

Toward a Parsimonious Definition of Traditional and Electronic Mass Customization

Andreas M. Kaplan and Michael Haenlein

Although mass customization, a term introduced by Davis (1987) to describe the oxymoron of mass producing customized products, has been part of research for more than a decade, literature has not come up with a commonly accepted definition of this term up to now. The present article attempts to close this gap by proposing a definition of traditional and electronic mass customization, which is based on answering three research questions. First, for which kind of customized goods (products versus services) is mass customization applicable at all? Second, at which step of the value creation process must the customer be given the chance to customize his or her good to be able to speak of mass customization? And finally, which prerequisites in terms of production cost and monetary price need to be fulfilled when comparing mass-customized with mass-produced goods? Using an extensive analysis of extant literature in the field, the authors develop two definitions of traditional mass customization, a working and a visionary one, as well as one for electronic mass customization, stating how new opportunities arising from advances in communication and information technology can influence this concept.

Introduction

Ever since the distribution of labor started to shape our society and people no longer produced only what they needed for their own personal consumption but instead began to focus on tasks they were particularly good at, craftsmanship has become one of the main forces driving the modern economy. The advent of such professions as the tailor, blacksmith, and carpenter provided people with the opportunity to possess goods tailored exactly to their needs without having to know how to make the product themselves: They could simply purchase these items from the corresponding specialists.

However, the high degree of manual work and customization associated with these tasks often resulted in prices too expensive for most members of society to

afford. Hence, people started to implicitly trade off less customization for lower prices, which resulted in the rise of mass producers during the era of the Industrial Revolution in the nineteenth century—a period shaped by an increasing fragmentation of tasks and division of labor, the introduction of the first moving assembly line by Henry Ford in 1913, and Taylor's (1911) seminal publication dealing with questions of coordination and control. Around the mid-1950s peoples' resurrecting desire for customized products led to the concept of market segmentation (Smith, 1956), in which customers with similar preferences were clustered into market segments and were provided with a customized product covering the average customer's needs. Due to further increasing demand in many industries these segments were often so large that this customization was even possible without sacrificing the advantages of cost-efficient manufacturing. Hence, manufacturers in the twentieth century were able to choose between two distinct strategies: (1) being a cost-efficient mass producer

Address correspondence to: Andreas M. Kaplan, University of Cologne, Department of Information Systems and Information Management, Pohligstrasse 1, 50969 Cologne, Germany. E-mail: andreas.kaplan@uni-koeln.de.

with limited or no variety; or (2) offering highly customized and often expensive products resulting from a craftsmanship-like approach.

Toffler (1970), however, questioned the distinctiveness of these two strategies, and Davis (1987, p. 169) introduced the term *mass customization* (MC) to describe the oxymoron of mass producing customized products, which was subsequently elaborated in publications such as Gilmore and Pine (1997), Pine, Victor, and Boynton (1993), and Pine, Peppers, and Rogers (1995). Certainly the basic idea behind this approach is not revolutionary, since customers have always been able to customize certain mass-produced products by choosing from predefined modules as is, for example, the case when ordering a car with special features or a kitchen consisting of parts adapted to specific characteristics of the room or the cooking practices of the user. However, only recently new manufacturing techniques and advances in information and communication technology, such as the Internet, have made MC a viable option for a broad range of products.

Surprisingly enough, although MC has been part of research for more than a decade “extant literature has not established good conceptual boundaries for mass customization, nor has that literature presented a means to distinguish among the vast array of mass customization practices in a way that lends clarity” (Duray et al., 2000, p. 606). Until now, no one seems to have developed a commonly accepted definition of

MC—at least none that goes further than defining it as the mass production of customized goods.

The present article contributes to closing this gap by proposing a definition of traditional and electronic mass customization based on answering three research questions: (1) To which kinds of customized goods (products versus services) is mass customization applicable at all? (2) At which step of the value creation process must customers be given the chance to customize their good to speak of mass customization? (3) Which prerequisites in terms of production cost and monetary price should be fulfilled when comparing mass-customized with mass-produced goods?

Hence, this article is structured as follows. The next section elaborates on why developing a definition for a concept introduced to the literature more than 15 years ago could be of interest for academics. Then a definition of traditional MC is developed by answering the three research questions previously stated using extant literature in the field. Based on this characterization a definition of electronic MC is proposed, before the article finishes with a discussion of the findings and a presentation of areas for further research.

Why Develop a Definition for Mass Customization at All?

Before developing a definition, be it for mass customization or any other concept, it may be prudent to ask whether there is any relevance at all in defining concepts. The present article follows the argumentation of Socrates, who said that definitions are essential for research because nothing useful can be said or known about a concept until it is properly defined. Therefore, “definition and classification are essential preliminaries to analysis,” since they help to ensure that theories do not “remain in the purgatory between validation and rejection” (Madge, 1962, p. 538). In the product innovation area especially, it has been highlighted that a lack of common definitions may substantially slow down the diffusion of academic findings into the day-to-day reality of companies. For example, Garcia and Calantone (2002, p. 111) pointed out that managers are “looking for an understanding of how to address the idiosyncratic problems associated with radical innovations.” However, if new product researchers do not find consistency in labeling and identifying their concepts, it is virtually impossible for an external party to make use of their findings. Therefore, “for empirical research to have an impact on practice, it

BIOGRAPHICAL SKETCHES

Andreas M. Kaplan is a Ph.D. candidate in the Department of Information Systems and Information Management at the University of Cologne. He holds a master of science in business administration from the ESCP-EAP European School of Management and a bachelor of science in business administration from the University of Munich. Andreas was a visiting Ph.D. student at the HEC School of Management in Paris and at INSEAD (European Campus–Fontainebleau). Additionally, he is pursuing a master of public administration at the Ecole Nationale d’Administration (ENA; French National School of Administration) in Strasbourg.

Dr. Michael Haenlein is assistant professor of marketing at the Paris campus of the ESCP-EAP European School of Management. He holds a Ph.D. and a master of science in business administration from the Otto Beisheim Graduate School of Management. He has published work in *Electronic Markets* and *Understanding Statistics*. Before joining ESCP-EAP, he worked for five years as a strategy consultant for Bain & Company, where he mainly served clients in the telecommunications and high-tech industry. His research interests lie in the area of customer lifetime valuation/customer relationship management, structural equation modeling, and stochastic marketing models.

should be focused, clear and report ‘true’ differences, not results biased by mis-defined outcomes” (Garcia and Calantone, 2002, p. 111). In particular, it is essential that researchers across a broad range of disciplines—such as innovation management (e.g., Franke and Piller, 2004; von Hippel, 2001), marketing (e.g., Kotler, 1989; Sheth, 1992), strategy research (e.g., Ettlie and Ward, 1997; Kotha, 1995), or public affairs (e.g., Collins and Butler, 2003)—understand the concept of *mass customization* in the same way. Otherwise, it is difficult to ensure that everyone is referring to the same concept when using the same terminology, thus potentially creating a barrier to cross-fertilization among functional disciplines.

Such a common understanding does not presently seem to be the case. Table 1 lists some definitions of MC taken from different areas—these should be seen more as illustrative examples than as an exhaustive list. Following the structure of the three research questions raised in the introduction, it can be seen that some authors have defined MC as a concept applicable to products only (e.g., Ettlie and Ward, 1997;

von Hippel, 1998), whereas others have applied it to products and services (e.g., Hart, 1995; Zipkin, 2001). For some authors the definition is limited to the manufacturing of goods (e.g., Pine, Peppers, and Rogers, 1995; Rabinovich et al., 2003), whereas others also have used it to describe other value chain activities, such as distribution (e.g., Åhlström and Westbrook, 1999) or marketing (e.g., Sheth, 1992). Several authors have included considerations of cost (e.g., Hart, 1995; Lee et al., 2000) and price (e.g., Lau, 1995; Ragsdale and Zobel, 2004) into their definition, whereas many others have not mentioned these characteristics. All of these points indicate that not everybody seems to have the same understanding of the term *mass customization* and that there may be a need for developing a parsimonious definition of this term.

Definition of Traditional Mass Customization

As stated already, the definition of traditional mass customization is based on answering three research

Table 1. Overview of Exemplary Definitions of MC Used in Literature

Research Question 1: Is MC applicable to products and/or services?

Davis (1994, p. 180): “But mass customization is not restricted to products and services. It also applies to customers and markets”

Duray (2002, p. 314): “. . . offering unique products in a mass-produced, low-cost, high volume production environment.”

Ettlie and Ward (1997, p. 56): “Mass customization—providing products that are created to the customers’ specifications.”

Franke and Piller (2004, p. 403): “These ‘mass customization’ methods have enabled custom goods to be produced with near mass production efficiency.”

Hart (1995, p. 36): “. . . practical definition: the use of flexible processes and organizational structures to produce varied and often individually customized products and services.”

von Hippel (1998, p. 631–2): “Mass customization generally refers to the manufacturing of one-of-a-kind, ‘custom’ products . . . One can also logically extend the concept of mass customization to the production of customized services.”

Zipkin (2001, p. 81): “Mass customization is the capability . . . to offer individually tailored products or services on a large scale.”

Research Question 2: At which step of the value creation process should the customer be integrated?

Åhlström and Westbrook (1999, p. 262): “Mass customization is a term first coined to describe a trend towards the production and distribution of individually customized goods and services for a mass market.”

Glazer (1999, p. 63): “. . . is usually associated with flexible manufacturing and operations, it can also refer to strategies based on flexible marketing methods.”

Lavidge (1999, p. 72): “. . . to making mass customization of advertising practical.”

Pine, Peppers, and Rogers (1995, p. 105): “Customization means manufacturing a product or delivering a service in response to a particular customer’s needs, and mass customization means doing it in a cost-effective way.”

Rabinovich, Dresner, and Evers (2003, p. 66): “These product design and manufacturing policies have been grouped under the term ‘mass customization.’”

Sheth (1992, p. 61): “. . . is the practice of mass customization in which each element of the marketing mix . . . is based on standard platforms or architecture.”

Research Question 3: Which prerequisites in terms of production cost and monetary price need to be fulfilled?

Fogliatto, da Silveira, and Royer (2003, p. 1817): “. . . at prices similar to mass-produced items.”

Hart (1995, p. 36): “. . . at the low cost of a standardized, mass production system.”

von Hippel (2001, p. 256): “. . . at near mass-production costs.”

Lau (1995, p. 18): “. . . at the price of the comparable mass-produced items.”

Lee, Barua, and Whinstone (2000, p. 82): “. . . with mass-production efficiency and cost.”

Piller and Schoder (1999, p. 1111): “. . . at a price which is only marginally higher than that of the standard product.”

Ragsdale and Zobel (2004, p. 84): “. . . at an affordable price.”

da Silveira, Borenstein, and Fogliatto (2001, p. 1): “. . . at reasonably low costs.”

questions. Answering the first question helps to define the general domain of the construct. Regarding the second question, a discussion is provided as to at which stage of the value creation process the customer needs to be integrated to be able to customize the good. Finally the question of which additional characteristics—besides customization—need to be fulfilled when comparing mass-customized to mass-produced goods is analyzed. Hereby, the focus is set on a discussion of production cost and monetary price.

Products versus Services

Many researchers such as Hart (1995), Pine (1993, p. 44) and Zipkin (2001) have defined MC as a concept applicable to both products and services. However, the present article emphasizes that MC should be limited to products only and that referring to mass-customized services is either tautological or misleading.

As described previously, mass customization developed historically out of the desire to integrate the customer in the manufacturing process of mass-produced products to customize them so that they fit the needs and preferences of individual customers. However, when looking at services, two of their major characteristics are perishability and inseparability (Rathmell, 1966). This means that services cannot be stored and must therefore “be consumed in the moment of production” (Sundbo, 2002, p. 99), resulting in the customer always needing to be a coproducer and “part of the production and delivery process” (Kelley, Donnelly, and Skinner, 1990, p. 315). Consequently, the act of integrating the customer in the value creation process to develop an individualized offering is already inherently included in the services definition. Hence, this article is cautious in speaking of mass customization in the context of traditional services, as it would create a tautology.

Certainly it could be argued that the concept of mass customization could be applied to services in the sense that it may help to deliver them on a large scale and in a cost-effective way. This idea, similar in spirit to the “production-line approach to service” as proposed by Levitt (1972), can be found in case of standardized and self-services for which operations have been standardized to provide them faster, more conveniently, and at lower unit costs (Regan, 1963). For example, using a supermarket—often referred to when talking about standardized services—as an illustration, it is obvious that even these standardized

services could be customized on an individual level using modern communication and information technologies. In the past, traditionally people went to the nearby grocery store to do their shopping, where they communicated their wishes to a clerk who served them. However, since this approach was highly people intensive and was associated with substantial variations in service quality, supermarkets increasingly substituted “fast and efficient self-service for the slow, inefficient, and often erratic clerks of the traditional service store” (Levitt, 1972, p. 46). These supermarkets could only be built in a standardized way or, at best, adapted to the needs of a certain customer group—in the same way as a standardized product may be tailored to the preferences of a particular market segment—but it was impossible to mass customize them so that each customer had a supermarket perfectly adapted to his or her preferences. However, the Internet has changed this to a great extent. By using individualized websites that only show information relevant to the potential buyer in a given situation, online retailers, such as Amazon, are able to create a standardized service in a mass-customized way. A similar tendency can be seen in the insurance industry. Whereas a life insurance policy 20 years ago only allowed for adaptation to the individual customer’s need in a very limited number of dimensions, such as total contract duration or amount owed per month, it is now possible to build an offering tailored to each individual by using the basic kit every insurance agent carries on a laptop.

This approach, which is built on the concept of modularized standardized services, “may provide another avenue for mass customization” (Duray et al., 2000, p. 624). However, in this context the emphasis is not on customizing a mass product—as is inherent in the oxymoron *mass customization*—but on delivering a customized service to a mass market in a cost-effective way. In other words, the focus is no longer on customizing a low-cost mass produced product but on delivering an individualized service at lower cost. Since a mass-customized service in this sense is coming from a different direction, namely decreasing cost given high customization versus increasing customization given low cost—hence quite the opposite of a mass-customized product—*mass customization* is considered to be misleading in this context. Therefore, using another term, such as *modulization* as proposed by Sundbo (2002), is recommended for these situations and limiting the use of *mass customization* to products only.

To summarize, including the applicability to services into a parsimonious definition of MC does not seem prudent, because services are always customized and are either tailored to a specific customer—leading to tautology—or intended to be delivered on a large scale—the opposite of the basic philosophy behind MC. Hence, this article limits a definition of mass customization to products only, which also explicitly excludes situations where “you standardize the commodity and customize the services that surround it” described by Davis (1987, p. 165). This line of thinking is reflected in Lampel and Mintzberg (1996) and von Hippel (1998), who both stated that the concept of mass customization could be extended to the production of customized services and hence implicitly expresses the opinion that mass customization in its core should be limited to products only. Additionally, this might be one explanation for the apparent “lack of studies dealing with MC in service operations” (da Silveira, Borenstein, and Fogliatto, 2001, p. 9): Although the concept is applicable to a service environment, it may be investigated under a different terminology and not labeled as mass customization.

However, it is necessary to highlight that mass customizing a product can be considered as a service itself. Rathmell (1966, p. 33) spoke of a product as a noun and a service as a verb, where “the former is an object, an article, a device, or a material . . . whereas the latter is a deed, a performance, or an effort.” Since, to stick with this terminology, mass customizing a product is certainly more a verb than a noun, it can be considered as a service offered in combination with a customized good.

Customization along the Value Chain

Mass customization belongs to a group of concepts dealing with integrating the customer in the value creation process through company–customer interaction. In the same way as mass customization, the literature has not come up with a commonly accepted terminology or definition for describing this phenomenon up to now. Hence, terms such as *coproduction*, *collaboration*, and *cooperation* are often used interchangeably to describe this form of industrial value creation where “the consumers . . . take part in activities and processes which used to be seen as the domain of the companies” (Wikström, 1996, p. 361) and that have been studied extensively in product innovation management literature (e.g., Meyers and Athaide, 1991;

Stump, Athaide, and Joshi, 2002). By considering the customer as part of the value creation process, the company can obtain specific information about needs and desires, which can then be translated into concrete product specifications (Zipkin, 2001). In contrast to the traditional way of working, this approach leads to a “synchronic and interactive” versus a “linear and transitive” process (Ramírez, 1999, p. 50) and may result in a competitive advantage, as customer integration concepts generate more and new types of value compared to sequential mass-production logic (Milgrom and Roberts, 1990, 1995; Wikström, 1996).

To properly distinguish among the different concepts of customer integration discussed in the literature, Porter’s (1985, p. 37) value chain framework (see Figure 1) can be used, along with trying to answer at which step of the value creation process the customer is integrated. In the present article, mass customization is thought to be used only to describe company–customer interaction at the operations level of the value chain. Certainly, it is not the intent of this article to state that company–customer interaction can only take place at the operations level. However, whenever interaction takes place at other levels, using a different terminology is recommended, similar to the preceding products versus services discussion. For example, *user innovation* could be used to describe integration at the technology development level, or *interactive marketing* could be employed in cases where customers are integrated at the marketing and sales level. Since these concepts are often confused with mass customization, commonalities and differences between them and mass customization are discussed later in this article.

Regarding the specific degree of integration of the customer at the operations level, two different viewpoints can be identified in the literature. One group of researchers has said that customers should be given the opportunity to create a product fitting their needs exactly without any restrictions imposed by the company. Westbrook and Williamson (1993, p. 40), for example, defined MC as offering “a truly customized product—one made to the customer’s precise specifications from the ground up.” Other studies (see, e.g., Duray et al., 2000), however, have considered this approach as hardly feasible since no company is able to offer unlimited choice of true product variations without sacrificing the efficiency of mass production. In addition, such a process might be too demanding and, hence, costly for the customer (Shugan, 1980), leading to mass confusion (Huffman and Kahn, 1998) instead of mass customization. See also Dellaert and

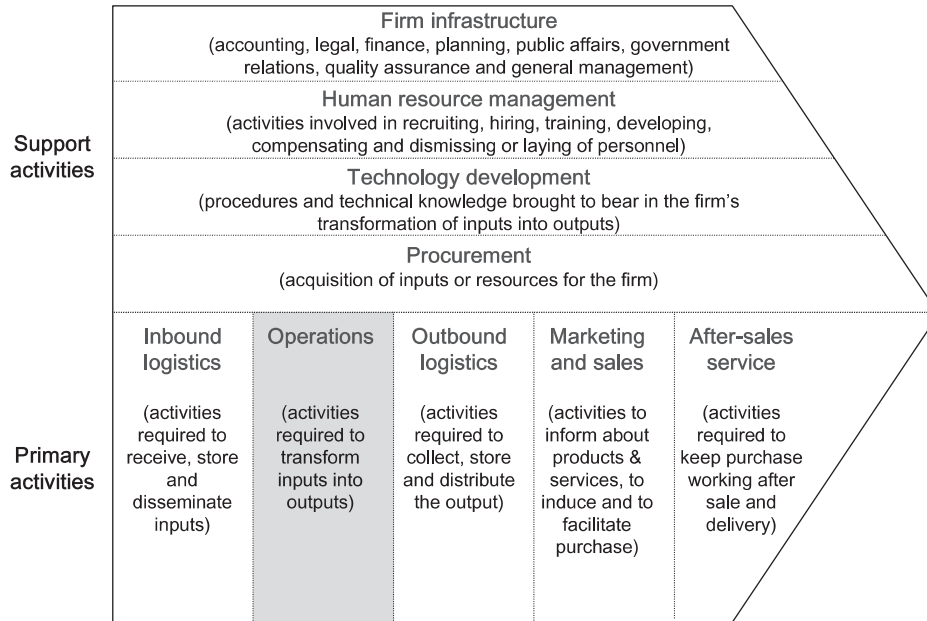


Figure 1. Mass Customization Along the Value Chain (adapted from Porter, 1985, p. 37)

Stremersch (2005) for an empirical investigation of the negative effect of complexity on the utility of mass customization. Consequently, it is not recommended to give the customer unlimited choice but instead to offer a certain range of options. Generally, this approach is based on the concept of modularization, which describes a relatively high level of prefabrication allowing scale-oriented basic manufacturing. The resulting modules are then combined or completed only at the final steps of production according to specific customer preferences. In this sense, modularization is often regarded as a key success factor for mass customization (Duray et al., 2000; Feitzinger and Lee, 1997; Pine, 1993, p. 196; see also Tu et al., 2004 for an empirical investigation of their relationship), since “a product with a modular design provides a supply network with the flexibility that it requires to customize a product quickly and inexpensively” (Feitzinger and Lee, 1997, p. 117).

Similar to Hart (1995), the present article considers the first case—in which customization starts at the design stage—to be visionary and the second situation—based on integrating the customer at later stages of the production cycle (i.e., fabrication or assembly; see Duray et al., 2000)—to be the more feasible solution. However, when giving a definition of MC both approaches should be included, as effective mass customization always depends on internalizing as many of the visionary elements as possible. This approach is familiar from a definition of the term *total quality*,

which is based on setting a goal of zero defection. Although this goal can never be achieved in reality, every company should strive for it; a similar approach should be taken when defining MC. Hence, the present article provides two definitions of mass customization: (1) a visionary one based on MC at the design stage; and (2) a working definition that covers customization at the fabrication/assembly stage.

As highlighted already, mass customization is often confused with other concepts that either provide choice to the customer or integrate the customer in the value creation process. Since the conceptual definition of any construct is always based on defining distinctions between the new construct and existing ones, how MC differs from other concepts with high prominence in the literature—namely product variety, user innovation, and interactive marketing—is now discussed.

Mass Customization versus Product Variety. *Product variety* is used most often in conjunction with *mass customization*, and many researchers even employ it in their respective definitions of MC. Pine (1993, p. 44) defined mass-customized products as having “enough variety and customization that nearly everyone finds exactly what they want.” Similarly, Lee, Barua, and Whinston (2000) considered a variety-to-choose approach, in which companies produce many product variations to fit the average needs of small and specific customer segments; according to them this is the most popular and probably the easiest approach to MC.

However, MC and product variety are distinct concepts and must not be confused with one another for two reasons. First, a mass-customized product is always intended to correspond to the specific needs and preferences of a particular individual customer. In contrast to this approach, variety is based on offering choice to the customer (Duray et al., 2000). Among a vast range of product variations the chance certainly may exist for all customers to find a product perfectly suited to their needs, but this may just as well not be the case. Only at its limit, where a variety-to-choose approach is based on a customer segmentation with only one customer per segment, do both concepts become congruent. Second, the basic idea of MC implies that there cannot be an inventory of finished goods (Zipkin, 2001) because every product is tailored to one individual customer. Following a product variety strategy, however, generally leads to a significant finished-goods inventory, except for the few cases in which companies combine it with a perfect just-in-time approach.

Very similar to producing a broad range of product variations is the concept of offering variety within one product. Some researchers, such as Gilmore and Pine (1997), have considered a standard product designed to be flexible enough for customers to alter it exactly to fit their needs as a special case of mass customization. This article, however, follows the arguments of Zipkin (2001), who expressed that configurable products should not be part of a definition of mass customization, for the same reasons as stated previously.

Mass Customization versus User Innovation. User innovation describes a situation in which a customer develops a product that may subsequently be produced and commercialized by a company for the mass market. According to von Hippel (1982, p. 119) customers might be willing to “develop commercially attractive new goods when their return from using the product is high enough to justify it and they cannot get, or do not want to get, a product manufacturer to develop the item for them.” Hence, user innovation occurs either when a manufacturer knows about a customer’s needs but considers the overall market to be too small or risky to invest in developing a product for the customer or when the customer hides his or her need for a specific product from the manufacturer (von Hippel, 1982). Under these circumstances product development may be transferred from the manufacturer to the consumer; subsequently, the

manufacturer can decide whether the new product should be produced for the mass market or not.

User innovation and mass customization are similar in the sense that customers create a product exactly tailored to their needs. The difference between the two concepts is as follows. In user innovation, the user develops a new product and sends a blueprint to the manufacturer. The manufacturer then still keeps the right not to produce the product. In mass customization, the user can be sure that the product is actually produced because the user is involved in the operations level of the value chain, which is the step where production actually takes place. So although mass customization gives customers reassurance that the customized product will indeed be manufactured, user innovation has a risk that the product might be developed but never produced. Additionally, a product resulting from user innovation does not necessarily have to be customized to each individual customer but also can be a mass product developed not by the company but just by one particular user.

However, synergy may be achieved by combining mass customization and user innovation. Offering customized products exposes a company to two problems: “first, learning how to design specialized products efficiently (the R&D problem), and, second, learning how to manufacture those goods cheaply and quickly (the production problem)” (Thomke and von Hippel, 2002, p. 11). In this sense user innovation and mass customization are seen as complementary, since the first can help a company to determine which options (e.g., modules) to offer (von Hippel, 1998; Urban and von Hippel, 1988) and the second one supports the manufacturing of customized products for each individual customer. This can be a very attractive option. Franke and Piller (2004, p. 412) showed empirically that “the amateurs’ designs were attributed on average approximately the same value by the market as the best-selling standard models created by professional designers.”

Mass Customization versus Interactive Marketing. During the last two decades, several new marketing concepts such as relationship marketing, one-to-one marketing, and continuous marketing have increasingly been discussed in the literature. Although these approaches differ conceptually, they share the idea of being highly customer centric. However, being customer centric does not necessarily imply that a true interaction occurs between the com-

pany and its customers. In the following discussion the term *interactive marketing* is used to describe a form of marketing based on company–consumer interaction (see also Wind and Rangaswamy, 2001 for a similar concept of customerization). However by doing so the claim is not made that the aforementioned concepts cannot at least be partially subsumed under this term.

As in mass customization, interactive marketing provides customers with integration in the value creation process, enabling them to control the information flow from the company and to choose the information that is relevant at a certain point in time. For this reason, interactive marketing creates value by reducing information overload. However, comparable to the distinction between MC and user innovation, MC and interactive marketing differ with respect to the level of the value chain where interaction takes place. Whereas MC focuses on the operations level, interactive marketing takes place at a later stage of the value creation process: the marketing and sales level.

The three concepts mentioned so far—product variety, user innovation, and interactive marketing—should not be seen as an exhaustive list but rather should be understood as examples of several terms often used in conjunction and confused with mass customization. Another phrase to add to the list is *build-to-order*. Although MC implies following a build-to-order strategy, meaning a product is built only in response to a customer order, build-to-order is not equivalent to MC, since ordered products may or may not have been customized. As a final example, *personalization* should not be used to characterize MC. Whereas MC relates to changing, assembling, or modifying product components or the whole product design according to a specific customer's needs and preferences, personalization is more about selecting and filtering information (Tseng and Piller, 2003). Personalization is therefore more similar to recommendation, in which customer specific recommendations are selected from a large set of possibilities (Elofson and Robinson, 1998; Resnick and Varian, 1997), than it is to mass customization.

Cost and Price of Mass-Customized Products

When compared to mass-produced goods, mass-customized products should have similar or only slightly higher production cost and monetary price; under certain circumstances, it may even be possible

for them to be manufactured at a lower cost and sold at a lower price than their mass-produced counterparts (Pine, 1993, p. 48).

Mass customization means manufacturing customized products at the cost-efficiency of mass production. Thus, several researchers (see, e.g., Dertouzos et al., 1989, p. 129; Pine, 1993, p. 7) have stated that the cost of mass-customized products should be approximately the same as the cost of mass-produced goods, whereas others have explicitly allowed them to be slightly higher by noting that MC enables “companies to tailor or customize individual offerings at little additional marginal cost” (Glazer, 1999, p. 63).

Under at least two circumstances, though, costs may be lower for mass-customized than for mass-produced products: in markets with fast-changing consumer preferences and in industries showing significant economies of scale. Concerning high volatility in consumer preferences, cost advantages result from the fact that mass customizers do not hold any inventory, since each product is manufactured based on individual customer preferences at the time of order. This results in a lower risk of obsolescence and lower working capital requirements compared to mass producers. Regarding significant economies of scale, lower cost can result from a higher customer demand, leading to higher production volumes and lower per-unit cost. This increase in demand, when compared to mass-produced goods, can be, for instance, the result of customer lock-in (Amit and Zott, 2001), which prevents the use of multiple vendors to satisfy demand. As soon as customers have purchased and customized the first product, the knowledge they transfer to the company can be seen as a switching barrier, which increases customer loyalty and may lead to higher purchases (Reichheld and Sasser, 1990).

In the literature, a common understanding seems to be that the monetary price of mass-customized products should be approximately the same as mass-produced goods. Pine (1993, pp. 7–8) stated that “the leading pioneers of mass customization are providing . . . individual customization, at prices comparable to standard goods.” Duray et al. (2000, p. 605) also highlighted that MC allows “customers to reap the benefits of customized products with relatively low prices.” Tu et al. (2001, p. 204) mentioned that “consumers expect to receive customized products at close to mass production prices.”

Certainly there may be situations in which manufacturers can demand a price premium for their products. However, there are two reasons why it is

necessary to bear in mind that the monetary price for mass-customized products should always be closer to that for mass-produced ones than to the price of goods manufactured in a craftsmanship-like approach. First, as mentioned previously, mass customization developed out of the desire to possess customized products without paying high prices resulting from craftsmanship-like manufacturing. Thus, it does not seem sensible to demand an excessively high price premium for mass-customized goods, since it would violate the basic philosophy behind this concept. Second, it is necessary to consider that the perceived price for a mass-customized product is influenced not only by the monetary price but also by other sacrifices (see Zeithaml [1988] for a more detailed elaboration of this point). Since customizing a product requires an additional investment from customers by forcing them, first, to be willing and, second, to take the time to reveal personal preferences, the perceived price of a mass-customized product can be higher than a mass-produced one, even when the monetary price of both is the same. Hence, there may be cases in which a manufacturer needs to set the price even lower for mass-customized than for mass-produced products to create an overall compelling offer. This aligns with Franke and Piller's (2004) findings that consumers' willingness to pay was only slightly higher for a mass-customized product than for the best-selling standard product. Taking these positions regarding cost and price to their extreme, mass customization can help a company to simultaneously pursue a hybrid strategy that combines the generic options of cost leadership and differentiation.

According to Porter (1980) any company needs to choose among three generic strategies: overall cost leadership, differentiation, and focus. Consequently, sustained competitive advantage can be created by achieving overall cost leadership in an industry, by differentiating the product or service offering and creating something that is perceived industry-wide as being unique, or by focusing on a particular buyer group, segment of the product line, or geographical market (Porter, 1980). Therefore, Porter (1980, p. 41) stated that a firm not concentrating on one of these three strategies and therefore "stuck in the middle" is "almost guaranteed low profitability." Several studies have tried to empirically validate this framework but were either unable to confirm the existence of companies with pure generic strategies (e.g., Miller and Friesen, 1986) or could not show that high performance is always correlated with singularity in strategic

orientation (e.g., Dess and Davis, 1984). Other studies have viewed it from a theoretical perspective, stating that in some cases establishing a sustained competitive advantage may require a firm to simultaneously pursue more than one of these strategic options (e.g., low cost and differentiation) and that differentiation can be a means of achieving an overall low cost position under certain circumstances (e.g., Hill, 1988).

The basic idea underlying Porter's (1980) framework is that value for the customer can be created either by offering a low price resulting from a low-cost position, given a certain degree of differentiation, or by selling products that differ to a great extent from competitors' offerings, given a certain price. With mass customization, however, these options are no longer contradictory but rather are complementary, since a company can offer a maximum degree of differentiation by offering a product customized to each customer's preferences at cost and price below those of mass-produced goods. This approach of defining MC as a hybrid strategy combining the two generic Porter strategies of cost leadership and differentiation, as done by Piller and Schoder (1999), for example, is only applicable in a visionary sense, though. Hence, it is only referred to in the visionary definition given for MC in the present article.

A Definition of Traditional Mass Customization

Summarizing this discussion, it was first argued that *mass customization* should be applied to products only, because using it in the context of services would be either tautological or misleading. Subsequently, the point that mass customization requires customization at the operations level, either starting at the design stage (i.e., visionary definition) or later, at the fabrication/assembly stage (i.e., working definition), was elaborated on. Finally, it was shown that mass-customized goods should have production cost and monetary price similar to those of mass-produced products. In a visionary sense, mass customization can even be seen as a hybrid strategy combining the two generic Porter strategies of cost leadership and differentiation. So two definitions of traditional mass customization can now be given: a working one and a visionary one.

Traditional MC—working definition: Mass customization is a strategy that creates value by some form of company–customer interaction at the fabrication/

assembly stage of the operations level to create customized products with production cost and monetary price similar to those of mass-produced products.

Traditional MC—visionary definition: Mass customization is a strategy that creates value by some form of company–customer interaction at the design stage of the operations level to create customized products, following a hybrid strategy combining cost leadership and differentiation.

Definition of Electronic Mass Customization

As stated in the introduction, only recent advances in manufacturing and communication technology, such as the Internet, have made MC a viable option for a broad range of products. Since mass-customized goods incorporate environmental data, such as information regarding customers' preferences and wishes, they are information-intensive products (Glazer, 1991). Therefore, modern information technologies may be as important an enabler for mass customization as, for example, flexible manufacturing technologies (Piller, Moeslein, and Stotko, 2004). The Internet is especially suited to support their production, as it can help to facilitate information collection and processing. Because of this, the decision was made to develop for this article a separate definition for electronic mass customization (eMC), taking the specific characteristics of Internet-supported MC into account.

In a world characterized by perfect information, every company following a mass-customization strategy would be able to tailor its product offering exactly to every customer's preferences from the very first time company and customer are in contact with each other. In reality, however, perfect information does not exist, and building a lasting customer relationship "will depend on the firm's ability to learn about what these [the customer's] needs are in the first place—on how well it is able to collect and process information about its customers" (Glazer, 1999, p. 68). For this reason, mass customizers need to build an integrated knowledge flow that not only covers one transaction but also uses the information gathered during each single customer contact to improve the knowledge base of the company (Pine, Peppers, and Rogers, 1995). By providing interactivity and allowing company and customer to communicate on a one-on-one basis, the Internet helps to build this knowledge flow and to support data collection and information

processing (Kannan, 2001; Zhuang and Lederer, 2003). It is not surprising that Ansari and Mela (2003, p. 131) even went so far as to state that "the web makes mass customization eminently possible." Online user registration and cookies are just two examples of how information can be gathered via the Internet. Combined with techniques like collaborative filtering and data mining, it can facilitate a continuous learning relationship between the company and its customers, which is critical to achieve long-term business success (Pine, Peppers, and Rogers, 1995).

Besides fostering information exchange between a manufacturer and its customers, additional synergies can be achieved by combining MC and e-commerce. E-commerce can be defined as the use of computer networks to conduct business—that is, the buying and selling of goods, services, and information—electronically with suppliers, customers, and competitors or among customers (Urbaczewski, Jessup, and Wheeler, 2002). For example Lee, Barua, and Whinstone (2000) analyzed the complementarity of MC and e-commerce using five criteria: quality, price, customization, time, and profit. They showed that mass customization can be a very costly and unprofitable strategy when not carried out in combination with e-commerce and that companies adopting both concepts are more profitable than companies focusing on only one of them. Lampel and Mintzberg (1996) also considered electronic networks involving buyers, producers, and suppliers as an essential prerequisite for the implementation of MC. Dewan, Jing, and Seidmann (2000) and Piller and Schoder (1999) analyzed the combination of MC and e-commerce and reached similar conclusions.

The work of Choi, Stahl, and Whinstone (1997) was used to define electronic mass customization and to explain the distinction between MC and eMC. These authors differentiate between traditional and electronic commerce using three market components: players, products, and processes. Choi, Stahl, and Whinstone (1997, p. 17) reported that "market players are sellers, buyers, intermediaries and other third parties, such as governments and consumer advocacy groups." Products are the commodities—either products or services—that are subject to the market exchange. And processes are the interactions between market players and include activities such as product choice, purchase order, customization, production, payment, delivery, and consumption. Each of these three dimensions can be either physical (offline) or digital (online); the resulting $2^3 = 8$ combinations can

be visualized using a three-dimensional cube (see Figure 2). According to Choi, Stahl, and Whinstone (1997), in traditional commerce all three dimensions are physical and in pure e-commerce all are digital. All of the other six combinations, which include a mixture of digital and physical dimensions where at least one is digital, represent some form of e-commerce—but not a pure one. Using the same classification scheme, traditional MC exists when all three dimensions are physical, and pure eMC occurs when all of them are digital; all other cases are referred to as eMC.

A newspaper can be used as an illustration for this classification. A traditional daily newspaper is a physical product, printed with ink on paper. However, the same information also can be presented in digital format—maybe in the form of an e-mail newsletter—that would then become a digital product. Customizing this newspaper, for example by influencing the choice and arrangement of single articles in the paper, could be done either in a one-on-one interaction with a clerk (i.e., physical process) or by using an electronic product configurator (i.e., digital process). This interaction can either take place by speaking face to face with a clerk or using a computer situated in a mall with a corresponding configurator installed on it (physical player) or virtually using the Internet (digital player). Thus, traditional MC is analogous to a traditional newspaper's customization process completed face to face with a clerk; pure eMC compares to an e-mail newsletter's customization using an Internet-based product configurator; eMC mirrors a traditional newspaper's customization using a telephone-based configuration system.

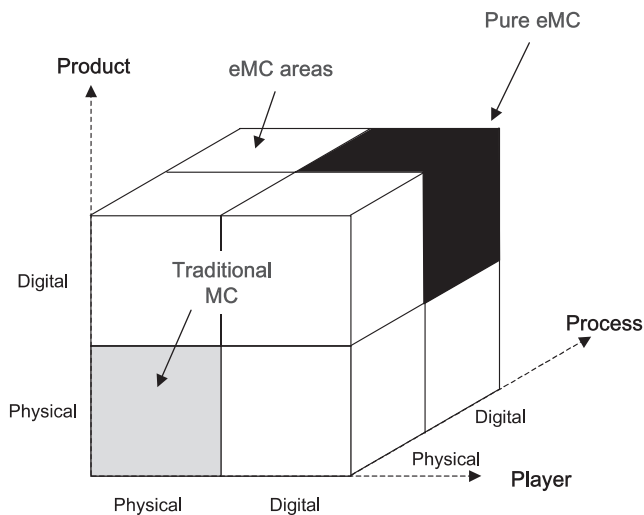


Figure 2. Dimensions of Electronic Mass Customization (eMC) (adapted from Choi, Stahl, and Whinstone, 1997, p. 18)

Based on this classification and building on the working definition derived earlier, a definition for electronic mass customization is now provided.

eMC—Definition: Electronic mass customization is a strategy that creates value by some form of company–customer interaction at the fabrication/assembly stage of the operations level to create customized products with production cost and monetary price similar to those of mass-produced products, where at least one of the three market dimensions—player, product, and process—is digital.

Conclusion

Summary

Mass customization is a concept of great interest for researchers in the area of product innovation management. Although it may not be the ultimate solution for the late-stage crises experienced by many new product development (NPD) projects, it can help to support NPD activities, such as product improvement or product technological innovation (Calantone, Vickery, and Droege, 1995), by shifting these tasks from the company to the consumer. It is apparent from the literature that MC is never a suitable option for all types of products (see Fogliatto, da Silveira, and Royer, 2003; da Silveira, Borenstein, and Fogliatto, 2001 for more detailed elaboration), but the empirical work of Franke and von Hippel (2003) provides an indication that it may be an alternative for a substantial share of the whole product range. However, as highlighted in the introduction, although MC has been part of research for more than a decade the literature has not yet come up with a commonly accepted understanding of this term.

This article attempts to close this gap by giving a definition of both traditional and electronic mass customization based on three findings. First, *mass customization* should be applied to products only, since using it in the context of services is either tautological or misleading. Second, mass customization should only be used to describe company–customer interaction at the operations level of the value chain. Finally, mass-customized products should have production cost and monetary price similar or only slightly higher than those of mass-produced goods. Based on these results, the article presents a working definition of

traditional MC: a strategy that creates value by some form of company–customer interaction at the fabrication/assembly stage of the operations level to create customized products with production cost and monetary price similar to those of mass-produced products. A definition for electronic mass customization is subsequently developed by applying the classification scheme of Choi, Stahl, and Whinstone (1997), which takes into account the specific influence of advances in information and communication technology. eMC is a strategy that creates value through some form of company–customer interaction at the fabrication/assembly stage of the operations level to create customized products with similar production cost and monetary price to mass-produced products, where at least one of the three market dimensions—player, product, and process—is digital.

Future Research

During the analysis, two additional aspects of MC seemed of particular importance but were excluded because a final answer to these points could not be reached. A detailed investigation of these two aspects would serve as topics of further research. First, according to Davis (1987, p. 169) MC “means that the same large number of customers can be reached as in the mass markets of the industrial economy.” It is, however, uncertain whether market potential—that is, the number of people that can be reached with the mass-customized product—should be part of a definition of MC. Is it more important to actually reach masses of people or to produce customized products at prices affordable for the masses? It could be argued, for example, that if a price is found to be perceived as acceptable to the masses, then the particular market for this product is already a mass market. If this is the case, then the present article’s definition of MC already implicitly includes the fact that the market potential for the product is large enough. Therefore, explicitly stating it in a parsimonious definition would be tautological and redundant.

Second, another issue is how quickly a mass-customized product should be available to the consumer. Whereas with craftsmanship customers usually must wait a certain amount of time for the product to be produced, one advantage of mass production—besides the lower prices—is that customers can go

into a shop, buy a product, and immediately take it home, at least in most cases. As mass customization can be seen as a combination of the advantages of both craftsmanship and mass production, the logical conclusion is that a mass-customized product needs to be available to the consumer as quickly as a mass-produced one. This is also in line with the work of Åhlström and Westbrook (1999, p. 263), who described MC as offering “numerous customer-chosen variations on every order with little lead time or cost penalty.” In addition, Anderson (1997, p. 25) defined MC as “the ability to design and manufacture customized products at mass production efficiency and speed.” However, whether the time aspect should be a defining criterion of mass customization or whether an increase in time to market is simply a result of this strategy itself, enabling companies to offer a product fitting every customer’s needs instead of producing and delivering each one on request is not certain.

An ABI/INFORM study by Lampel and Mintzberg (1996, p. 28) “indicates that from 1971 to 1980, an average of only twenty articles on customization appeared annually; from 1981 to 1990, 234 articles; and after 1990, 2,324.” This shows an already increasing interest in mass customization that will no doubt continue to increase in the future. It should be noted, however, that the majority of these studies are conceptual, not empirical. The few empirical articles can be divided into two groups: (1) publications that approach company–customer interaction in general and mass customization in particular from a company perspective, either by identifying best practices within certain industries (e.g., Duray et al., 2000; Feitzinger and Lee, 1997) or by carrying out large-scale empirical studies (e.g. Åhlström and Westbrook, 1999; Piller and Schoder, 1999); and (2) (a much smaller group of) publications that focus on the customer side of the equation, treating questions such as how customers handle choice and experience the integration into the value creation process (e.g., Franke and Piller, 2004; Huffman and Kahn, 1998; Liechty, Ramaswamy, and Cohen, 2001).

For the sake of the present article, it is believed that at least two types of empirical studies, should be carried out in future to increase understanding of mass customization. First, articles focusing on measurement and operationalization in the context of MC are recommended. Since the 1980s marketing scholars have been raising their voices against the lack of

construct validation (e.g., Churchill, 1979), and more and more research has begun to emphasize this during the past few years. Since it is obviously not appropriate to proceed to theory testing as long as the measurement properties of the key constructs prove to be inadequate, focusing on developing a scale for measuring both traditional and electronic mass customization is strongly recommended (see Tu, Vonderembse, and Ragu-Nathan, 2001 for a first step in this direction).

Second, after a set of indicators suitable for measuring MC and eMC have been defined, studies focusing on electronic mass customization may be of special interest for the field. Dewan, Jing, and Seidmann (2000, p. 23), for example, highlighted the ability “of the Internet in reducing the costs of collecting consumer preference information and enabling cost-efficient custom product design.” Consequently, it might well be the case that a strong relationship exists between electronic mass customization and the visionary definition of traditional MC. A detailed study investigating this relationship could be an interesting research project.

Certainly, the present article should not be viewed as trying to develop the ultimate definition of a term as complex and multidimensional as *mass customization* but more as one additional step in the direction of better understanding the nature of this concept. In no way is it intended to decrease the value of the various contributions made by the multitude of research in this area simply because their understanding of MC does not fit into this definition. However, hopefully this work helps to start a polemic, at the end of which might provide the discipline with a parsimonious definition of MC. As emphasized by Kurzbar and Soldow (1987, p. 46), “disciplines are, in part, characterized by the questions they ask. Those questions suggest methodologies. And those methodologies, in turn, determine what will be regarded as evidence for significant answers.” Definitions are an essential prerequisite to ensure a common understanding within and across disciplines. This becomes particularly visible in a discipline as formalized as mathematics: Euclidean geometry differs from elliptic or hyperbolic geometry simply in the definition of the parallel postulate. A lack of clear definitions regarding what to understand under the term *parallel straight lines* would make a distinction between these different areas of mathematics (and hence the posing of relevant research questions within them) impossible.

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