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Future Alternatives for Automotive Configuration Management

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Abstract

This research investigates the phenomenon of increasing cost that results from growing product complexity. To explore this phenomenon, interviews with ten senior managers and engineers with long experience in the automotive business were conducted at a car manufacturer. The interviewees agreed that configuring cars becomes more time-consuming and costly with increasing product complexity. In this paper we reason that there are upcoming solutions suitable for complex configurations. As a basis for this, we propose a distinction between limiting and managing product complexity, and stress that these approaches affect internal cost over time differently. If companies choose to limit complexity we suggest optimizing configuration rules, reducing variants or both. Conversely, we propose and contrast two different configuration strategies for managing complexity, 1) the Modular approach, and 2) the Configurable Component (CC) approach. The Modular approach may limit the ability to change. However, only few changes in manufacturing systems are needed. The CC approach is a long-term fully flexible configuration approach prepared for changes. As a drawback, the CC approach may involve high fixed costs due to the need for suitable manufacturing systems. We conclude that both the Modular approach and the CC approach are feasible for managing complexity. In a long-term perspective, it might be necessary to be able to prepare for change and reduce internal cost over time. The choice of limiting or managing complexity might therefore be a demarcation of future competitiveness.

Keywords: Configuration ; Product Complexity ; Internal Cost ; Modular Platform ; Flexible Product Architecture

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1. Introduction

The traditional research on platforms and component reuse often focuses on economies of scale for manufacturers of consumer goods in the production phase[1]. In the beginning of the 20th century Ford's mass production system dictated that identical products should be produced over and over again to reduce overall cost of manufacturing. Prices went down, the mass-producing companies became successful by offering mass-produced goods, and workers' salaries went up. However, in this paradigm companies discovered a market for customized products, which they targeted with niche products for specific customer needs. These customers were prepared to pay a premium for a customized product. What we can see now is upcoming enablers, both in manufacturing and design, to further integrate design, configuration and manufacturing processes. Advanced manufacturing systems and configurable products let companies benefit from a low-cost production in a long-term perspective while being able to offer personalized products.

1.1. Product Architecture in the Automotive Industry

In recent decades, car manufacturers have increased investments into product development and manufacturing processes in order to reduce internal cost[2]. In this way, companies also address issues concerning the product architecture and how to adapt when customer needs change over time. Widely defined, product architecture is "*the scheme by which the function of a product is allocated to physical components*"[3]. In these terms, a product's architecture is intended to carry benefits such as commonality across product variants whilst each individual variant is perceived as distinct by the customer[4].

Product complexity is increasing. This complexity is typically addressed by implementing a platform strategy to either serve several products or brands (in time) or to prolong the product's lifecycle and make it upgradeable or suitable for face-lifts in the future (over time). A platform strategy may be introduced to increase the reuse of components between products and the reuse of processes, as for managing internal cost[5]. Therefore, a product's architecture defines the essential economies of a product, while it extensively may affect company results[6].

1.2. Configuring Products within and outside the Platform's Design Boundary

In addition to the definition above, a platform may also be defined as "*a set of subsystems and interfaces that form a common structure from which a stream of derivative products can be efficiently developed and produced*"[7]. Thus, a platform can be the basis for a range of products that are configurable within a specified design bandwidth, manufactured and available for customers over a given range of time. However, while customer needs evolve, the tangible platform may become out-dated, forcing the development of products outside the design boundary of the platform. The design bandwidth can, in this context, be described as the platform's feasibility in different products within a given variation in design[8]. An illustration of an arbitrary design bandwidth is shown in Fig. 1.

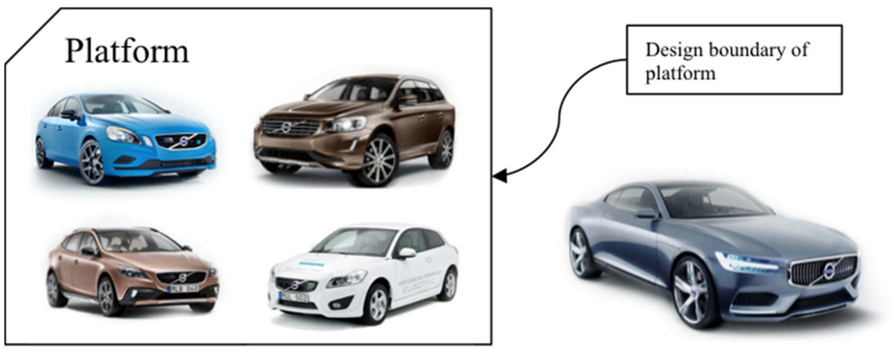

Fig. 1. Illustration of an arbitrary bandwidth of a platform, where a number of product variants can be found within and outside a platform's design boundary.