

Mass customization: Literature review and research directions

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Abstract

Mass customization relates to the ability to provide individually designed products and services to every customer through high process flexibility and integration. Mass customization has been identified as a competitive strategy by an increasing number of companies. This paper surveys the literature on mass customization. Enablers to mass customization and their impact on the development of production systems are discussed in length. Approaches to implementing mass customization are compiled and classified. Future research directions are outlined. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Mass customization relates to the ability to provide customized products or services through flexible processes in high volumes and at reasonably low costs. The concept has emerged in the late 1980s and may be viewed as a natural follow up to processes that have become increasingly flexible and optimized regarding quality and costs. In addition, mass customization appears as an alternative to differentiate companies in a highly competitive and segmented market.

In this paper, we present a literature review on mass customization (MC). Our main objective is to provide a framework to understand the several

developments that emerged in the literature in the past 10 years. We also point to future research directions, based on the current state-of-the-art of the subject. In view of the expanding number of articles and books dealing with MC, there is clear need for a research agenda developed based on existing gaps in the study of MC.

We developed a framework for presenting a survey where MC is deployed from concept to practice in four sections. We start by conceptualizing MC. We want to explore the extent at which theoretical MC concepts describe a production strategy that may be indeed pursued in practice. We then look at the different levels at which MC may be implemented. In other words, we classify levels of individualization that may be provided to customers. After, we move to more applied matters, listing a number of factors that, according to several authors, may lead to a successful implementation of MC. Finally, we discuss in length the enabling

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processes and methodologies to MC implementation.

There are two main contributions here. First, this article presents a comprehensive guide that should help researchers to screen the vast MC literature in search of references on specific topics. Through a structured framework, seemingly unconnected aspects of MC are brought together and explored in enough detail to provide a useful introduction to the subject. Second, we set a research agenda covering a variety of important and unexplored facets of MC that should motivate both academics and practitioners to further explore the subject. Despite the increasing attention it has been receiving in the literature, MC is still a novel concept lacking more extensive development. While there is little contention on theoretical aspects such as the MC concept, objectives and justification, the debate over more specific and often practical questions remain somewhat inconclusive.

2. Mass customization concept

Mass customization (MC) can be defined either broadly or narrowly. The broad, visionary concept was first coined by Davis [1] and promotes MC as the ability to provide individually designed products and services to every customer through high process agility, flexibility and integration [2–4]. MC systems may thus reach customers as in the mass market economy but treat them individually as in the pre-industrial economies [1]. MC systems are positioned below the main diagonal of Hayes and Wheelwright's [5] product–process matrix, i.e. having medium to high-volume process types such as manufacturing cells or assembly lines that are able to deliver the high product varieties usually associated to functional or fixed-type operations.

Many authors propose similar but narrower, more practical concepts. They define MC as a system that uses information technology, flexible processes, and organizational structures to deliver a wide range of products and services that meet specific needs of individual customers (often defined by a series of options), at a cost near that of mass-produced items [4,6–9]. In any case, MC is seen as a systemic idea involving all aspects of product sale,

development, production, and delivery, full-circle from the customer option up to receiving the finished product [6,10].

The justification for the development of MC systems is based on three main ideas [4,7,11,12]. First, new flexible manufacturing and information technologies enable production systems to deliver higher variety at lower cost. Second, there is an increasing demand for product variety and customization (according to Kotler [13], even segmented markets are now too broad as they no longer permit developing niche strategies). Finally, the shortening of product life cycles and expanding industrial competition has led to the breakdown of many mass industries, increasing the need for production strategies focused on individual customers.

3. Levels of mass customization

Determining the level of individualization characterizing truly mass-customized products seems to be a major point of contention in the MC debate. Purists may attribute the MC concept only to products that contemplate all requirements made by individual customers. Pragmatists suggest MC to be simply about delivering products following customer options, independent of the number of options actually offered. According to Hart [4] the solution for this contention lies in careful determination of the range in which a product or service can be meaningfully customized, and how individuals make options upon this range. To Westbrook and Williamson [14] successful MC systems should be able to mix true individualization with high part variety and standardized processes.

Several authors [15,16] propose a continuous framework upon which MC may be developed; namely, MC can occur at various points along the value chain, ranging from the simple “adaptation” of delivered products by customers themselves, up to the total customization of product sale, design, fabrication, assembly, and delivery. Gilmore and Pine [16] identify four customization levels based mostly on empirical observation: collaborative (designers dialogue with customers), adaptive (standard products can be altered by customers during

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