Chapter 5
Managing Technological Innovations Affecting Product Complexity, Modularity, and Supply Chain Structure

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Abstract Modularity is one of the most relevant paradigms in manufacturing as it has made mass customization possible through the introduction of postponement and through the effective management of product complexity. Hence, the study of the relationships between mass customization, modularity, technological innovations, and the supply chain still has elements that can be used to extend existing knowledge in the field. This chapter provides an insight of the management of technological innovations using modularity to provide customized products. The cases in the automotive industry addressed reveal that the capability of handling a modular architecture in a complex product can offer an infinite number of bespoke configurations with the sources of innovation for modular architectures located within the firm. The findings support the use of a modular architecture to assist in the introduction of technological innovations with a minimum disruption to the supply chain.

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5.1 Introduction

The objective of the work presented in this chapter is to understand the use of modularity to handle product complexity as a result of technological innovations, especially in those sectors where economies of substitution, upgradeability, and inter-changeability have been achieved. In recent years the need to manage technological innovations in an efficient way has driven organizations to pay attention to modularity, supply chain management, and product complexity. Modularity is a well acknowledged practice used to address the operational issues raised by mass customization (Salvador et al. 2002). The concept of mass customization has been defined as the ability to provide customized products or services through flexible processes in high volumes and at reasonably low costs (Da Silveira et al. 2001). The resulting tradeoff between product variety and operational performance may be mitigated by organizations deliberately pursuing modularity in designing their final product architectures, allowing them to obtain final product configurations by mixing and matching sets of standards components (Salvador et al. 2002). Huang et al. (2007) state that under the modular product architecture, platform products normally have a fixed number of modules with customization being achieved through variant modules to choose among a set of given module options.

It has been through the introduction of postponement and the effective management of product complexity that modularity has reached a top place among practices adopted by firms in diverse sectors. In general terms, modularity permits the management of complexity of products to attain sustainable growth (Christensen 1998; Baldwin and Clark 1997, 2000, Hsuan 2003; Sanchez and Mahoney 2003, Mahoney 2004). For Baldwin and Clark (1997) the successful implementation of a modular architecture depends upon key factors such as the architecture definition, the interface between core-module definition, and standard modules.

The adoption of modularization and the opportunity it gives us to handle mass customization can have an impact on customer satisfaction, especially for products with high innovation content. For example, White (1996) mentions quality, delivery, dependability, cost, flexibility, and innovation as variables that influence customer satisfaction. On emphasizing the importance of competitiveness, Koufteros et al. (2002) define a series of constructs across industries to measure flexible product innovation, quality, delivery dependability, competitive price, and premium price. The results of their work based on 244 firms across four industries