Editorial

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1 Introduction

The six papers published in this special issue all deal with modularisation in the automotive industry. Modularisation is a concept that has become very common among many companies in the industry during the last couple of years (Anderson et al., 2001). Recently each and every automotive company has been talking about modularisation, especially in Europe (Takeishi and Fujimoto, 2003).

Modularisation is used by automotive companies for different reasons and purposes, for example to deal with the constantly decreasing product life cycles (Bullinger et al., 1995). For example, the Volvo 240 car was launched in 1974 and not taken off production until 1993. Its life cycle was almost 20 years. The Volvo 850 was on the market from 1991 until 2000, thus for 9 years. Further, at the same time as the product life cycles are decreasing, the product variety is increasing (MacDuffie et al., 1996) – that is, an increasing number of different product models as well as variants is offered to customers simultaneously. For instance, cars become more and more customised (Clark and Fujimoto, 1991). Today, customers can make their own choices of colour, seats, and steering wheels. In addition, the development time for new products has decreased. Oliver et al. (2001) found in a study of Japanese auto makers that the development lead-time decreased from 27.7 months in 1994 to 18.3 months in 1999. Together these trends imply more re-use (Muffatto and Roveda, 2002) of components, knowledge, production facilities and processes etc. This is done in order to decrease development cost as well as development time. One approach for doing so is to implement a modularisation strategy and use modules in the development and manufacture of products.

An example of a company having a modularisation strategy is Mercedes-Benz (presently Daimler-Chrysler), which introduced modularisation on a large scale in the end of the 1990s, for example in their plant at Vance in the USA. In this plant they assemble cars from relatively large subassemblies, or modules (Takeishi and Fujimoto, 2003). But there are also a few examples of automotive companies having a long history of modularisation. The truck company Scania successfully employed a modularisation strategy already in the 1940s (Johnson and Bröms, 2000). Each Scania truck is built up with four major modules: the engine, the transmission, the cab and the chassis. The challenge is to standardise these modules so that any size of one module is capable of fitting together with all sizes of the other modules. For example, each of the three different types of cabs will take any engine size (there are four different sizes). This has been made possible through standardised module interfaces, in this particular case by locating the attachment mounts in identical places in all three cab designs to hold all the varieties of engine sizes. Each of the major modules has also been divided into smaller, self-contained modules (Johnson and Bröms, 2000). By making only minor

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changes in some of these smaller modules it becomes possible to affect the performance of the whole truck. Using this modularisation strategy, the company can create trucks that are customised to the individual customer, but still maintain economies of scale in manufacturing.

Another example is the Smart car, developed in the mid-1990s by the joint-venture Micro Compact Car (MCC), consisting of the German car maker Mercedes-Benz and the Swiss maker of Swatch and Longines watches (Gould, 1999; Takeishi and Fujimoto, 2003). MCC decided upon a design of six different major modules, such as cockpit modules, rear axle modules, and door modules (Takeishi and Fujimoto, 2003). At the same time, they implemented a corresponding organisational structure.

2 Benefits of modularisation

The essence of modularisation is the building of a product from smaller subsystems that can be designed independently, yet function together as a whole (Baldwin and Clark, 1997). Personal computers, for example, often consist largely of modular components like hard disk drives, flat screen displays, and memory chips (Langlois and Robertson, 1992). Through establishing standardised interfaces between the modules, companies can independently develop and produce modules that can be assembled into highly customised final products. The benefits of implementing a modularisation strategy are many. Three of the most commonly discussed benefits are as follows.

- The division of a product into decoupled modules which are independent of each other allows a company to *economically increase product variety* that can be offered to customers (Starr, 1965; Sanchez and Mahoney, 1996; Baldwin and Clark, 1997; Ulrich and Eppinger, 2000). Companies can create customised products and still maintain economies of scale in the individual modules (Starr, 1965).
- Modularisation can also *create strategic flexibility*, since it increases a company's ability to respond to various demands from dynamic competitive environments. The strategic flexibility can be increased since it becomes easier to re-use modules across product models or model generations (Worren et al., 2002).
- Modularisation allows *reduced task complexity* and enhances the ability to complete tasks in parallel (Ulrich and Tung, 1991; Sanchez, 1996). The modularisation of a product means that it becomes decomposed into nearly independent modules, which makes possible the concurrent development of modules and components to be carried out autonomously by loosely coupled organisational structures (Sanchez and Mahoney, 1996). One example of this is MCC's development of the Smart car, a product divided into six major modules, with a development organisation corresponding to these modules. Thereby MCC was able to develop the modules in parallel, because they dovetailed perfectly with each other (Gould, 1999).

3 Challenges in modularisation

As noted, numerous companies state that they have a modularisation strategy and have adopted the concept of using modules. However, compared with other sectors,

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modularisation has only taken its first steps in the automotive industry (Lynch, 1999). The modularisation being advanced in this industry refers largely to sub-assembling parts in bigger units than done traditionally, and outsourcing this task to external parts manufacturers (Takeishi and Fujimoto, 2003).

Most of the present literature in the modularisation field concerns mainly the product, and most often takes the perspective of production and sometimes also outsourcing. However, modularisation must be an issue that concerns more than just the production function in the company. The organisation and the product development process must also be of great importance. Several different organisational functions in a company (for example purchasing, market, product development, production, service and after-sales etc.) are possibly affected by a modularisation, and also place different requirements on the modularisation process. Despite the popularity of modularisation; much of the literature is based on success stories, with few examples of the difficulties that may arise during the process of modularising products and suggestions on how these difficulties could be overcome. In this special issue it will be shown that modularisation is a multi-faceted concept, and is also related to a lot of difficulties and challenges in its implementation; some of these challenges are highlighted in this issue.

4 The contents of the special issue

This issue was initiated by a call for papers, commissioned in late December 2004. During 2005 the review process took place, and in the end six refereed manuscripts were accepted for publication. Overall, ten authors contribute to this issue; they come from four different countries and represent three continents, Europe, North America and South America. In my opinion all the six papers in this special issue are high-quality studies, all of them dealing with modularisation but from different perspectives. This fact shows that modularisation is a concept able to give a company diverse benefits, but that there are a number of challenges to deal with in order to be successful.

The paper by Morris and Donnelly discusses modularisation from a more strategic point of view, and argues that modularisation is both a strategy and a process. In the present literature there are a number of stories regarding the numerous benefits for a company to achieve by implementing modularisation, but in this paper it is argued that there are also limitations to what can be achieved through modularisation.

The paper by Batchelor is about some of the implications of the relationship between product architecture, organisational design and system integration capability, when modularisation is used as a strategy in the product design process.

Modularisation is often used as a strategy in production; many companies define and develop modules that are then manufactured and assembled by different suppliers. The third paper in this special issue, then one by Fredriksson, is addressing one key aspect of the combined use of modular production and supplier park concepts – that is, the co-existence of cooperation and conflict between the suppliers and the car manufacturer involved. The paper is based on a long-term case study at Volvo Car Corporation.

The paper by Miguel and Pires is also based on a case study, namely of the VW truck and bus chassis plant at Resende in Brazil. In this paper it is concluded that modularisation is not only important for production, but also a key concept for the

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product development in a company. To be successful in implementing a modularisation strategy, there is a need for collaboration between the product development and production functions in the company.

The fifth paper is one by myself (Persson). The paper is based on a case study done in an automotive company, which made a change in one of its modules that made it less decoupled. The results show that changing a module's interface, to make the module less decoupled, calls for caution. Large differences were found between some of the estimated effects and the actual ones, indicating the importance of making holistic evaluations of the changes before they are carried out. This special issue is ended by a paper by Mondragon et al. In their paper there is a discussion of the causes of the shift toward automotive architecture openness (in other words towards more modularity) and the utilisation by OEM's of Full Service Vehicle Suppliers as tools for value creation.

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