

# Towards a Systematic Planning of Standardization Projects in Plant Engineering

M. Amberg, M. Gepp and S. Horn

**Abstract**—In today's economy plant engineering faces many challenges. For instance the intensifying competition in this business is leading to cost competition and needs for a shorter time-to-market. To remain competitive companies need to make their businesses more profitable by implementing improvement programs such as standardization projects. But they have difficulties to tap their full economic potential for various reasons. One of them is non-holistic planning and implementation of standardization projects. This paper describes a new conceptual framework - the layer-model. The model combines and expands existing proven approaches in order to improve design, implementation and management of standardization projects. Based on a holistic approach it helps to systematically analyze the effects of standardization projects on different business layers and enables companies to better seize the opportunities offered by standardization.

**Keywords**—layer model, plant engineering, standardization.

## I. INTRODUCTION

THE plant EPC (Engineering, Construction, Procurement) industry is characterized by its diversity. Companies provide engineering, construction and service of industrial - especially large-scaled - plants for e.g. petroleum refining, chemical processing, iron and steel processing or power generation. Orders are processed in form of projects. Contract volumes range up to several hundreds of millions of dollars [1].

Plant EPC companies compete in a dynamic environment. They are challenged by competition, customer and investors to reduce costs and development time while meeting increasing expectations on innovation and quality [1], [2].

Those challenges intensify since competition gets broadened by the rising internationalization of this business, in the last years especially by an increasing number of Asian low-cost competitors entering the international market [2].

*These various influences on plant engineering industry result in three major challenges [1]-[3]:*

- Need to reduce costs
- Shortened time-to-market
- Increasing complexity of plants and machines

To be able to compete with a rising number of low cost providers, companies have to *reduce costs* for engineering, procurement, construction and other cost centers [1].

*Time-to-operate* of plants, machines and components is becoming shorter. In order to keep up with the competition companies need to shorten engineering time as well as erection time [1].

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Another challenge is the increasing complexity in plant EPC business. Motivated by the fact that bigger plants lead to significant cost reductions per production unit the size of projects grows. This involves an increase of complexity in projects not only on a technical level e.g. by an increasing number of components and interfaces but also by an increased organizational complexity caused by global coordination needs [1], [4].

To face these challenges and still remain competitive companies implement numerous improvement and optimization programs largely focused on efficiency.

One possibility to achieve better efficiency in plant projects is to increase the degree of reuse by the creation of reusable artifacts (e.g. process activities, process results). These artifacts are independent of a specific project, so they are suitable for repetitive use in several customer projects [5]. The creation process of such artifacts can be regarded as standardization. It is usually implemented in form of a project - a so called standardization project (SP). SP are usually not focused on one specific customer project, but are intended to create cross-project benefits.

## II. SYSTEMATIC APPROACHES FOR STANDARDIZATION

The term "standardization" is used in multiple ways in literature and industry. The common denominator is the concept of reuse. A short overview in the following will summarize common interpretations of standardization [6].

- 1) In a market context standardization describes the process of establishing technical standards. The development of such standards can be initiated by institutions like the International Standards Organization or by the companies internally.
- 2) Another interpretation considered in this article understands standardization as an improvement and optimization program. This contains approaches to increase the degree of unification of products and processes.

While 1) considers the impacts of standardization on whole markets and society 2) focuses on the effects on a business' performance. The best-known effects are the improvement of cost, quality and time through the management of technical and organizational complexity [6].

Analogous to the varying interpretations of the standardization term the concepts about standardization content as a business improvement program differ, too. Each SP consists of a specific set of methods and measurements assembled by the company to realize its standardization goals [6].

Despite of their specific assembly SP primarily help to manage complexity in the three areas resources, process and results (Fig. 1) [7]:

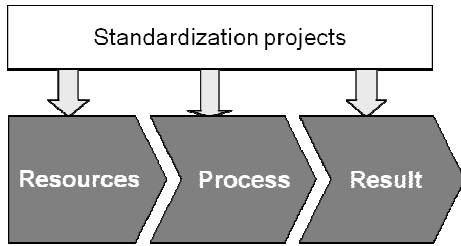


Fig. 1 Categories of standardization projects

The field “resources” describes prerequisites necessary to enable a plant manufacturing company to process orders, like employees, knowledge or IT-tools and their data formats. The most common approach in this field is tool standardization where companies try to standardize their data and their IT-tool landscape.

A process describes the way people should work in a company. Process standardization is intended to make processes more efficient by increasing the repeatability of process activities. It is typically part of the domain process management.

The field “result” addresses the output of a value-added process, mostly on a technical level. Results can be components and parts, machines, but also mechatronic products, services or software. A popular standardization approach in this field is based on modularization of products or plants and the respective module standardization.

### III. THE LAYER MODEL

#### A. Motivation

The authors analyzed eight SP a large global plant EPC company implemented to improve its engineering projects. The SP where applied to engineering projects of airport baggage handling systems, metal processing as well as power transmission and generation. The analysis showed that SPs had various influences on the business as well as vice versa which we will illustrate in section C to G. These influences had been of strategic, tactic and operative nature; they were affecting different departments of the company and were acting along the supply chain.

To ensure the success of their SP, project managers need to consider these mutual influences when planning and implementing SP. To manage the complexity and the large number of these influences categorizing these impacts is an appropriate approach. The authors propose a model-based approach to structure categories for such complex relations. To integrate all relevant influences a holistic design of the model is necessary.

Literature already proposed a model which provides a holistic view on enterprises and is suitable to structure influences on business areas: the EFQM-model [8]-[10]. But the focus of the EFQM-model lies on traditional, functionally organized, permanent organizations which fundamentally differ from dynamic project organizations [11]. This difference makes it difficult to use this model in project business [10].

Westerveld's Project Excellence Model adapts the EFQM-model for the use in project business. It consists of two distinguishable categories containing project success criteria and critical success factors. The varying structure of organizations in project business (e.g. project size, uniqueness) is considered by the definition of project types [10].

For planning and implementing SP the authors propose another model which has been developed in engineering consulting practices and improvement programs in plant EPC business – the layer model. Like the Project Excellence Model it provides categories (=layers) to structure influences, success criteria and success factors, but integrating them into a single compact model. By putting those categories into a hierarchical relationship it is also suitable to visualize influences of SP on business areas and vice versa. Since it has been applied and validated already for other types of improvement programs in plant EPC it can easily be adapted for SP in this field.

#### B. Structure

The model consists of six layers. The layers are hierarchically structured and clearly distinguishable by their content. Each layer is representing a specific level of management and planning in an enterprise (Fig. 2)

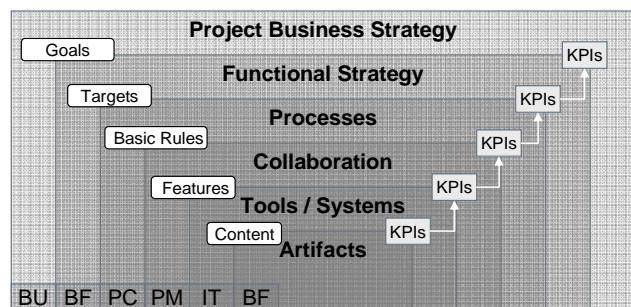


Fig. 2 The layer model

Each layer addresses questions, problems, targets and measurement issues which should be taken into account when planning or implementing a SP. These issues are specific for every company and it's SP.

The layers have assigned owners (BU: business unit, BF: business function, PC: process management, PM: project management, IT: information technology department) responsible for the design, management and controlling of the layer. There are outer and inner layers. The outer layers are a framework for the inner ones. They define guidelines, targets and control mechanisms. A staged key performance indicator (KPI) development procedure allows the measurement of the performance of respective inner layers.

The number of layers can be tailored to correspond to the organizational structure of an enterprise.

For this model the authors suggest a linear progression through the frames in a sequential manner from the outside to the inside. The following paragraphs illustrate how the layer model can be applied and how the mentioned influences on and of SP can be assigned to a specific layer. For a better understanding just one single business function is being

considered. The description of each layer is completed with a practical *example* of the analyzed SP in plant engineering.

### C. The Business Strategy Layer

This layer is a framework to structure influences of standardization on the business on a strategic level and vice versa.

On this level the overall goal of standardization is defined. It is important that the goals of SP are conform to the business strategy: an SP only focusing on costs might contradict to the company's quality strategy.

If there are other business improvement programs SP needs to be coordinated with respect to synergies or even conflicts.

In the end the overall performance of an SP must be monitored on a strategic level to justify the SP effort. This is achieved by setting goals for the functional strategy and installation of meaningful KPIs, derived from the company strategy.

*An overall goal of a SP can be the improvement of the competitive cost position.*

### D. The Functional Strategy Layer

On this level the business strategy is broken down into more concrete functional strategies, which are assigned to a specific business function. In plant business they typically consist of research and development, engineering, procurement, construction and service.

Each functional strategy shall support the business strategy. But in many cases companies do not have consistent but conflicting functional strategies. While procurement usually is cost savings oriented, engineering strategies are quality driven. When planning a SP, it has to be decided which functional strategies have to be primarily supported.

*To support the goal "improvement of competitive cost" a company can move from its functional strategy of pure order specific plant solutions to an approach that is based on pre-developed standard products.*

### E. The Process Layer

Processes are a formal description of operative work and implement the functional strategy on an organizational level. They are designed to ensure that work meets the targets set by the functional strategy by defining how people should work together, which tools they should use or which results they should produce.

Impacting this layer an SP defines processes suitable for developing standardized products. It further requires the definition of the degree of formalization of process description, as well as the evaluation of interfaces to other processes and finally the estimation of cost for process changes.

*To support the functional strategy a common process to develop, use and update standardized products has to be defined.*

### F. The Collaboration Layer

This layer summarizes all collaboration activities on an operational level. In contrast to "process" it contains all

activities which are actually done by the employees – the lived processes. Ideally those activities follow the processes defined on the process layer. Practically there is a certain degree of difference between defined processes and lived processes.

When planning an SP it has to be ensured that standardization addresses and improves the lived processes. Otherwise the effect of an SP would remain on a process definition level rather than being visibly implemented in the organization. This requires an analysis of current workflows and a mapping to the processes on the process layer.

The appointment of a promoter or owner, a person who is responsible for standardization of e.g. a product line drives long term implementation and prevents standardization efforts from dying after some time has passed.

Also the need for training and qualification measures for employees has to be considered to successfully implement SP in a company.

*After the definition of the process SP managers have to assign responsibilities and analyze the as-is workflows and design review a systematic.*

### G. The Tools and Systems Layer

This layer addresses tooling aspects regarding the implementation of tools to support standardization efforts or the standardization of tools themselves. After reviewing suitable data concepts and system architectures a decision has to be taken which tools need to be standardized and how.

When introducing a new tool its implementation in the existing software landscape has to be considered, as well as interfaces and influences between the respective other tools of that software landscape. Economic considerations like investment cost estimation and maintenance costs are just as important as the definition of the scope of customization.

*The development of standardized products requires the definition a globally standardized tool landscape, the definition of a tool environment for the administration of product data and global Engineering collaboration.*

### H. The Artifacts Layer

Artifacts are the output of operative activities i.e. what can be sold to the customer. They range from physical products like machines or components to lists, models, drawings, documentation or software.

When standardizing artifacts, at first it needs to be identified which artifacts and which functions of the artifacts are essential for customer satisfaction. Then managers of the SP have to decide how to modularize these artifacts and which modules are suitable for standardization.

*This layer contains the definition of type & degree of standardization as well as the prioritization of plants and products to be standardized.*

## IV. VALUE CHAIN INTEGRATION

A holistic view requires that the model is not only used for analyzing the impact of standardization in one business function. Depending on the cross-functional impact of SP, the layer model can be extended to the intra-corporate value chain (Fig. 3)

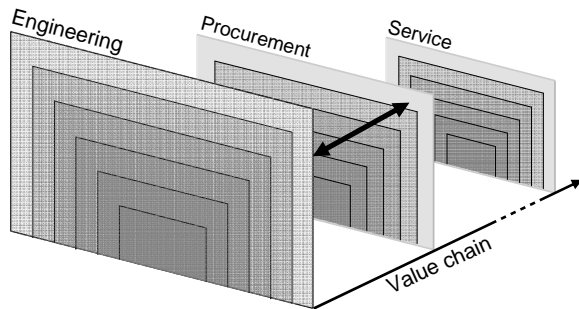


Fig. 3 Cross-functional implementation of the layer model

Particular attention must be paid to dependencies and interfaces between the layers of different value chain positions e.g. between functional strategies or cross-functional processes and tools. This helps to get an overall picture of how standardization can affect a company.

#### V. SCOPE OF APPLICATION

The main purpose of the layer model is the systematic structuring of impacts of SP on business and vice versa. An open time horizon helps structuring both short and long-term effects of standardization.

The authors suggest using this model as a framework for categorizing influences, success factors, risks and benefits, costs and efforts of SP. Additionally it can support the management in investment decisions for SP.

#### VI. CONCLUSION

SPs are an optimization program wide in scope. They have various impacts in large parts of a company, but standardization effects are not leveraged fully. The holistic approach of the layer model will lead to a better systematization of these impacts and will help to better seize the opportunities of SP. The layer model supports the planning and implementation of SP. It cannot guarantee the success of SP but it should help management to reduce risks by providing a framework for consideration of standardization effects. It has not been designed to be overly prescriptive but to be a tool that should be of benefit in the planning, implementation, management and controlling of SPs in plant EPC business.

#### VII. OUTLOOK

This paper proposed an approach to systematically analyze planning and implementation of SP in plant EPC based on a layer model. This approach is currently applied and further developed at Siemens AG [13]. Research showed that it is impossible to generate a universal checklist of project success criteria suitable for all projects. They differ from project to project depending on a number of attributes [10], [14]. Analogous the choice of appropriate content and KPIs for each layer in the layer model to describe an SP is up to the respective company. The definition of a reference catalogue from which companies can choose content and KPIs adequate to their needs is subject of further study.

To apply the model meaningfully, the quality of the data is critical. To evaluate adequate data it is advised to identify and involve experienced individuals in a company. They need to have an overview and significant knowledge about the company's operations and key areas where impact of standardization can be observed. At the same time, these individuals also need to have business knowledge to be able to assess the economic benefits of the use of standards.

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