

Commonalities in the Development Process

Part 2: Increased Development Efficiency with Modular Product Architecture

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Abstract:

Structural commonalities allow for a more efficient product development process through stable and modular product architectures. They enable the modular product development, which eases the coordination of partial project and allows for more flexibility with regards to the integration of new customer requirements. The concentration on fewer technological solutions (commonalities) increases the competitiveness of companies.

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Part 1: Increased Development Efficiency with Modular Product Architecture

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The first part of this article described that cost savings through commonalities cannot only be realized in the order processing process, and how additional advantages in product development efficiency can be created. Structure, solution, process and component commonalities are the four types of commonalities that were derived for the development process. Thereby the commonality structure is of particular importance, as it forms the basis for the three additional forms of commonalities. In this second part of the article, the effects of common structures and solutions will be described in more detail.

Commonality of Structures

The more complex a technical product, the more important is the interpretation of the product as an overall system in the early phase of product development. This is valid concerning the future functionality and thus the market acceptance of the product, as well as the definition of the total product costs. A common design of principle structures within product families has therefore substantial effects on the following development process.

Consistent System Design: For the overall design of a complex mechatronic product, the fundamental mode of operation of the product is fixed. Therefore, very frequently, a heterogeneous team with different experts is necessary. However, this sub-process does not have to take place for each variant individually. An intelligent and comprehensive system layout can be used as a basis for several product derivatives.

A standardization of the conceptual system design is also interesting for plant engineering since the order-specific engineering portion can thereby be limited. This presupposes an intelligent product architecture designed for longevity.

Efficient Variant Configuration: A stable, modular product architecture forms the basis for an economic supply of a broad product assortment. It allows for the generation of individual customer solutions on the principle of combination instead of reconstruction. If a component has to be changed despite the combination possibilities, it only requires the change of one module in the case of a product structure with an efficient variant configuration. Customized adjustments are thus shifted from the system level to the component, or respectively, the sub-assembly level.

A High Degree of Innovation: Common structures do not only support the efficient fulfillment of customized requirements. In a similar way, novel functions or technologies can also be integrated with little expenditure of time and money into existing products or derivatives. New products developed in such a manner, thereby differ only in local changes to the existing range of products and services. However, the customer often perceives them as true innovations (Fig. 1).

Transparent Project Organization: Due to temporal bottlenecks, complex development projects are accomplished not only by several persons, but frequently also by several teams. These teams are sometimes at different locations and even work at different companies. Traditional development projects place substantial demands on the organization and coordination of the overall task. Modular product architecture is based on a detailed description of the system interfaces between the individual modules. This structural information can partly or completely take over the coordination of the development projects. Across departments problems rarely arise. This decoupling leads to highly efficient teams. A stable and modular product architecture supports the cooperation of several companies during development projects, as well as the integration of externally developed subsystems. Thus, the ability of a company to work in networks increases.

Structured Knowledge Management: Transparent product structures lead to a clear breakdown of the development task and create a distinct image of the competencies, which is needed for these tasks. The commonality structure leads to two effects for knowledge management: On the one hand, the learning process of the individual engineers is accelerated by focusing on the subtasks, on the other hand, the transparency of the technological know-how existing in the company increases, which considerably improves its usefulness.

Commonality of Solutions

Because of the already mentioned distribution of development projects into subtasks, the probability also increases that similar or even the same problem definitions for different parts of the product or customer groups arise. The separate development of these sub-problems frequently creates completely different solutions. This leads to a variety of solutions, which does not represent added value to the customer, and therefore would be classified as unnecessary variance. If the similarity is however already considered by sub-problems during the structural lay-out of an overall product, the reusability of solutions is increased considerably. Such common solutions however, should not be understood as final components in this circumstance. The solution should comprise the principles and transferable product technologies as well as predefined and properly documented technical solutions.

Common Basic Engineering: Many companies try forcing the re-use of existing solutions through central and generally accessible databases. Due to the very often complex search, and the different individual abstraction and/or description of the problem, the effects of having a centralized database frequently lag expectations. Active commonality management however, relies on the planning of uniform solutions. Based on the identification of the similarity of sub-problems in the early phase of development, the use of common technical principles can be substantially supported by the targeted structure of the overall system.

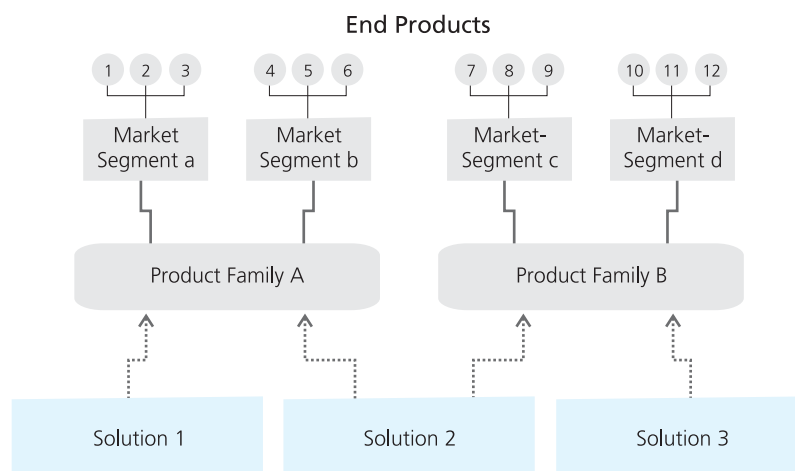


Figure 1: Solution Competence as a Basis for Broader Market Success (following Hamel/Prahalad 1990)

Focused Technology Development: The concentration on common solutions can also be used to bundle resources in technology development. For substitutable technologies, the concentration on only one competence is desirable to achieve complexity reductions. The broad application of an internally developed technology in several products can not only create a crucial competitive lead in the market, but also increase the profitability of technology development through the use of an already established expertise. Since production technologies only have an indirect influence on the products, and therefore are usually not strongly affected by the dynamics of the market requirements, such commonalities can be realized more easily than with product technologies.

Market Expansion through Competent Solutions: Further potential of managing commonalities of solutions consists of transferring the existing technological know-how of a product family to other products and markets. The broad use of competencies for several market segments does not only lead to a higher return of the performed investments for the development of the technological know-how. By extending the development capabilities into different application areas, an advantage can be developed compared to competitors, who concentrate only on a few target markets. The technological position of the company is thus secured in all markets (Fig. 2).

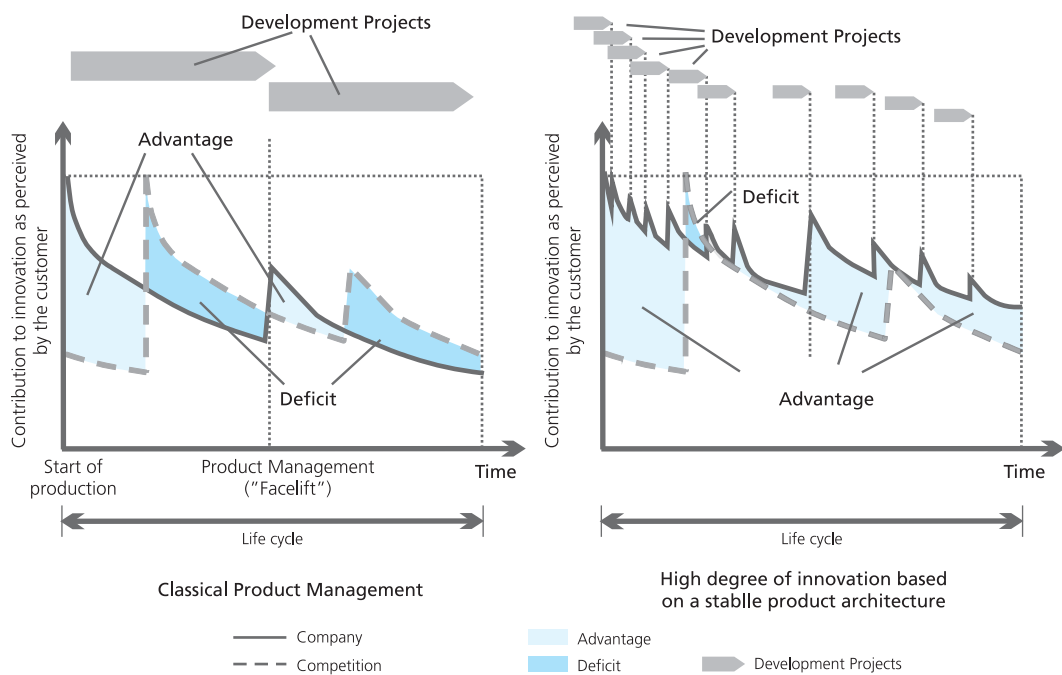


Figure 2: Maximization of the Perceived Degree of Innovation

Common Use of Virtual Product Models: Information technologies also become of increased importance during the product development process. The increasing use of virtual product models and the associated large proportion of software-supported development activities, as well as the functionality of these new technologies speak for the fact that the thought of commonalities is also applied to these processes. To be precise, in this context efficiencies can be obtained through the flexible organization of product models, which allow for the re-use of electronic data. Systematic variant planning, in consideration of the crucial flexibility parameters, makes the development of such virtual models commonality possible. The effort to create such a model is only incurred once. The detailed engineering for different derivatives can be automated or at least be derived from the principle model with few efforts.

Conclusion

By performing long-term planning of product programs and creating targeted commonalities, development processes can be performed more efficiently. The design of modular, solid product architectures make the use of structured commonalities possible. Common solutions are based on principles. Companies avoid being forced to reinvent the wheel every time and facilitate the focused use of development resources.

In the next issue of the Complexity Management Journal, the possibilities of component and process commonalities are described. Likewise, a development process with commonalities in mind is outlined.

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