concrete levers that are utilizable through Strategic Grid Management with positive effects on costs, regulation or revenue.
- A process blueprint comprising the categories:
  - Grid Information Management
  - Grid Value Management
  - Grid Asset Management

  These process categories establish the foundation of Strategic Grid Management and directly correlate with the respective capability areas.

GRID ASSET MANAGEMENT SUITE (GAMS)

The Grid Asset Management Suite (GAMS) [2] is the reference implementation of Siemens for Strategic Grid Management. GAMS provides grid companies the capabilities required for Strategic Grid Management through reference processes supported by respective software modules and system architecture. Once implemented, those capabilities enable the grid operator to utilize the identified business levers and to optimize grid asset management with respect to the actual business values.

Both the GAMS reference process and the GAMS software modules are strictly designed in a modular structure. This is a key requirement, as the actual asset management processes of network operators differ significantly depending e.g. on the system level, where in transmission the individual equipment is considered with much more detail than in distribution, on the general condition and operational performance of network equipment or on the given regulatory framework. Moreover, also the targets that are to be supported by the asset management processes can differ significantly, from e.g. increasing supply reliability and/or decrease losses at the lowest possible cost, via maintaining the technical performance for minimum cost to just using an available budget in the way realizing the highest technical impact.

The separate process steps and the related software modules, which are based on SAP's NetWeaver technology, are defined in the sense of generic templates that can be easily and to a wide extent adapted to the specific customer requirements, or be integrated with existing tools in the customer's IT architecture. The integration of the available IT systems and data, together with the clear and strict process definitions opens significant improvement potential. But at the same time, of course, this is the basis for the implementation of additional data items, analysis methodologies or prognosis models that can be easily integrated into the GAMS solution.

In order to increase the efficiency and resource usage in asset management, one basic prerequisite is to prioritize with respect to both the impact of the various measures/activities on the defined targets, and the relevance of the separate network components to the defined targets. A major feature of GAMS is therefore the flexible definition of *grid structures* – groups of network components selected according to traditional criteria such as functional type, system topology and hierarchy, but also comprising technical and economic performance criteria. For example, the actual asset management strategies for a certain technical type of transformers can be differentiated according to the relevance of the individual transformers for the system's total SAIDI performance – rather than applying the same strategies to all transformers of this type, as it is standard in most cases today.

The grid structure orientation combined with a comprehensive 360° view on the grid enable the system to leverage the physical properties of grid segments to provide systemic KPIs like e.g. the overall fault probability and the penalties at risk for a certain grid structure.

GAMS REFERENCE PROCESS MODEL

The GAMS process model, see **Figure 1**, is divided into nine process categories whereof seven have a direct focus on asset management (grey boxes in Figure 1) and two have a technical orientation (dark blue, vertical boxes in Figure 1), forming the actual basis for the asset-management-related processes.

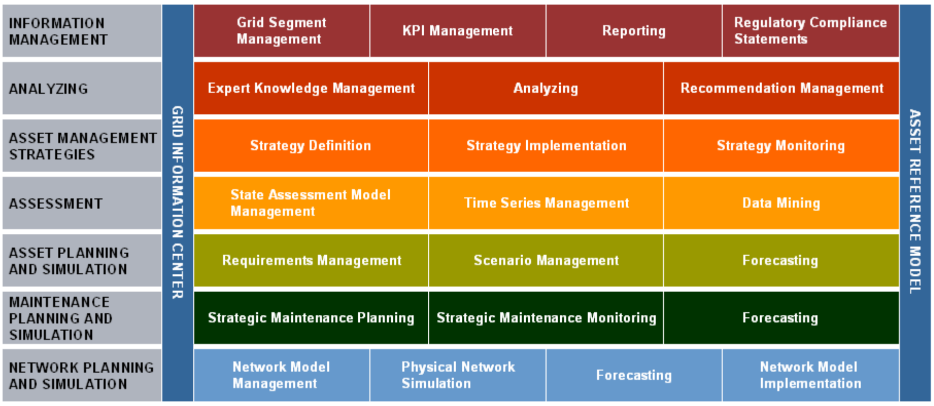

Figure 1: GAMS Reference Process Model

The process definitions are matching today's good practice plus several new developments making use of the additional opportunities created by the GAMS solution. In practical application, the GAMS process definitions relevant for the individual situation of a utility and its business targets are selected, and adapted to the specific situation and requirements.

Subsets of the process categories are grouped into so-called GAMS business scenarios, representing typical functional levels of Strategic Grid Management:

- **Grid Reporting & Analytics (GRA)**
  Within GRA the *Asset Reference Model* and the *Grid Information Center* are the two process categories on the technical side. Those two categories build the basis for integrating different IT systems using a central reference table and for supplying other processes with both technical and commercial information about the grid utilizing a data warehouse. The process categories *Information Management* and *Analyzing* complete this scenario.
  This scenario provides processes for managing hierarchical grid structures as well as for management of KPIs and regulatory reporting. Analysis functionality supports the identification of weak points in the grid, or to evaluate different what-if scenarios for strategic decision support.
  GRA forms the basis for the Grid Strategy & Assessment scenario.
- **Grid Strategy & Assessment (GSA)**
  The second scenario GSA contains four process categories:
  - *Asset Management Strategies* focused on the definition, implementation and monitoring of grid structure oriented strategies,
  - *Assessment* comprising processes for management and validation of assessment models as well as management of time series,
  - *Asset Planning and Simulation* using the defined and validated assessment models in combination with asset management strategies and the asset bases to create scenarios that are evaluated to forecast the development of technical and financial KPIs,
  - *Maintenance Planning and Simulation* containing processes for definition, monitoring and simulation of strategic maintenance plans.
- **Grid Planning & Simulation (GPS)**
  The third scenario GPS introduces the ninth process category *Network Planning and Simulation*, comprising processes for management of network models, physical network simulation as well as technical and financial forecasting. Thereby grid structure oriented extension, alteration and removal has a special focus. Additionally the process category contains process enhancements for asset management strategies and simulation capabilities of the GSA scenario. The GSP scenario completes the Strategic Grid Management capabilities.

GAMS ARCHITECTURE AND INTEGRATION

The modular approach of the GAMS processes is also realized on the IT side. Within GAMS all functionalities are provided via explicit processes only, and each of the GAMS process categories is implemented into a stand-alone module. Those modules contain the template implementation of the processes ready to use with a service-oriented architecture (SOA) platform, SAP NetWeaver. The platform is the central hub for GAMS and enables the connection of multiple external systems such as SCADA, GIS, ERP, etc. via an integrated service bus. Furthermore, it supports through its different components the execution of human- and system-centric processes, and offers data warehousing and software lifecycle management functionalities.
The logical architecture, see **Figure 2**, features several different layers with a central core. The central core in this case is the platform which is responsible for presentation and control. It is surrounded by a first layer consisting of process scenarios. Each process scenario consists of a set of modules and utilizes the core as anchor. The second

layer comprises the orchestration of services to animate and connect the process scenarios. An outer layer carrying all published services finishes the construct. The GAMS system is completed by relevant external systems integrated into the logical architecture, as they provide many of the published services and most of the required input data.

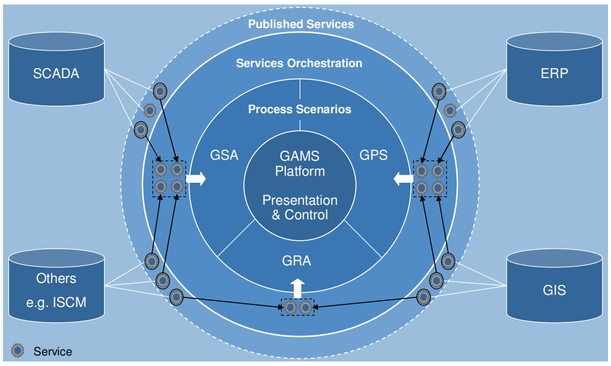

Figure 2: GAMS Logical Architecture

GAMS IMPLEMENTATION FRAMEWORK

Any actual project requires that both the GAMS reference process and the GAMS software modules are adapted to match the specific situation, needs and goals of the customer. For this process, the GAMS Implementation Framework has been defined. The Implementation Framework, see **Figure 3**, comprises six services and has been designed to fully support the value based project approach of GAMS considering the specific situation and history of the individual utility:

- **Value Engineering**
  - Matching of existing capabilities with capabilities of the business concept
  - Matching of current mode of operation with levers of the business concept
  - Creation of business case
  - Setup of value improvement program
- **Process Design**
  - Customizing of the process model
- **Business Packages**
  - Adaption of the implemented template processes
  - Identification and specification of missing adapters
  - Deployment of the adapted template processes on the platform
- **Enterprise Integration and Migration**
  - Implementation of standard interfaces to systems like SCADA, GIS, ERP
  - Implementation of non standard interfaces
  - Integration test
- **Platform Packages (Optional)**
  - Providing the complete platform (hardware, software, licenses, installation, configuration) required for GAMS, or parts thereof
- **Application Management (Optional)**

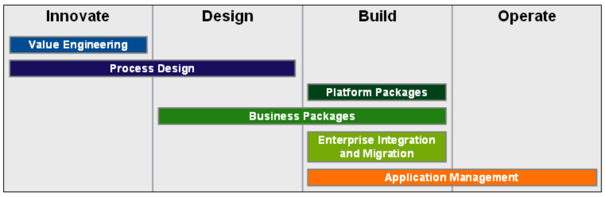

Figure 3: GAMS Implementation Framework

CONCLUSION

Utilities today have to find the optimal balance between cost efficiency and reliability – in an ever more complex and challenging situation characterized by a number of different technical and economic requirements. In this context the completion of asset management through capabilities that allow strategic and business value oriented management of the grid are a vital prerequisite for long-term entrepreneurial success and for securing the required system performance. However, practical application of Strategic Grid Management is still hindered in many cases by inappropriate process definitions and unavailability, or inaccessibility, of input data.
The Grid Asset Management Suite (GAMS) solution – comprising the GAMS process model and the related software modules – currently under development provides a reference implementation that can be easily adapted to build customer specific solutions for Strategic Grid Management. The flexibility of the strictly modular and process-oriented concept is supporting a precisely focused implementation addressing the most relevant levers to increase the efficiency in asset management and to improve the utility's value position.

The GAMS solution provides advanced and comprehensive analysis and monitoring of technical and economical performance of individual assets, asset groups and the system. The user is enabled to investigate the defined performance indicators in detail – thus providing valuable support in identifying weak points in the system and to derive inputs for more efficient power system design – also by analyzing "what-if-scenarios" in order to consider different alternatives and the related performance levels as a basis for decision-taking.

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