

Brownfield Process: A method for modular product family development aiming for product configuration



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Modularisation, product platforms, product families and product configuration are efficient product structuring tactics in mass customisation. Industry needs descriptions of how the engineering should be done in this context. We suggest that key engineering concepts in this field are partitioning logic, set of modules, interfaces, architecture and configuration knowledge. A literature review reveals that methods consider these concepts partly or with different combinations, but considering all of them is rare. Therefore, a design method known as the Brownfield Process is presented. The method is applied to an industrial case in which the aim was rationalisation of existing product variety towards a modular product family that enables product configuration. We suggest that the method is valuable in cases with similar goals.

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End users of products can be segmented into different market groups based on the same kind of expectations related to the products (Liu, Kiang, & Brusco, 2012). There are companies which are competing for the share of a single or several market segments. When a company has to consider customer segments with changing requirements towards products, the cost effectiveness of offering product variants is one challenge. This paper studies this kind of environment. Our research background is familiar with studying companies that operate in projecting business and produce products in small series (the size of a series can be just one). In these surroundings, the costs of engineering are relatively high in comparison with the cost of producing the product. The case discussed in Section 2 considers similar context. Product variety describes the number of different versions of a product offered by a firm at a single point in time (Randall & Ulrich, 2001). Companies should be able to respond to different customer needs while keeping their operations profitable. For this challenge, modularisation, product platforms, product families and product configuration are suggested

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product development tactics, which are considered as part of the mass customisation paradigm (Pine, 1993).

Linking modularisation, product platform and product family development approaches with product configuration aspects is unusual in design methods, although these tactics and their importance are highlighted separately for supporting design reuse and enabling several benefits in the business environment of companies. Consequently, there is a need to study how to structure the key engineering concepts in this field and how these concepts could be synthesised in order to support a design situation in which existing product variety should be rationalised towards a modular product family that supports product configuration. The focus is on the existing product variety because for example Oja (2010) describes that the designing of a completely new product is rare in the manufacturing industry because of the risks.

The paper presents a more advanced method description of our approach to modular product family development compared to the earlier publication (Lehtonen, Pakkanen, Järvenpää, Lanz, & Tuokko, 2011). Considering the research method, the current situation was analysed first. The original method description did not consider the most relevant modularisation aspects, though they were considered in the same industrial case discussed in this paper. This conclusion was supported by the literature review and also empirical findings from other projects on modularisation prior to and following the case. As an outcome of the review, an improved design method for modular product family development was described. Validation of the results is based on existing research and academic publications, in which many of the suggested tools and approaches have been presented separately and demonstrating the use of method in a case. The case experiments were originally performed during 2010–2011.

The background of the research context was discussed briefly in this section, but the literature review is continued in Section 1. A modular product family development method for configurable products is presented in Section 2. In Section 3, the conclusions are discussed.

1 Background and motivation

This section focuses on existing research on product family development and product configuration based on standardisation and modularisation.

1.1 Standardisation and modularisation

Standardisation is an important enabler of design reuse and refers to a situation in which several components are replaced by one component that can perform the functions of all of them (Perera, Nagarur, & Tabucanon, 1999). Pahl and Beitz (1996) emphasise that designers should always use readily

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