
The International Journal of Flexible Manufacturing Systems, 16, 313–334, 2004

Mass Customization: Reflections on the State of the Concept

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Abstract. The opportunities of mass customization are acknowledged as fundamentally positive by theoretical and empirical studies for many years. Many companies are already operating on this new business model successfully. But most of them are rather small start-ups which utilize the novelty effect of mass customization to enter mature markets. Large scale mass customization operations are still limited to a few examples. The objective of this paper is to analyze the recent state of mass customization practice by answering four basic questions which are frequently raised by managers and scholars when talking about the challenges of this approach: Do customers need customized products? If yes, what prevents them from purchasing these offerings? Do we have the enabling technologies for mass customization? And why do many firms fail during and after the introduction of mass customization? To answer these questions, this paper develops twelve propositions. These refer to terminological problems, a shortage of reliable information about the real demand for customized products in various markets, the state of implementation of configuration technologies, lack of management knowledge about organizational and strategic capabilities of mass customization operations, and the demand for sincere change management activities. These issues may explain why the present state of practical implementation of mass customization lacks behind the description and discussion of the phenomenon in the management literature.

Key Words: mass customization, personalization, customer co-design, configuration, review

1. Why is mass customization not there yet?

The editor of this special issue invited me to provide an introduction to mass customization. I will build this introduction around a single question: *Why is mass customization not there yet?* During the last ten years of my academic career, I have spent a fair amount of time on research about mass customization.[1] During this time, I had a chance to visit numerous companies performing mass customization. Many more examples are documented in the business press. We also discussed the concept intensively at various conferences and workshops with managers and scholars alike. My personal library of mass customization books, journals and articles is steadily growing. However, I still believe that mass customization is not there yet, that it is not practiced to an extent that justifies all the talk and buzz around this term. If you are an academic, just try this simple exercise in your next class: Ask how many of your students have heard about mass customization, how many can name a mass customization company, and how many have ever purchased a mass customized product. On an average, I get numbers of twenty, ten, and two percent, respectively. If we would repeat this survey with a representative sample of consumers in US or Europe, I believe that these numbers would be even lower (an indication as provided by Evans, 2005).

But these low numbers are not surprising. Only a handful of mass-market brands have moved to mass customization beyond pilot testing and niche markets. Mass customization is still very much a niche business (Piller and Ihl, 2002; Zipkin, 2001), dominated by highly specialized businesses that are small and often young. Based on my personal understanding and experience gained from teaching, researching and consulting on this concept, I put forward twelve propositions about the recent state of mass customization practice in this paper. These propositions could become starting points for a scholarly and managerial discussion in future. Given my background in business administration, I will focus on management and marketing issues (for challenges resulting from supply chain management, engineering, and product design, see, e.g., Boer and Dulio, 2003; Brown and Bessant, 2003; MacCarthy, Bramham, and Brabazon, 2003; Salvador, Rungtusanatham, and Forza, 2004; Squire, Readman, Brown, and Bessant, 2004; Tseng and Jiao, 2001; Tseng, 2002). I will further focus my discussion on companies serving typical "mass" markets, conventionally characterized by made-to-stock and inventory based distribution systems.

2. The term– mass customization

Davis, who coined the phrase in 1987, refers to mass customization when "the same large number of customers can be reached as in mass markets of the industrial economy, and simultaneously treated individually as in the customized markets of pre-industrial economies" (Davis, 1987: 169). Pine (1993a) popularized this concept further and defined mass customization as "providing tremendous variety and individual customization, at prices comparable to standard goods and services" to enable the production of products and service "with enough variety and customization that nearly everyone finds exactly what they want." Tseng and Jiao (2001) introduced a pragmatic but precise definition. Mass customization corresponds to "the technologies and systems to deliver goods and services that meet *individual* customers' needs with *near* mass production efficiency." But beyond these understandings, the term is used today for all kind of strategies connected with high variety, personalization, and flexible production (just search google for a definition of "mass customization" to get an impression, or see Piller (2003b) for an overview).

Today, mass customization is a buzzword. This is a major part of the problem as no clear definition and common understanding of the term have evolved. "Extant literature has not established good conceptual boundaries for mass customization", state Duray et al. (2000: 606) after a literature review. But unless we agree on a definition and common understanding, mass customization will become neither an academic discipline nor a broad strategic concept recognized by managers. The field must not suffer from a definition debate. It needs a definition that can capture the uniqueness of mass customization with its own distinctive properties. There is also a need to delimit the domain. Not all flexible manufacturing strategies or customer-orientated product design methodologies can be termed as mass customization. There is still work needed to describe mass customization as a domain whose objectives, processes, performance, and governance are unique in respect to a firm's resource allocation (Sheth and Parvatiyar, 2002) approaches. From this observation evolves my first proposal to explain, "why mass customization is not there yet":

Proposition 1. *The lack of a common definition and understanding prevents the spread of implementation of mass customization. It remains a fuzzy buzzword and is not connected with a distinctive set of processes and capabilities which is unique for this domain.*

To contribute to this task, I revised my definition of mass customization several times within the last decade to focus my thinking on the issues that really distinguish mass customization from similar concepts. In my most recent understanding, mass customization refers to a

> *Customer co-design process* of products and services, which meet the *needs of each individual customer* with regard to *certain product features*. All operations are performed within a *fixed solution space,* characterized by stable but still flexible and responsive processes. As a result, the *costs associated with customization* allow for a price level that does *not imply a switch in an upper market segment*.

In the following, I have attempted a closer look on the genus and the differentia (basic elements) of this definition.

2.1. Customer co-design

The genus of mass customization is customer co-design. Customers are integrated into value creation by defining, configuring, matching, or modifying an individual solution. Customization demands that the recipients of the customized good transfer their needs and desires into a concrete product specification. Different than a do-it-yourself (DIY) setting (i.e., autonomous creation activities of consumers), this is done in a mode of interaction with the manufacturer who is responsible for providing the custom solution ("co-creation," Ramirez, 1999). Co-design activities are performed in an act of company-to-customer interaction and cooperation (Franke and Piller, 2003a, 2004; Khalid and Helander, 2003; Toffler, 1980; Tseng, Kjellberg, and Lu, 2003; von Hippel, 1998; Wikström, 1996). This is the core element that differentiates mass customization from other strategies like lean management or agile manufacturing. Customer co-design also establishes an individual contact between the manufacturer and customer, which offers possibilities for building up a lasting relationship. Once the customer has successfully purchased an individual item, the knowledge acquired by the manufacturer represents a considerable barrier against switching suppliers. Reorders are much easier (Pine, Peppers, and Rogers, 1995; Wayland and Cole, 1997). Co-design has important implications for strategic design of the activity system of a mass customizer, as I will explain in greater detail in the following sections.

2.2. Meeting the needs of each individual customer

From a strategic management perspective, mass customization is a strategy of differentiation. Referring to Chamberlin's (1950, 1962) theory of monopolistic competition, customers gain from customization, the increment of utility of a good that fits their needs better than

the best standard product attainable. The larger the heterogeneity of all customers' preferences, the larger is this gain in utility. From a managerial point of view, customization can be carried out with regard to *fit*, *style*, and *functionality*. Take the example of a shoe. Here, fit is mostly defined by its last, but also by the design of the upper, insole, and outsole etc. Style is the option to influence the aesthetic design of the product, i.e., colors of the leather or patterns. The functionality of a shoe can be defined by its cushioning, form of heels, or the structure of cleats. In the case of cereal, these options could be translated into package size (fit), taste (no chocolate and raisins, many strawberries), and nutrition (vitamins, special fibers). To match the level of customization offered with customers' needs is a major success factor of mass customization.

2.3. Stable solution space

The space within which a mass customization offering is able to satisfy a customer's need is finite. The term solution space represents "the pre-existing capability and degrees of freedom built into a given manufacturer's production system" (von Hippel, 2001). Correspondingly, a successful mass customization system is characterized by *stable* but still flexible and responsive processes that provide a dynamic flow of products (Pine, 1995). Value creation within a stable solution space is the major differentiation of mass customization versus conventional (craft) customization. A traditional (craft) customizer re-invents not only its products but also its processes for each individual customer. But a mass customizer uses stable processes to deliver high variety goods (Pine, Victor, and Boynton, 1993). This allows a mass customizer to achieve "near mass production efficiency," but also implies that the customization options are limited *to certain product features*. Customers perform co-design activities within a list of options and pre-defined components. This space determines the universe of benefits that an offer intends to provide to customers, and then within that universe, the specific permutations of functionality that can be provided (Pine, 1995). Mass customization does not mean to offer limitless choice, but choice that is restricted to options which are already represented in the fulfillment system. In the case of digital goods (or components), customization possibilities may be infinite. In the case of physical goods they are, however, limited and may be represented by a modular product architecture (Tseng and Du, 1998; Tseng and Jiao, 2001). Setting the solution space becomes one of the foremost competitive challenges of a mass customization company. I believe that many firms still lack the capability to define and set an appropriate solution space.

2.4. Adequate price and cost levels

Often, the definition of mass customization is supplemented in the literature by the requirement that individualized goods do not carry the price premiums connected traditionally with (craft) customization (Davis, 1987; Hart, 1995; Pine, 1993b; Victor and Boynton, 1998; Westbrook and Williamson, 1993). However, mass customization practice shows that consumers are frequently willing to pay a price premium for customization to reflect the increment of utility they gain from a product that better fits their needs than the best standard product attainable (see Franke and Piller, 2004; Levin, Schreiber, Lauriola, and Gaeth,

2002; Piller, Hönigschmid, and Müller, 2002). The mass customization definition is not to be restricted to "mass production prices". To distinguish mass customization from craft customization, I chose the differentia that mass customized goods are targeting the same market segment that was purchasing the standard goods before. Traditionally, craft customization is related to price premium to such an extent that it targets a completely different market segment. Premium of mass customization offerings may be substantial, but still has to be affordable. I admit that this definition is still rather fuzzy, but it should fit the reality better than the traditional differentia to offer customized goods at mass production prices.

From the manufacturer's perspective, this price level demands for a cost level that allows such affordable premium. Piller, Möslein, and Stotko (2004) discuss the value creation mechanism of mass customization. They show that customized production can allow for *economies of integration,* cost saving potentials resulting from better planning conditions, a reduction of fashion risks, a drop in distribution stock-keeping, or higher customer loyalty. The information acquired during the co-design process allows the firms to cut back on pools of fixed costs that came about due to the necessity of maintaining a high level of operational flexibility. Economies of integration are substantially based on better access to knowledge about the needs and demands of the customer base (see also Kotha, 1995; Piller, 2003a; Rangaswamy and Pal, 2003; Squire et al., 2004; von Hippel, 1998).

Managing the cost and value drivers of mass customization is an important task that is not understood by many companies entering mass customization. I will build my following argumentation on the principles of mass customization expressed in the above definition. My discussion can be structured around four basic questions that are frequently raised by managers and scholars when discussing the challenges of mass customization: Do we have the enabling technologies for mass customization? Do customers need customized products? What prevents customers from purchasing customized products? And why do many firms fail when introducing mass customization?

3. Co-design and interaction systems: Do we have the enabling technologies for mass customization?

From the firm's perspective, the costs of mass customization include two factors: (i) the cost of providing high flexibility in manufacturing, and (ii) the cost of eliciting customer preferences. Till today, mass customization research and practice is closely connected to the first factor, i.e., the potential offered by new manufacturing technologies to reduce the trade-off between variety and productivity (Ahlström and Westbrook, 1999; Fogliatto, Da Silveira, and Royer, 2003; Kotha, 1995; Pine, 1993a; Thoben, 2003; Victor and Boynton, 1998). But if a firm cannot transfer the customers' preferences cheaply into a fitting product design, the best available manufacturing technology is of no meaning (Reichwald, Piller, and Moeslein, 2000). In a co-design system, the solution space, i.e., the product architectures and the range of possible variety, is fixed during a preliminary design process (autonomously by the firm). But a second step takes place in close interaction between the customer and the manufacturer, the elicitation process of mass customization (Zipkin, 2001). The costs arising from customization broadly comprise interaction and information costs. They are accounted for by the investigation and specification of the customers' demands, the

configuration of individual products, the transfer of the specifications to manufacturing, an increased complexity in production planning and control, the coordination with the suppliers involved in the individual prefabrication and the direct distribution of the goods.

Co-design hence demands adequate interaction systems to cope with co-design. In consumer markets, systems that are able to handle the increasing intensity of information became available only with the advent of the Internet. Flexible manufacturing machinery for efficient fabrication of high variety goods is, however, accessible for many industries already much longer. This discrepancy between the availability of flexible manufacturing systems versus the availability of sufficient information systems may also explain the time lag between the long discussion of mass customization in the literature (starting with Toffler in 1970) and its late implementation in practice (Piller, 2002). It has only been a few years since sufficient technologies have existed which have been able to reduce the information flows resulting from deep customer-firm interaction (especially in consumer markets). In former times, firms reduced the information content of their processes in order to reach cost efficient outputs. But today the opposite can be true: An increasing information richness of products and processes guarantees a cost efficient and individualized production (Dellaert and Syam, 2002; Duray, 2002; Fulkerson and Shank, 2000; Lee, Barua, and Whinston, 2000). Mass customization is only possible if flexible manufacturing processes are supported by adequate systems for customer co-design.

These systems are known as configurators, choice boards, design systems, toolkits, or co-design-platforms. They are responsible for guiding the user through the configuration process. Different variants are represented, visualized, assessed, and priced with an accompanying learning-by-doing process for the user (von Hippel, 2001). Whenever the term "configurator" or "configuration system" is quoted in literature, it is used for the most part in a technical sense addressing a software tool. Taking up an expression from von Hippel (2001), I propose the more generic term "toolkits for customer co-design" in the following (Franke and Piller, 2003). The number of firms operating with toolkits is growing steadily in industrial as well as in consumer markets, along with an exploding number of software vendors offering standard toolkits for product configuration. A recent literature review revealed that research on toolkits going beyond the technical argumentation in the computer science and information systems literature is, however, still scarce (Franke and Piller, 2003, 2004; Piller, 2005). The evolving literature on mass customization concentrates on technical and production aspects instead of the interface between user and producer, that is, the toolkit itself. The literature which directly addresses toolkits, mostly supplies only anecdotal studies and describes toolkit cases in a narrative style. Further, publications focus on firms implementing and using toolkits, not on users interacting with them. Despite promising developments recently (e.g., Dellaert and Stremersch, 2005; Kamali and Loker, 2002; Schreier, 2004; Terwiesch and Loch, 2004), there is little user-focused research about configuration toolkits. Also, knowledge on how to integrate configuration systems from an organizational point of view in an existing sales system is more or less lacking. This leads me to two further propositions on why mass customization may have not evolved as a common business practice so far.

Proposition 2. *While mass customization has been described and talked about for a long period of timenow, adequate systems to perform customer co-design efficiently and*

effectively have been available since a couple of yearsonly. The enabling technologies for customer co-design have just started to penetrate the market space.

Proposition 3. *Research and managerial knowledge on the design and implementation of toolkits for customer co-design is lacking aspects of organization, marketing, usability, and their role in corporate strategy. This leads to a rather technology and not strategy focused implementation of a central enabling resource of a mass customization system.*

4. The market for mass customization: Do customers need customized products?

Manufacturing and co-design technologies will be, however, just an artifact if the market demand for custom products would be not large enough to cover all the costs to implement the new system. Obviously, the *heterogeneity of customer preferences* influences the likelihood that customers are attracted by a mass customization offering. If heterogeneity is large, mass customization could provide huge additional value; if it is low, it would be more efficient for manufacturers to develop one product efficiently that fits all (Broekhuizen and Alsem, 2002). It is commonplace to state that customer preferences in many markets are heterogeneous and change quickly (see for a synopsis of the reasons of this development Blaho, 2001; Ettenberg, 2002; Heil, Parker, and Stephens, 1999; Piller, 2003a; Zuboff and Maxmin, 2002). To date, however, there are only few studies that *quantify heterogeneity* of customer preferences.

In an empirical study of software, Franke and von Hippel (2003) show that users in fact have very unique needs, leaving many displeased with standard goods. Users claimed that they were willing to pay a considerable premium for improvements that satisfy their individual needs. In a meta-analysis of published cluster analyses, Franke and Reisinger (2003) find evidence that this dissatisfaction is not an exception. Current practice in market segmentation generally leads to high levels of total variance, left over as in-segment variation (over 50% on average). The reason for this dissatisfaction can be seen in the missing capability of mass or variant manufacturing to respond to individual needs regarding the desired ideal product of individual customers. Standardized products are produced on-stock, meeting only the mean preferences of an average customer in a market segment. This implies that a major group of customers stays somewhat dissatisfied with standard offerings, even when it comes to the seemingly mature markets. Also several empirical studies summarized by American Demographics, a market research institute, indicate that consumers increasingly demand that products and services are tailored for them (Frazier, 2001). In many instances, customers are willing to even swap their privacy for that level of customization. Another indicator for heterogeneity of user needs is the fact that many users are already *modifying existent products*. In fields sampled to date, nearly ten to forty percent of users report to have modified or developed a product for in-house use (in the case of industrial products) or for personal use (in the case of consumer products) (Franke and von Hippel, 2003). Franke and Piller (2004) finally show for a test market that it demands a very high number of standard variants to reach just fifty percent of the customer satisfaction level of customization (customer satisfaction were defined as the degree of fit between the actual product characteristics and the customer's expectations).

In a number of market surveys by our own mass customization research center at the TUM Business School, we looked into the potential for mass customization in several fashion markets (footwear, clothing, watches) and found that on an average, average ten to twenty percent of the overall market population (representing twenty to thirty percent of the market volume) seems to be interested in mass customized products (see EuroShoE Consortium, 2002; Franke and Piller, 2004; Jaeger, 2004; Kieserling, 1999; Piller and Müller, 2004; Piller et al., 2002; Reichwald, Müller, and Piller, 2005). Even if mass customization will not become the dominating system, these seem to be no niche markets, but promising market segments, often totally uncovered as of today. But all market research on mass customization faces one important limitation, restricting the interpretation of the findings: The majority of research subjects have had no hand-on experience with customization. Already, surveys concerning consumer-purchasing behavior of standard goods face numerous biases due to the survey situation, and these biases are multiplied in the case of customized goods. Most consumers have an imagination about customization, but no experience with it. They will answer positively when asked if they could image to purchase a good customized to their individual wishes and desires. But are they also willing to wait till the product is produced? Will they trust the supplier and pay in advance for a product that they cannot see? Only the data gained from observing consumers in real purchasing situations will provide evidence on the real market for mass customization. But this kind of research is almost non-existent yet.

Proposition 4. *Due to the very limited experience of customers with customization in many industries, reliable predictions based on surveys of willingness-to-purchase do not exist. The lack of reliable market information and studies about the real market potential for customization is preventing firms to invest in mass customization.*

At this point, further research has to look upon the factors driving customers' demand for custom goods. The value of a custom good can be measured as the increment in utility that the customers get from a product that fits better to their needs than the second best solution available (Lancaster, 1966). But this does not mean that customers are buying "individuality"; they are purchasing a product or service that exactly their needs and desires (Bitner, Brown, and Meuter, 2002; Piller and Ihl, 2002). Only few customers honor long co-design processes (see below) and purchase a product for the sheer fact that it is a mass customizable good. Anecdotal evidence let me assume that mass customization concepts, which are based primarily on the promise of customization, will fail (GetCustom, Custom-Foot, or Customatix are all examples of companies which stressed already in their brand name customization as the unique differentiator of their product; they all are not existing any more). The question where and how exactly mass customization delivers which kind of value (and depended from which contingency factors) for customers is still not answered for me (and there is only limited research in this area). Remember that customization can begin on three levels: style, fit (measurement), and functionality. These dimensions may help to explore this question a bit further.

- *Style (aesthetic design)* relates to modifications aiming at sensual or optical senses, i.e., selecting colors, styles, applications, cuts, or flavors. Many mass customization offerings

are based on the possibility to co-design the outer appearance of a product. This kind of customization is often rather easy to implement in manufacturing, demanding a late degree of postponement (Duray, 2002). But does custom style really provide value? Exact empirical evidence is lacking, but I saw many companies which just offered style customization, fail. The desire for a particular outer appearance is often inspired by fashion, peers, role models, etc.; and the individuals' desire is to cope and adapt to these trends, but often not to create them. In the psychological marketing literature, the construct of *consumers' need for uniqueness* is discussed. Consumers acquire and display material possessions for the purpose of feeling differentiated from other people or by actions that consumers perform explicitly to be recognized by others (counterconformity motivation; see Nail, 1986; Schreier, 2004; Tepper, Bearter, and Hunter, 2001). Some consumers express their desire for uniqueness by selecting material objects (fashion) that are ahead of the average trend, by purchasing handcrafted items, or vintage goods from non-traditional outlets. Customer co-design could be a further means to express their uniqueness, when consumers can design products to own personal specification in order to look different then the rest. Our customer surveys mentioned before however show that a rather small numbers of consumers want to be unique in this understanding. Style customization hence will serve only a very limited market need. From my experience, it serves well as an additional means to differentiate a mass customization offering from the competing mass-produced products. But in most industries, it provides rather limited sustainable value as the sole customization option. Most mass customization offerings in the consumer good field, however, still focus on style customization only.

- *Fit and comfort (measurements):* Customization based on the fit of a product with the dimensions of the recipient is the traditional starting point for customization, i.e., tailoring a product according to a body measurement or the dimensions of a room or other physical objects. The market research mentioned earlier identifies better fit as the strongest argument in favor for mass customization. But it is also the most difficult dimension to achieve in both manufacturing and customer interaction, demanding expensive and complex systems to gather the customers' dimensions exactly and transfer them into a product which has to be based on a parametric design (to fulfill the requirement of a stable solution space). This often commands for a total redesign of the product and the costly development of flexible product architectures with enough slack to accommodate all possible fitting demands of the customer base. In sales, expensive 3D scanners or other devices are needed, which in turn demand highly qualified sales clerks to operate them (this is a major challenge for many mass customizers, see Berger, Moeslein, Piller, and Reichwald, 2005). This leaves mass customizers with the challenging situation that the most promising dimension of mass customization is often also the most difficult one to implement.
- *Functionality* addresses issues like selecting speed, precision, power, cushioning, output devices, interfaces, connectivity, upgradeability, or similar technical attributes of an offering. Functionality is often overlooked as a dimension of customization. It demands similar efforts to elicit customer information about the desired individual functionality as the fit dimension. Manufacturing, however, can be easier in some instances, when increasing software content of the material product allows for a rather simple possibility to

increase the customizability of functional components (self customization). Embedded configurators could become a very promising new technology that would allow customers to continuously re-configure a product. But in such a case, there would be no need to distinguish mass customization as a special domain any more (a related approach is to sell a standard product and create a customized solution by offering add-on services). Not all customization demands, however, can be integrated as software in a product. There is a strong need for manufacturing-based customization concerning functionality. From the three dimensions of customization, functionality is the least utilized in today's mass customization practice.

I hypothesize that mass customization offerings will be most successful and sustainable when they would combine all three customization options. This leads to two further propositions:

Proposition 5. *Many mass customization offerings do not create sufficient additional value for customers compared to their pre-fabricated alternatives, as many mass customizers focus on style (aesthetic design). But given growing peer orientation and brand awareness in many markets, this customization option may be the least appealing to consumers.*

Proposition 6. *Mass customization offerings combining fit, functionality and style will be most successful in attracting consumer demand. Most of today's mass customization offerings, however, focus on only one of these levels.*

Note that the fulfillment of individual customers' needs builds, first of all, on objective product attributes that are being customized. In addition, however, various other aspects seem likely to influence the value created by mass customization from a customers' perspective (and hence creating market potential). Products that are co-designed by a customer may also provide symbolic (intrinsic and social) benefits for the customer, resulting from the *process* of co-design, and not its outcome (e.g. Füller et al., 2004; Piller, 2005; Prandelli, Verona, and Raccagni, 2004; Reichwald et al., 2005; Schreier, 2004). Schreier (2004) quotes, for example, a pride-of-authorship effect. Customers may co-create something on their own which may add value due to the sheer enthusiasm about the result. This effect relates to the need for uniqueness as discussed before, but is based here on a unique task, and not its outcome. In addition to enjoyment is a sense of creativity in task accomplishment (Lakhani and Wolf, 2005). To participate in a co-design process may be considered as a highly creative problem-solving process by individuals engaged in this task, becoming a motivator to purchase a mass customization
product.

An important precondition to process satisfaction is that the process itself is felicitous and successful. The customer has to be capable of performing the task. This competency issue involves *flow*, a construct often used by researchers to explain how customer participation in a process increases satisfaction (Csikszentmihalyi, 1990). Flow is the process of optimal experience achieved when motivated users perceive a balance between their skills and the challenge during an interaction process (Novak, Hoffman, and Young, 2000). Interacting with a co-design toolkit may lead exactly to this state. However, the peculiarities

of user design with a co-design toolkit limit a direct transfer of the findings in other fields to co-design. Further empirical insights in this matter are therefore a prerequisite (Franke and Piller, 2003). Marketing researchers are just realizing this research opportunity, and a number of interesting studies are coming up (e.g., Dellaert and Stremersch, 2005; Randall, Terwiesch, and Ulrich, 2005; Simonson, 2005). But if mass customization would be just driven by process satisfaction and intrinsic or social benefits (demanding, first of all, investments in highly sophisticated toolkits), it would become an entertainment product and its appeal would be based on novelty—not a really promising option for many manufacturers.

Proposition 7. *Process satisfaction and value for customers offered by the co-design process itself are important complementary factors driving mass customization, but they should not become the center of the value proposition of a mass customizer.*

5. Mass confusion: What prevents customers from purchasing custom products?

The last section has discussed the value of mass customization and its resulting market potential. In this section, I will focus on the costs and efforts for customers in a mass customization system. In the end it is the *perceived (net) value* that influences the customers' willingness to purchase a mass customization offering, defined as the difference between the customers' utility (value) and costs (note that also mass production is connected with various costs for customers, see Zuboff and Maxmin, 2002). From the customers' perspective, costs of mass customization can be differentiated in direct and indirect cost.

The direct cost of mass customization for customers is the price premium of a custom product compared to its standard alternative. Empirical research has shown that customers are often willing to pay up to 150 percent more for the increment of utility they get from a product that fits better to their needs than the second best solution available (Bendapudi and Leone, 2003; Franke and Piller, 2004; Piller et al., 2002). Microeconomic literature has discussed since decades that customers' willingness-to-pay is connected with the fit of a product to their preferences (Chamberlin, 1950, 1962; Lancaster, 1966; Henkel and von Hippel, 2003). Product customization allows firms also to capture individual differences in the willingness-to-pay between different customers: Instead of discriminating prices on the level of fully developed products, firms can differentiate their price on the level of a specific customer design.

In addition to the direct cost of mass customization in form of the price premium customers may perceive psychological or cognitive (indirect) costs. Cognitive costs result from the perceived risk of being involved in co-creation, which can be understood as the expectations of customers to realize a loss (Baker, Parasuraman, Grewal, and Voss, 2002; Stone and Gronhaug, 1993). The uncertainty of customers about whether their engagement in the co-design process results in a positive net value or not, relates to the cognitive costs of perceived risk and complexity. Thus, some authors emphasize the downsides of the co-creation behavior for the customer, especially in the context of toolkits for user innovation and co-design (Broekhuizen and Alsem, 2002; Dellaert and Stremersch, 2005; Franke and Piller, 2003; De Meyer, Dutta, and Srivastava, 2002; Huffman and Kahn, 1998; Zipkin, 2001). They argue that the active role of the user-designer may lead to "*mass confusion*".

The arguments and reasons for this "mass confusion" can be differentiated in two types of indirect costs of co-creation (Piller, Schubert, Koch, and Moeslein, 2005):

- *Burden of choice.* Marketing research has demonstrated since decades that customers strive to minimize time and effort, and value convenience by a higher willingness-to-pay (Anderson, 1972). When the purchasing act becomes too time-consuming, customers regularly stop it and relocate their purchasing budget to another offering or product category (Babin, Darden, and Griffin, 1994; Simon, 1976). One limit of mass customization often quoted is that *excess variety* may result in an external complexity. Customers might be overwhelmed by the number of possibilities at their disposal (Franke and Piller, 2004; Huffman and Kahn, 1998; Kamali and Loker, 2002; Stump, Athaide, and Joshi, 2002; Wind and Rangaswamy, 2001). Anyone who has been forced to choose from a fairly wide selection—for example, in a restaurant that offers 500 entrées—knows that equating a large number of possibilities with high customer satisfaction would be blind optimism. The human capacity to process information is limited (Miller, 1956). The burden of having to choose from too many options may simply lead to information overload (Maes, 1994; Neumann, 1955). Consequently, users may turn away from the liberty to choose and decide for the standard (or starting) solution offered by a toolkit (Dellaert and Stremersch, 2005; Hill, 2003)—or they may even frown and turn their backs completely. In addition to large variety and the burden of choice, customers often simply lack the knowledge and skills to make a "fitting" selection, i.e. to transfer their personal needs and desires into a explicit product specification (Huffman and Kahn, 1998). Even a standard and rather simple product like a pair of sport shoes becomes a rather complex product if one has to decide explicitly between different widths, cushioning options for the insole, patterns for the outsole, and color options.
- *Information gap regarding the behavior of the manufacturer.* For many consumers, customizing a product is still an unfamiliar process. In this regard, uncertainty also exists in connection with the potential behavior of the provider (Kamali and Loker, 2002; Terwiesch and Loch, 2004). The cooperative character of the configuration results in an asymmetrical distribution of information—a typical principal agent problem: The customer (principal) orders (and pays) a product she has never seen. Additionally, she may have to wait some days or even weeks to get the product. This problem is common for catalog order or online retailers. However, compared to distance shopping of standard goods, customers of customized goods often have much higher problems to claim that they do not like a product after receiving it. Without a clear reference point for the definition of an optimal performance, it is difficult to judge whether a case of warranty arises compared to purchasing standard mass-produced goods.

These sources of uncertainties can be interpreted as additional transaction costs for customers looking for a custom product. Note that the extent of the mass confusion problem—influencing the demand for a custom product per se—depends on a number of contingency factors such as the type of the product, the extent of customization options, sociodemographics of the users, or previous user experience with both the product provider and customization of another product. These considerations influence the decision of a customer

to participate in co-creation. Only if the customers' perceived (net) value is positive,will they continue to purchase mass customization goods beyond the motive to explore a novelty. To set the optimal extent of co-design options (i.e., to set the right freedom within the solution space) also becomes, from this perspective, one of the most important capabilities of managing mass customization. I hypothesize that many mass customization offerings fail to minimize the cognitive costs of customers. This may be another explanation why mass customization is not there yet:

Proposition 8. *Potential customers of custom products face risks resulting directly from the customization process (as compared to purchasing a pre-fabricated good). These risks may be much stronger than the restricting effect of additional price premiums. Many mass customizers are not aware of these risks.*

To solve this problem, the manufacturer has to invest in *signaling activities* to ensure that the customers' efforts are worthwhile and adequately rewarded. This could include references to value created by customization for other users, dedicated areas on the website or a hotline to provide information, intensive warranties (return policies), and a marketing communication strategy aiming towards consumer education in general. But not all risks can be efficiently reduced by signaling. Therefore, *trust* is an important supporting means for successful transactions. Trust is regarded here as a social mechanism enabling actors to bear risks in a situation when full information does not exist. Building trust is a demanding task and requires special care of the firm (Donoghue, 2000). Mass customization research could profit enormously in this regard from earlier service management research, where similar issues are discussed since decades (as the customer-specific production and its lack of pre-fabrication is a defining element of a service; see Bateson, 1985; De Meyer et al., 2002). This bridging of research domains, however, has just started (see Piller 2005 for an overview). From my personal observation, I have seen only very few mass customizers providing this kind of signaling and trust building activities. This may prevent customers from purchasing these goods.

Proposition 9. *Many mass customizers lack adequate signaling and trust building to prevent the perception of "mass confusion" (cognitive costs of customers). As a result, mass customization offerings are often less attractive compared to their standard alternative.*

6. Change management: Why do many firms fail when introducing mass customization?

My last observation relates to companies that created wonderful mass customization offerings, experienced a sufficient and sometimes even overwhelming customer feedback, and sill failed in their mass customization attempts. A repeating pattern of failure can be seen in unsuccessfully managing the change process from a product-focused, mass production firm to a customer centric mass customization organization. Shifting the locus of value creation towards customers requires no less than a radical change in the management mind-set (Piller, 2005; Ramirez, 1999). I also assume that the expectation of a difficult change

management process required to implement mass customization successfully may prevent managers from investments in this system. Already Pine (1993a) mentioned that the transition from mass production to mass customization would often be gradually phased, given the complexity of this process. Literature and research on change management for mass customization basically does not exist (promising research projects have just been started at the Tampere University of Technology in Finland and at the TUM Business School in Germany). Broekhuizen and Alsem (2002) and Hart (1995) refer in this context briefly to organizational readiness. They claim that an organization has to arrive at complete consensus regarding the execution and implementation of mass customization. A senior management buy-in and a top-down implementation approach are essential to address the following subjects.

At the outset, firms have to cope on the level of normative management with the challenge to change old, often negative perceptions of the customers in an organization (Gouthier, 2003). The genus of mass customization as a co-design process of collaborative value co-creation has to be deeply implemented into the cultural mindset of the organization. However, like all humans, business managers and their employees are socialized in a dominant logic, shaped by the attitudes, behaviors, and assumptions that they learn in their business environments (Huff and Möslein, 2004; Prahalad and Bettis, 1986; Prahalad and Ramaswamy, 2004). Their thinking is conditioned by managerial routines, systems, processes, budgets, and incentives created under the mass production framework. As a result, management concepts like buffering demand from supply, inventory management, forecasting, plant scheduling, cycle time, and seasonal product development cycles evolved and became the common ground for action. Unsurprisingly, interactions with customers are often approached in a similar fashion. In essence, a company that is including customers in product design in the course of the co-design process is outsourcing valuable activities that were once proprietary and have been a source of strategic advantage in the past (Prahalad and Ramaswamy, 2004). This calls for a deep understanding and debate about mass customization on the top management level of an organization. Many mass customization initiatives, however, are regarded just as a marketing gimmick and nice PR-tool, neglecting the needs and possibilities of dealing with single customer orders. This lack of a change process on the level of normative management may be one further explanation why we do not find more successful, large-scale mass customization operations today:

Proposition 10. *Many mass customizers neglect the necessity of a cavernous change management process when introducing mass customization. Larger companies more likely demand a more complex migration process. This may explain why there are few big corporations that have exploited mass customization in an adequate scale relatively to their overall size of operations.*

Internal change management for mass customization demands that the firm's (top) management actively installs programs to comply the organization's norms and routines with customer co-design. The most generic starting point is this regard is to adjust the firm's cultural guidelines. Today, most firms have written principles, which are taught to all members of the organization. Within these guidelines, often a code of conduct concerning the firm's

stakeholders is regularly included, also mentioning the customer. On this level, the role of customers as a value co-creator has to be deeply integrated and communicated.

But just writing about the need for co-design is not enough. Another area where change management initiatives inside the manufacturer's organization have to take place is to define a fitting organizational arrangement at the customer interface including retailers and other intermediaries (Berger et al., 2005; Franke and Piller, 2003; Gummesson, 2002). This generates its own complexity: Traditionally, the competitive advantage of a retailer is based on its ability to provide an appropriate assortment of goods for the targeted market that falls within its capabilities for connecting with one or more distribution chains. Mass customization, in contrast, means that assortment, efficient stock keeping, and distribution are no longer the driving sources of competitive advantage. On the contrary, interaction skills and matching customization possibilities with the needs of a specific customer during the process of co-design are becoming the primary sources of competitive advantage (Piller, 2003a). In traditional mass production, retailers are acting as a buffer between (end-)customers and manufacturers. In a co-design system, the manufacturer has to get direct and unbiased access to information on each single customer in order to fulfill the customers' order, demanding for interaction and cooperation between customers, retailers, and manufacturers. While this task is of general importance in many retailing contexts, I argue that co-design has even higher demands. It is therefore critical to design an appropriate cooperation setting. Also here, research has just started. As mentioned before, many researchers studying the customer interface focus on usability issues and questions of presenting choice in the co-design toolkit. Research on multi-channel strategies for mass customization is sill lacking. Correspondingly, the mass customization retail practice is characterized by trial and error learning and experimentation (see as an example, the case of miAdidas documented in Berger et al. (2005)).

Proposition 11. *Customer co-design demands an organizational setting at the customer interface that includes the manufacturer and often retailers and other intermediaries too. This interface can become the source of various channel conflicts, holding up the implementation of mass customization (either due to the existence or the sheer expectation and fear of these conflicts).*

A final area of change management for mass customization is related to the exploitation of customer knowledge gained during the co-design process. As mentioned before, value creation for the firm is substantially based on better access to knowledge about the needs and demands of the customer base (economies of integration). The co-design process allows customer specific information which is often "sticky" (von Hippel, 1994, 1998) and hence difficult to transfer with conventional methods of market research. Tastes, design patterns, and even functionalities are rather subjective and difficult to describe. By transferring customer needs and wishes into customized products by the means of a co-design toolkit, a company gains access to sticky information and can transfer it to explicit knowledge. By aggregating this knowledge, the company can generate better market research information and more accurate forecasting concerning customer needs. This is especially true when the firm's main business is still following the made-to-stock and inventory based (mass) production system (Kotha, 1995). For the portion of business that is (still) manufactured on

stock, the custom segment provides important market research information, which can be used to improve variant development and forecasting accuracy of products made-to-stock. To utilize this capability, however, the firm has to obtain adequate capabilities to design and re-design the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge (Zahra and George, 2002). Change management has to support the transformation capabilities of a firm and its employees. The objective is to prevent a new "not-invented-here" syndrome and to avoid the negative scenario that might arise from conflicting process designs and interest constellations between conventional sources of customer information (like market research surveys) and new sources resulting from the co-design process. So far, I have come across very few companies that explicitly utilize this capability. Hence, a major potential for value creation by mass customization remains idle.

Proposition 12. *Few companies utilize the full span of possibilities for value creation by mass customization. Many managers focus on the customized production process, neglecting the opportunities to aggregate customer co-design information to customer knowledge for innovation and strategic planning.*

7. Conclusion

The mass customization landscape today reveals a somewhat sobering picture. The opportunities of mass customization are acknowledged as fundamentally positive by theoretical and empirical studies for many years. They have attracted a lot of attention by managers from all kinds of industries within the last few years. Many companies are already successfully operating after this new business model. But most of them are rather small start-ups that utilize the novelty effect of mass customization to enter mature markets. Large-scale mass customization operations are still limited to a few examples. The objective of this paper was to present some personal reflections on the state of mass customization. My arguments are largely predicated on my own experience from working with numerous mass customization companies and interacting intensively with the international research community in this field. My analysis presented in this paper thus is exploratory in nature and only proposes a number of reasons why mass customization has not reached its predicted growth and state of implementation. Further research is needed to provide more insight in the mechanisms, which are framed in my propositions and to determine their relative causality for the success of mass customization.

Possible explanations why mass customization "is not there yet" are plenty, and the twelve propositions developed in this paper may be just the beginning. They are ascribed to terminological problems, the state of implementation of adequate co-design technologies, missing research and management knowledge about organizational, marketing-related and strategic capabilities of mass customization operations, and missing reliable information about the real demand for customized products in various markets or a wrong focus of the customization options offered. Finally, I have argued that implementing mass customization demands sincere change management activities in existing organizations. Luckily, research on mass customization is still growing, and so I remain very optimistic about the concept per se and its opportunities. That mass customization is not there yet does not mean that it will

never come. We just might be still much more at the beginning of the "mass customization s-curve" than many protagonists in this field are thinking.

Remember that the mass customization discussion originated in the context of flexible machinery (manufacturing cells and flexible robots) and computer integrated manufacturing. From this time (late 1980s), a *first generation of mass customization companies* approached. Building on the benefits of efficient flexibility, they offered first of all customization and high variety, in most cases in a business-to-business context. A *second generation* of MC companies realized that the main cost driver of customization is not manufacturing but customer interaction. These companies built their business models on the capabilities of the Internet to reduce communication costs even while interacting deeply with millions of customers. During this time, in the second half of the 1990s, mass customization got a new boost. Second generation mass customization offers were aiming, first of all, to consumer markets. However, many players of generation two failed. Often, they were just focusing on offering customization, but not providing sustainable value for their customers. A third generation of mass customizers has a different approach. They use mass customization to improve mass production. They utilize mass customization principles to provide custom products for a demanding premium segment often not served adequately before. But above all they master to create value for the whole company from better customer knowledge to improve their businesses on a large scale, connecting mass customization with "open innovation" (Piller, 2005, relating to the use of co-design toolkits not only to configure mass customizable products, but also to create radical new solutions). Today, the mass customization reality is still characterized by many generation one and a few remaining generation two mass customizers. Third generation mass customization has just begun.

Mass customization is, I think, first of all a vision. A vision to perform a company's processes in a truly customer-centric manner, resulting in products or services that are corresponding to the needs and desires of each individual customer, and doing this without the surpluses traditionally connected with customization. There are many ways to make this vision a reality, and it seems especially true in a field like mass customization that there is not "one best way" (Lawrence and Lorsch, 1967), but many paths to success, customized to the particular situation of one company and its customers in one market. I am sure that the wonderful collection of papers, which the editors of this special issue have assembled will support the field and provide the ground for new research and applications of mass customization.

Note

1. The outcome of this research, building also the preunderstanding of this paper, is summarized in Piller (2003a, 2005). Its empirical foundation is based on a proprietary database of our research group documenting roughly 220 companies following customer centric strategies (with a focus on mass customization). The objective of this database is to document and evaluate different aspects of mass customization and customer-centric value creation. It has been created since 1995. Information on the cases is gathered from primary sources such as semi-structured interviews with the firm's management and company visits and complemented through secondary sources such as database research and expert interviews from outsiders. In addition to this database, our group coordinates an industry board of approximately twenty mass customization companies, which provides an in-depth insight into the evolution of mass customization strategies in these companies.

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