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Towards high value-added products and services: mass customization and beyond

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Abstract

Mass customization enhances profitability through a synergy of increasing customer-perceived value and reducing the costs of production and logistics. It inherently makes high value-added products and services possible through premium profits derived from customized products. This strength is particularly attractive to OEM-based industries. This paper discusses the opportunities and challenges of mass customization for manufacturing industries and service providers. Also outlined is a technological road map for implementing mass customization based on building block identification, product platform development, and product life-cycle integration.

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1. Introduction

Nowadays the manufacturing industry has been facing the particular challenge of quick response to dynamic customer needs as well as facing wide variations and increasing complexity of product design along with rapidly changing design and product technologies. The key to success in these highly competitive battlefields is a company's ability to design, test, and market high quality products within a short time frame and at a low cost. These counter demands for final products create enormous productivity challenges that threaten the very survival of manufacturing companies. In addition, increasingly high labor and land costs often put developed countries or regions, such as Singapore and Hong Kong, at a disadvantage in attracting manufacturing plants compared with neighboring countries. In order to meet these pragmatic and highly competitive needs of today's industries, it is imperative to promote high value-added products and services (Ryan, 1996). For example, it was reported that nine out of ten bar code scanner vendors

were planning to repackage their product offerings in 1997 to include a larger scope of value-added features and to pursue application-specific solution opportunities (Rezendes, 1997).

This paper discusses the opportunities invoked by mass customization (Pine, 1993) for high value-added products and services. Mass customization enhances profitability through a synergy of increased customer-perceived value and cost reduction in production and logistics. Therefore, mass customization inherently makes high value-added products and services possible through premium profits derived from customized products. This strength is particularly attractive to OEM-based industries. This paper outlines an approach to integrating product life-cycle concerns in terms of how proactively to connect customer needs to the capabilities of a manufacturer or service provider during the product development process. Major technical challenges of realizing mass customization are also summarized.

2. Mass customization

The term "mass customization" was anticipated in 1970 by Alvin Toffler (1971) in "Future Shock" and

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coined by Stan Davis in his book, “Future Perfect” (Davis, 1987). Pine (1993) documented its place in the continuum of industrial development and mapped out the management implications for firms that decide to adopt it. Mass customization is a new paradigm for industries to provide products and services that best serve customer needs while maintaining near mass production efficiency. Fig. 1 illustrates the economic implications of mass customization (Tseng and Jiao, 1996). Traditionally, mass production demonstrates an advantage in high-volume production where the actual volume can defray the costs of huge investments in equipment, tooling, engineering and training. On the other hand, satisfying each individual customer’s needs often can be translated into higher value, in which, however, low production volume is unavoidable and thus cannot justify the large investment. Accommodating companies to garner economy of scale through repetitions, mass customization is therefore capable of reducing costs and lead-time. As a result, mass customization can achieve higher margins and thus be more advantageous. With the increasing flexibility built into modern manufacturing systems and programmability in computing and communication technologies, companies with low to medium production volumes can gain an edge over competitors by implementing mass customization.

In reality, customers are often willing to pay premium price for their unique requirements being satisfied, thus giving companies bonus profits (Roberts and Meyer, 1991). From an economic perspective, mass customization enables a better match between the producers’ capabilities and customer needs. This is accomplished through either developing the company’s portfolio, including products, services, equipment, and skills that the market demands, or through leading customers to the total capability of the company so that customers are better served. The end result is the improvement of resource utilization. In addition, its benefits have several significant ramifications in business. For example, it can potentially develop customer loyalty and hence propel company growth and increase market share by widening the product range (Pine, 1993).

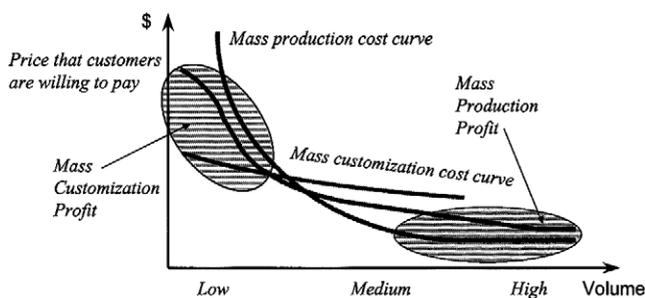


Fig. 1. Economic implications of mass customization.

3. An overview of state-of-the-art research

In recent years, mass customization has attracted tremendous interests from both academia and industrial practitioners. The work involves many, if not all, aspects and issues of manufacturing enterprises and tackles them from various perspectives, such as in the fields of business strategy, marketing, product management and engineering design, manufacturing technology, customer engineering, and information technology, to name but a few. One area where mass customization has been prevailing in recent years is strategic management. In this context, much research has focused on contrasting mass production to mass customization approaches to competitive strategy (e.g., Pine et al. (1993); Kotler (1989)). Some research work has been carried out towards mass customization by highlighting organizational mechanisms that foster knowledge (e.g., Kotha (1996)). Roberts and Meyer (1991) anchored mass customization to the viewpoint of technology management and pointed out the correlation of a firm’s product strategy to its core capabilities. Hart (1995) defined and discussed mass customization in the context of the service industry. Some contributions relate mass customization to marketing (e.g., Baker (1989)). The organizational issues of mass customization have been discussed by Teresko (1994) and Pels and Erens (1992).

From an implementation viewpoint, a large number of research emphasizes the importance of information technology as an instrument for mass customization (e.g., Kallock (1994); DeRoulet (1993); Moad (1995)). Quite a few stretches out from manufacturing management (e.g., Safizadeh et al. (1996); Beaty (1996) or advanced automation technologies (e.g., Eastwood (1996); Moad (1995)). Lee and Bilington (1994) advocated supply chain management for mass customization. Hart (1995) also tackled the logistic issues of mass customization.

Moreover, mass customization research overlaps and intertwines with many other topics encompassing customer driven manufacturing (e.g., Wortmann et al. (1997)), lean production (e.g., Hayes and Pisano (1996)), flexibility (e.g., Choi (1996); DeWitt (1995)), agile manufacturing (e.g., Port (1994)), and one-of-a-kind production (e.g., IFIP, 1992).

In terms of product development and engineering design, approaches to, and strategies for, variety design and product families and mass customizing goods are prevalent in the literature, whether in operations research, computer science, marketing/management science, or in engineering design. Most of literature on strategic management and marketing research seeks to categorize or map the evolution and development of product families (e.g., Meyer and Utterback (1993)). Meyer (1997) emphasized the importance of establishing product platforms for product strategy and corporate suc-

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