

Resource Flexibility and Innovation Capacity through Product Family Management

— A Case Study —

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Summary

As an answer to the challenge for managing the complexity of offering greater product variety, firms in many industries are considering platform based development of product families. Key in this approach is the sharing of components, modules and other assets across a family of products.

In this case study we use the segmentation of product family and processes as a hierarchy building principle to combine an effective market positioning with an efficient process organization. Based on a detailed case study, we argue that building a product family based on a layout platform is a powerful strategy for reaching competitive advantages in case of complex products and systems. Combined with the segment-specific restriction of the product family, different market segments can be served while retaining effective differentiation. The saved process resources can be effectively used for increasing engineering and sales capacity, and for strengthening the innovation capability of a company.

The Case: Transport and Sorting Systems (TSS)

The company contributing to this case study is dedicated to the design, implementation and service of automated material handling systems. With sales exceeding 300 million US\$ and over 900 employees, it is on of the world's top suppliers of automated transport, storage and sorting systems for application in baggage handling, manufacturing, distribution, and express delivery services.

Initial Situation

Transport and Sorting Systems comprise the unloading, transport, sorting, and loading of parcels for express delivery. The system receives parcels unloaded to multiple collection conveyors, identifies their destinations, transports the parcels to one or multiple sorters, where they are sorted to their destination points and loaded for further distribution. While the high-capacity market segment is dominated by few rivals, the low-capacity segment is characterized by a distinct cost pressure due to the competition against manual sorting systems and by many (often local) suppliers. Many efforts to enter the lower price segment with the existing systems approach had proven unsuccessful due to difficulties in realizing effective reuse potential regarding concepts and designs. The relatively high (compared to the system price) engineering cost for the single line systems prevented establishing a strong competitive position in a market where many local players compete and where cost leadership is essential.

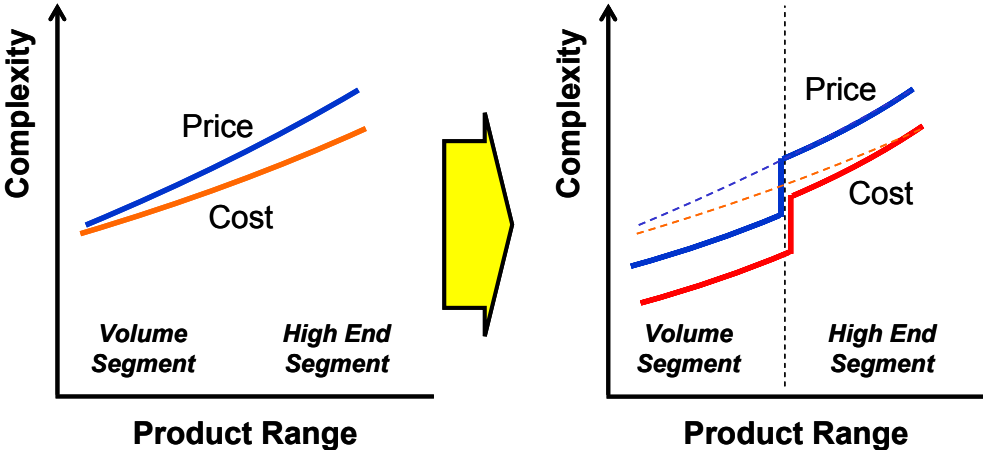


Figure 1: Goal of Product Family Segmentation

The systems are built of different subsystems which are arranged in a system layout. A virtually unrestricted combinatorial variety of assemblies and their arrangement in a system layout leads to increased complexity in controls and operations design and cost of commissioning and testing. The analysis of the product architecture showed high levels of variety resulting in high process complexity in both market segments.

Although the modular product architecture on the *assembly* level resulted in a high degree of component reuse, reuse on the *system* level could not be consistently realized from project to project. Especially the customer-specific design of the system layout resulted in high levels of detail engineering, and increased project costs and risks. The inefficient use of resources lead to high system cost and lead times in the volume market segment; in the high-end segment it lead to a resource bottleneck and limited the resources available for development, research, and innovation activities.

New Product Family Concept

Typical characteristics of complex systems are hierarchic product architecture and high levels of freedom in architectural choices. This can lead to considerable complexity and risk in design, engineering and manufacturing. The overall goal in this case was to realize a segment specific product range built on a common basis, and supporting distinct processes and process cost. The basic idea of using the platform concept was to search for commonality potential across all market segments with the goal to increase the reusability of concepts, especially in the low end market.

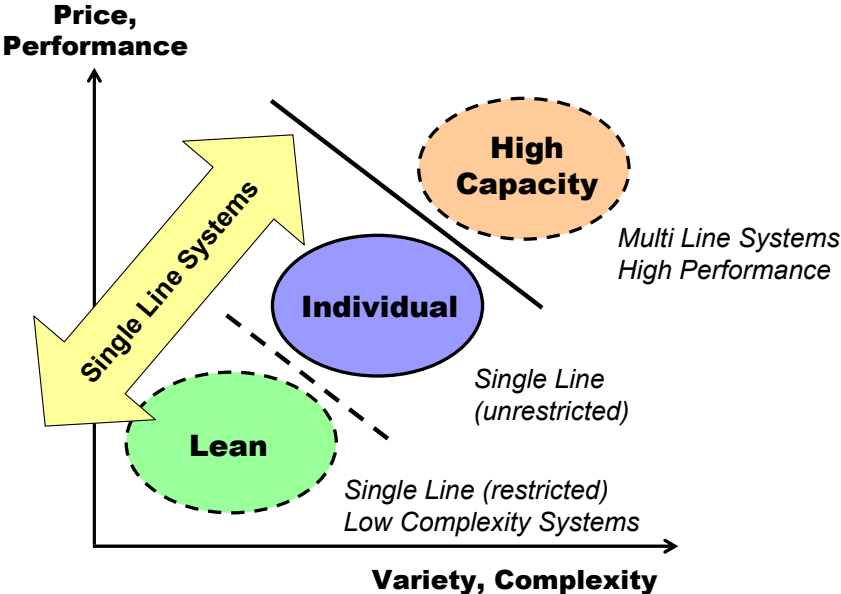


Figure 2: Product Family Segmentation Concept

The new product family concept is based on the following principles: (1) the separation of high-end (multiple lines) systems from the single line product family; (2) the standardization of the system layout for the remaining single line systems (commonality); and (3) the segment-specific definition of restrictions and processes (differentiation). This results in three market segments (cf. fig. 2). A *high capacity* segment for (complex) multi line systems and two segments for single line systems: The *individual* segment without restrictions and the *lean* segment with standards and restrictions to allow for the efficient reuse of concepts and elements to reduce engineering efforts and risks.

The new concept is based on the commonality potential on the assembly and on the layout level, while segment specific variety and system integration allow for differentiation. The commonalities of the product family are (1) standardized assemblies (product platforms) and (2) the standard arrangement of these assemblies (layout platform). Starting from a product range based on a standardized layout, segment specific restrictions were defined. *First*, the combinatorial variety of subsystems used in the system design was restricted to 14 predefined *system types* (cf. fig. 3). These system types were selected regarding (1) the sales history and expectations, to cover most known market demands with the lean concept, and (2) the engineering complexity, to ensure the exclusion of highly complex systems. A *second* deliberate restriction was made concerning the maximum *system capacities* and other critical *functional options* of the selected systems to ensure for simplified system design, engineering, installation, integration, commissioning, and testing. The *third* level of restriction concerned the *equipment* to be used by lean systems. Here, rules for equipment selection and system design were defined to limit system design and engineering efforts and to ensure the risk-less integration of equipment into the system.

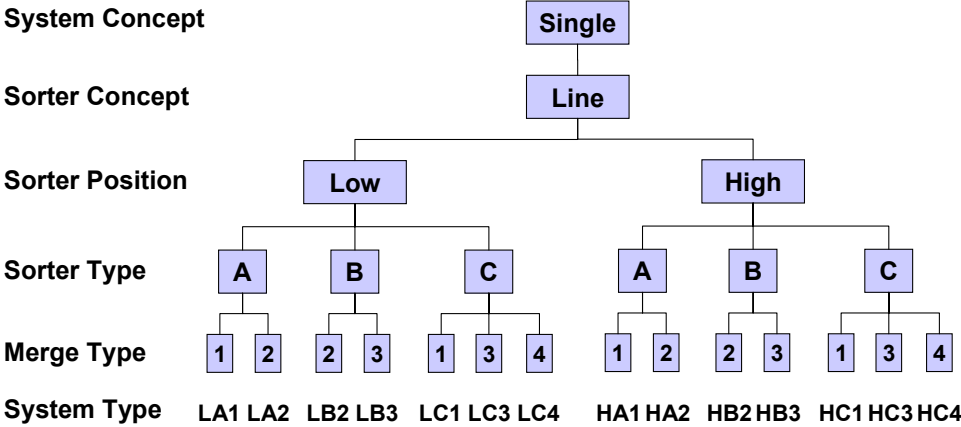


Figure 3: Restricted Single Line System Types

Segmentation Effects

The resource savings in the lean segment are realized by the segment-specific restrictions of system types, capacity, other functional options, and equipment. In the low-end (lean) market segment, the selection of predefined, highly pre-engineered systems is allowed, and the integration of the system is limited to a standard concept which prohibits the interconnection of multiple systems. In the individual market segment the full variety of systems and options (within the range of a single line layout) is offered, which leads to considerable efforts in the specification and realization of the system. As a result, the system layout defines clear boundaries for the product family which reduces design and engineering uncertainty and risk.

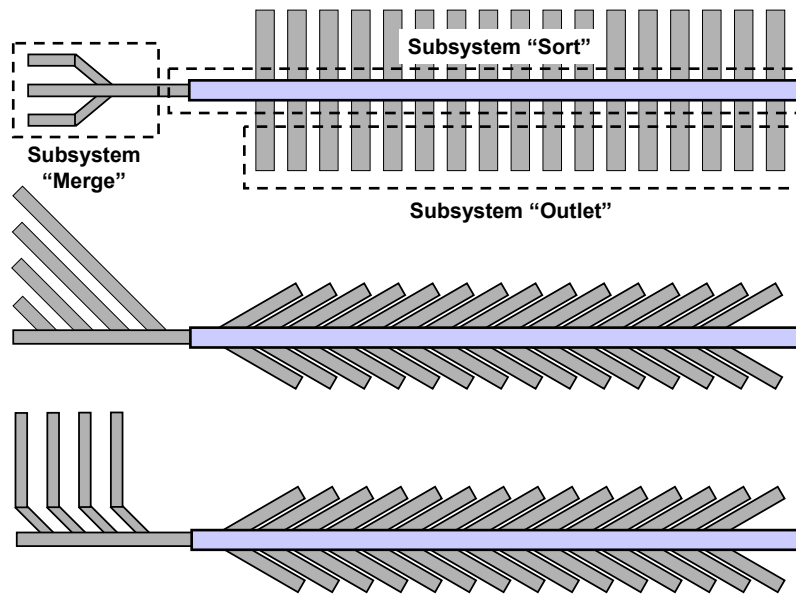


Figure 4: Single Line System Types (Sample)

Project-specific engineering profits from the reduced complexity in the lean segment through the restrictions on product (type), layout, capacity, and equipment level. The standardization of the subsystem arrangement facilitates the technical configuration of the overall system and supports the integration of controls systems. The order processing can be designed in a segment specific way. This helps to realize substantial time and cost savings through lower efforts for system specification, engineering and installation, and simultaneously lowers the operational risk in this market segment. The resources saved through lower complexity in the volume segment can be used for the more demanding handling of added-value tasks in the individual segment. The reuse of existing concepts is furthermore a means to achieve scale effects and to increase planning reliability in procurement and production.

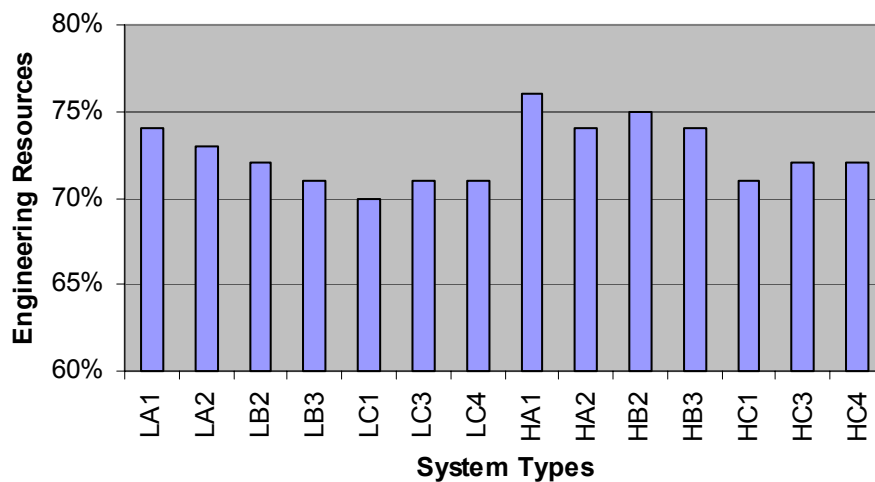


Figure 5: Engineering Resources needed for lean (vs. individual) Systems/Processes

Figure 5 shows the effects of process segmentation on engineering and project management hours for different system types (for individual versus lean systems). Over the whole range of single line systems, the lean systems can be realized with resource savings of 24 to 30 percent. Absolute savings are in the range of several hundred hours per project.

The resource savings of up to 30 percent for lower-complexity systems through the realization of lean processes has further influences on efficiency: (1) engineering capacity increases by 30 to 40 percent with the same resources, (2) order lead time is reduced by 10 percent from an average 25 weeks to 22 weeks, (3) a lean project can be realized by a considerably smaller team, and (4) engineering and order processing precision improves, resulting in lower project risk regarding calculation (over- and underpricing) and project engineering and system integration/testing.

The definition and design of segment specific systems and system variety is the key to entering the low-end market with a restricted range of products, and within clearly defined cost targets. Based on the sales history and market demand analysis, the new (lean) systems and processes are suitable for at least 50 percent of the expected sales volume (of single line systems).

Besides the advantages in market positioning, the increased engineering capacity can be employed for increasing sales, and for realizing product innovation activities through the availability of experienced (and former unavailable) engineers. In general, these effects are the basis for a strong market position through a highly competitive product range, realized by segment-specific, efficient processes.

In the medium-term perspective, the concept offers further opportunities: (1) the ability to extend the defined lean processes to encompass more system concepts and variety (without adding complexity), and (2) the leverage effect, when the concept will be adapted to other business areas.

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