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Activity-based costing as a method for assessing the economics of modularization—A case study and beyond

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Abstract

The paper accounts for an Activity-Based Costing (ABC) analysis supporting decision-making concerning product modularity. The ABC analysis carried out is communicated to decision-makers by telling how much higher the variable cost of the multi-purpose module can be compared to the average variable cost for the product-unique modules that it substitutes to break even in total cost. The analysis provides the platform for stating three general rules of cost efficiency of modularization, which in combination identify the highest profit potential of product modularization. Finally the analysis points to problems of using ABC in costing modularity, i.e. handling of R&D costs and identification of product profitability upon an enhanced modularization.

Keywords: Activity-based costing; Modularization; Commonality; Product costing; Case study

1. Introduction

In order to maintain competitiveness manufacturing companies in general aim to offer a wide selection of products to meet customers' increased demands for variety. However, even though empirical results are not consistent (Anderson, 1995, p. 364), it is generally accepted that increased variety, or more correctly increased heterogeneity in the product mix, impacts negatively on costs and operational performance (e.g. Miller and Vollman, 1985; Banker et al., 1995; Kaplan and Cooper, 1998). The company will have to source, produce and sell in smaller batches and support functions will have to be expanded to accommodate increased internal demand for activities such as planning, set-ups, documentation, etc. To mitigate the negative effects from increased variety, manufacturing firms may pursue process-based and/or product-based strategies (Fisher et al., 1999). Product-based strategies, which are the topic of this paper, focus on product designs that allow for high product variety at reasonable cost. One such strategy is that of modularization (e.g. Heikkilä et al., 2002). When individual modules can be used in different end products, the manufacturing firm can offer variety at lower levels of component heterogeneity by combining modules and at the same time preserve some of the benefits of mass production (Perera et al., 1999).

A review of the literature on the concept and multiple effects of modularity, and paradigmatic

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approaches to manage modularity (Jørgensen, 2004) reveals that the concept of modularity has many faces (Hansen et al., 2003) and that a number of the economic benefits of modularization are taken for granted although the methods applied in identifying and assessing these consequences have something to be wished for.

The task of the paper is twofold. The first task is to investigate the merits of the Activity-Based Costing (ABC) as a method for assessing the cost consequences of modularization. This is done through a case study followed by reflections on how ABC (might) need to be developed to be able to serve as the relevant costing tool. The second task is to infer some general rules on the cost efficiency of modularization from the case study. In this way our contribution is of a more pragmatic character than, for example, Nepal et al. (2005), who develop a fuzzy logic model to handle cost information at the early stages of the product development process.

The paper proceeds as follows: Section 2 searches the literature on management accounting and costing to identify those parts of the (internal) value chain where cost effects of modularization are likely to occur. Section 3 provides a brief introduction to ABC, and Section 4 accounts for the ABC case study and points out some general characteristics of situations where modularization is cost effective. Section 5 reflects on problems of the ABC method in analysing the consequences of modularization beyond the specific case context. Section 6 concludes the article.

2. Revenue and/or cost consequences of modularization

In order to assess the economic consequences of modularization it is essential to distinguish between modularization efforts where only cost effects are necessary to analyse and efforts where it is also necessary to account for differential revenues. Generally speaking, the consequences of modularization can be confined to costs, when the number of end products and their features—in the eyes of the customer—are the same whether produced with or without the use (or increased use) of modules. In that respect Fisher et al. (1999) suggest that components should be categorized according to their influence on quality in its widest sense, i.e. including the customers' perceptions of the product. Fisher et al. argue that components having high impact on customer-quality perceptions should have a minimum of sharing across products whereas components with low-quality perception impact can be—and ought to be—shared across products. In the words of Robertson and Ulrich (1998), this can be explained by an inherent trade-off between "commonality" and "distinctiveness": the higher the level of commonality, the less distinctive the products will be. As the manufacturer increases commonality to mitigate the negative effects of increased variety, the risk of products cannibalizing each other is also increased. Therefore, whether the commonality is visible to the customer or not—Labro (2004) suggests the terminology "internal commonality" (not visible) and "external commonality" (visible)—becomes an essential input to the process of financially evaluating and deciding on the appropriate level of commonality.

2.1. Cost effects of modularization

The basic rationale for introducing modular products is to obtain cost reduction (and reduced time-to-market) within an unchanged product variety. But as we shall see, one cannot unconditionally infer that the net effect is a cost reduction. In the following paragraphs three categories effecting costs are discussed: "economies of scale", "inventory carrying cost" and "cost of support activities" in terms of their behaviour in a modularity regime.

2.1.1. Economies of scale

There is an inherent trade-off between the level of variety offered by a firm and the achieved economies of scale (Starr, 1965). Modular products are perceived as a way to mitigate the poor scale economies resulting from high variety as modules or common components can be used in several products, thus increasing volume. Only in the rarest of cases, however, will the variable cost per unit of the common module be less than the variable cost per unit of each of the otherwise product-specific modules that it substitutes. Actually, it is more likely that it will be costlier than even the costliest of the product-specific modules that it substitutes. This is due to the necessary over-specification that allows for the same module to be used in different products (Zhou and Grubbström, 2005). For the total variable cost to decrease, the effect of over-specification has to be outweighed by purchase discounts, lower set-up costs (if these are handled as variable costs) or learning curve effects.