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On the evaluation of product customization strategies in a vertically differentiated market

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ABSTRACT

This paper presents a formal approach to evaluate the value of enhancing product customization in a vertically differentiated market. Different from most existing studies that tend to associate the level of customization with the number of product variants, we take a rather different view to the level of customization which we define as the degree to which consumers are involved along the value chain. Consequently, a higher level of customization is achieved when consumers are involved further upstream in the chain. The novelty of our approach stems from the integration of both marketing- and production-related factors that enable us to: consider trade-offs between customization, lead times and manufacturing costs; and analyze how these trade-offs should be addressed in a market in which one group of consumers is highly concerned about product customization, whereas the other group is more concerned about lead time. Through numerical examples, we demonstrate how the interplay between marketing- and operation-related factors affects firm's decision on the most appropriate level of customization.

1. Introduction

It can be argued that mass customization (MC) represents an essential manufacturing concept for firms striving to maximize the value that their customers derive from buying their products. This new manufacturing concept replaces mass production which is viewed as unsuitable for the present competitive environment (Pine, 1993). This is achieved by allowing customers to individually customize a product that closely matches their individual preferences without significantly compromising cost efficiency. Advances in manufacturing and internet-based information technologies are believed to be the focal enablers, which allow successful MC application in many product categories. For example, Dell allows customers to customize their notebooks; Timbuk offers customized bags; Nike and Adidas allow customers to create their most preferred trainers.

All the above examples are similar in that customers are given the freedom to choose the product specification (among abundant possible options) that best matches their individual preferences. Thus, customers are involved in the production processes, though to a limited extent. One can argue that this customer involvement marks a distinctive characteristic of MC from the more traditional concept that simply increases the number of product variants in response to the demand for variety. But one could also take a different view, arguing that MC would need a greater level of customer involvement than merely choosing among a large number of permutations. We agree with Lampel and Mintzberg (1996) and Duray et al. (2000) who suggest that the relative degree of product customization is determined by how far consumers are involved in the production cycle. A highly customized product is characterized by customer involvement in the early design stages. In contrast, the level of customization is low if customer preferences are included only at the final assembly stage (see Fig. 1).

While the existence of the two different views of customization cannot be disputed, it should be underlined here that since our main interest is to consider customization level determined by how far the customer can involve in the production cycle, the number of product variants becomes an irrelevant decision variable for the manufacturer. One could argue that whether the customer is involved at the fabrication stage or at the design stage of the production cycle, there could be an infinite number of product variants offered to the customer. However, it is arguable that involving the customer earlier at the design stages will enhance the perceived uniqueness of the product, which in turn contributes positively to the utility a customer experiences (Franke and Schreier, 2008). The consideration of the production and marketing factors in this paper allows us to examine how the choice of the customization level has an impact on the manufacturer's profitability by capturing the interplay between the

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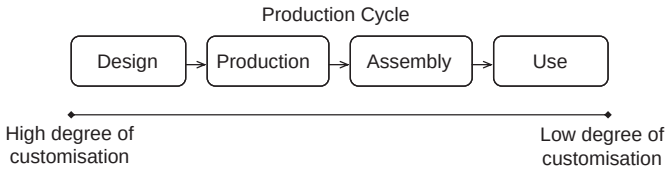

Fig. 1. Degree of customization.

different factors: lead time, production cost, and customer utility which all drive the customer demand level.

Let us consider the two following examples. Custom Furniture Design, based in San Fransisco, fabricates a wide range of custo mized furniture including armoires, cabinets, tables, desks, beds, etc. Everything the company makes is, in principle, custom made to order, ranging from modifications to a previous design to a truly original concept. A client may choose to modify a previously designed dining table, for example, by using his or her preferred wood finish and/or color. On the other hand, the company can also help a client to design a new dining table that fits very specific requirements. The second example we feature here is Ponoko (www.ponoko.com), a start-up company based in New Zealand, which adopts an emerging concept known as the *user manufacturing platform*. Ponoko offers customers different options to personalize their products. The lowest level of customization is offered through a selection of favorite designs ready to be shipped on receipt of an order. Ponoko also offers customers the possibility of buying a design, downloading the design files and making modifications to the files. The modified files are then uploaded and, after selecting the materials, Ponoko will fabricate and ship the product. Finally, Ponoko offers the highest level of customization to its customers by providing the option of creating their own product designs. The two examples described above substantiate the concept of MC as described in Fig. 1, where customers are given freedom to choose the degree of customization associated with their involvement in the production cycle. The following questions are relevant in these environments: Is it always better to offer multiple levels of customization as opposed to a single level of customization. In either case, what is (are) the appropriate level(s) of customization. Our research attempts to pursue this line of inquiry.

Our literature review suggests that most of the existing studies focus on the evaluation of a MC setting that offers a large number of product varieties in a make-to-order fashion as opposed to the traditional mass production setting that offers a standard product in a make-to-stock fashion. There seems to be a void in the literature concerning the evaluation of mass customization strategies that differentiate the level of customization on the basis of the point in the production cycle where customers can configure their final products. Our research attempts to fill this void, and in a stylized model, outline the factors that affect a firm's decision on the level of customization for a given production and market environment. In a monopolistic setting, the framework developed in this paper considers the interface between production and marketing as well as the trade-offs between customization and lead time or costs. Such a framework is in line with some empirical evidence suggesting that these trade-offs are influential in the successful implementation of MC strategies (Salvador and Forza, 2004, Squire et al., 2006).

While most extant studies consider a horizontally differentiated market, we consider a vertically differentiated market where consumers' preference heterogeneity is represented by two market segments. The first segment highly appreciates product customization and is not so concerned with lead time, whereas the second segment considers lead time a very important factor and is less concerned with product customization. It is in our interests to characterize conditions under which the manufacturing firm should target one of the segments or both. We believe that the consideration of a vertically differentiated market will reveal enriching insight into the effectiveness of MC strategies.

The rest of the paper is organized as follows: In the next section, we provide a survey of the relevant literature. Section 3 outlines the notation and modeling assumptions and presents a detailed description of the model. In Section 4, we present numerical examples and analyze the results, and in Section 5 we wrap up the paper with a concluding discussion and some suggestions for future research.

2. Literature background

The academic literature on mass customization is growing rapidly and is scattered across a number of fields such as operations management, management science, marketing, and economics journals. Our work is primarily related to product differentiation literature examining the positioning of product lines in the context of mass customization. In economics and marketing, the relevant studies focus on the optimal number of product variants, their positions, and prices; see for example Lancaster (1975), Green and Krieger (1985), Moorthy (1988), and Dewan (2003). We refer the reader to Lancaster (1990) for a comprehensive review of product variety strategies under different market structures. Several studies in marketing lend support to our motivation in analyzing customization in a vertically differentiated market (Franke and Piller, 2004, Schreier, 2006, and Franke et al., 2010). An interesting finding of the above-mentioned studies is that customers' willingness to pay increases with the level of customization.

Most of the work in the operations management area focuses on production strategies that accommodate MC. Postponement or delayed product differentiation is one of the strategies that are considered a cost-effective way to enhance product customization without involving prohibitive costs (see e.g. Lee and Tang, 1997, Feitzinger and Lee, 1997, Van Hoek, 2001, Aviv and Federgruen, 2001, Yang et al., 2004, Gupta and Benjaafar, 2004). Closely related to postponement, the concept of modularity represents another enabler supporting product proliferation strategies achieved through sharing common platforms or components (Baldwin and Clark, 1997, Desai et al., 2001, and Mikkola and Gassmann, 2003). More recently, Brun and Zorzini (2009) present a multi-case study research examining the relationships between postponement and modularization practices.

We now review the literature more closely related to our model, i.e. studies dealing with the coordination of marketing and production decisions in the context of mass customization. One such study is that of Jiang et al. (2006) who compare two configurations: mass production and mass customization. In each configuration, the company makes decisions on the number of product variants, production quantities and product price. This study considers product variety as a differentiating factor between the two configurations, but it does not include delivery lead time as a factor that affects customers' purchase decision. A model more explicitly taking into account the trade-off between the value gained by offering customized products and the cost associated with longer lead times is presented in Alptekinoglu and Corbett (2010). They develop a solution method to determine an optimal product line design that may consist of standard and customized products. As in our paper, the above two papers analyze a monopolistic setting.

Several studies analyze a competitive setting. Alptekinoglu and Corbett (2008) consider competition between a mass customizer offering custom products and a mass producer offering