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Observations on the present and future of mass customization

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Abstract A demanding task for many companies today is that of learning to regard customers as individuals, of proactively developing products and services according to the individual customer preferences, and of subsequently producing and distributing these offerings. Over the last decade, mass customization has emerged as an effective approach for tackling precisely this task. In this paper, I discuss the background of mass customization and the elements of this strategy. I will then comment on the implementation of mass customization in practice. I will end with a brief discussion of alternative strategies in this domain, namely personalization and matching services.

Keywords Mass customization · Case examples · State of the art · Personalization

As in every year, in December 2006 Time Magazine announced their person of the year, recognizing the person who matters most now. In previous years, this has been George W. Bush, John F. Kennedy, or Mohandas Gandhi, but also Charles Lindbergh or Bill Gates. In 2006, this person was *you*. You, the creative consumer. You, broadcasting your own media on YouTube. You, the engaged tinkerer hacking your Tivo box to overcome its limits. You, configuring your sneakers to your preferred running style. You, the co-designer of your personal product. And Time Magazine was not alone. With the advent of Web 2.0 and social commerce applications all over the Internet, we recently experience an exploding interest of

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companies and consumers alike for customized products and services. Individuality becomes the standard. Mass customization, now a concept with a history of almost two decades (the term was coined in 1987 by Stan Davis), seems to be becoming the norm in this century (as predicted by Davis in 1987; Pine 1993; and indeed by Toffler as early as 1970).

The term mass customization denotes an offering that meets the demands of each individual customer, but that can still be produced with mass production efficiency (Piller et al. 2006). "Today I define Mass Customization as the low-cost, high-volume, efficient production of individually customized offerings" (Pine 2007). To reach this efficiency requirement, a mass customization system is defined by a fixed solution space, characterized by stable but still flexible and responsive processes. As a result, the costs associated with mass customization should allow for a price level that does not imply a switch into an upper market segment. The solution space is utilized by customers who are integrated in the value creation process of the manufacturer by defining, configuring, or modifying their individual solution within the given set of choice options. Without the customers' deep involvement, the manufacturer would be unable to adequately fill each individualized product demand. Dedicated toolkits should enable the customers to perform this configuration tasks on their own.

A great example of mass customization is American Power Conversion (APC), a case described by Lars Hvam in a special case study issue of the *International Journal of Mass Customization* (Hvam 2006). APC sells, designs, produces, delivers, and installs large complex infrastructure systems for data centers, and components for these systems. At the heart of its mass customization strategy of this company are a module-based product range and the use of product configuration systems for sales and order processing. In addition, the company has implemented a manufacturing concept that involves the mass production of standard components in the Far East, and customer order-based final assembly at various production sites around the world within close customer proximity. The results of applying mass customization principles included a reduction of the overall delivery time for a complete system from around 400 to 16 days. Also, production costs were significantly reduced. At the same time, the company's capability for introducing new products has increased dramatically. Due to the modular system architecture, new component technologies can be integrated within a matter of days, and not months as before.

In addition to this best-practice example of mass customization, new promising initiatives have been developing during the last year. Indeed, not a month has gone by without a major mass customization initiative by an established company or a new start-up. Some good examples of mass customization in consumer goods that were launched in 2007 are Germany's MyMuesli (customized cereal), Blends For Friends (create your own tea blend), Conde Nast's TasteBook (customized cookbook with your favorite recipes), or John Maeda's innovative configurator for Reebok that turns the favorite song of a user into a custom sneaker style. A segment of mass customization that has been exploding recently is the market of user-created photo books, including providers like Picaboo, LuLu, CeWe, Blurb, Moo, and many others. Zazzle, Cafepress, and Spreadshirt take a similar approach

to selling custom-printed T-shirts, coffee mugs, mouse pads, and more. All these companies reported high double-digit sales growth in the last year.

In business-to-business, FESTO continues to establish its leading position in the automation industry by increasing its mass customization capabilities. The company manufactures thousands of highly customized industrial components for clients around the world with a lead time of 48 h. But FESTO or APC are still an exception rather than the norm. These two companies have entirely been created around the principles of mass customization.

Despite significant progress in individual cases, mass customization continues to be in the stage of a pilot or a marketing idea. I have commented in this journal before on the state of mass customization implementation (Piller 2005). In that review, I identified a number of challenges that prevent easy implementation of mass customization in industry. Those challenges included the proposition that a core characteristic of a mass customization system, customer integration in the configuration process, has been not supported adequately in the past. While mass customization has been described since a long period of time, adequate systems to perform customer co-design efficiently and effectively have been available for just a couple of years and are just starting to penetrate the market space. Also, their introduction is still characterized by a technology-focused rather than a strategy-focused implementation.

A recent report, sponsored by two trade publications and Cincom Systems, supports these propositions (Wilson 2007). The study is based on 72 interviews with senior engineering managers working for manufacturers of complex industrial, electrical, and transportation equipment and systems. While such an industry-driven report may be biased by the perspective of a technology vendor, the study provides a significant exploratory insight into the state of mass customization in many companies in the business-to-business domain. The broad majority of managers interviewed for this report state that requests for customized products have been increasing over the last 5 years, and 26% anticipate that the growth rate for such demands will be between 25% and 50% in the next 2 years. However, the report found that only 67% of build-to-order and engineer-to-order manufacturers had the capability to exactly calculate the cost to produce customized products, and 73% had no capability to assess the cost of engineering change orders. Notwithstanding, more than half of the survey respondents believed that they have the ability to charge a 25% or higher premium with a product customization strategy. Such a disconnect between pricing assumptions surrounding product customization and traceable costs is a barrier to sustaining mass customization momentum. The study also asked managers about the tools they use to support mass customization. Not surprisingly, computer-aided design (CAD) is the primary tool used to support the customization process (92%). Beyond the CAD system, most manufacturers are using ad hoc technologies such as spreadsheets (51%) or manual processes supported by documentation (41%). This implies that the customization process is primarily a drawing-driven effort based on trivial knowledge with heavy engineering involvement in the specification process. Few companies utilize automated configuration systems—a core characteristic of a true mass customization system. Of those who do, 30% use homegrown systems and only 24% use third-party

packages. These numbers indicate that there is woefully little integration of tools within the customization process. The lack of integration implies that there is a significant amount of manual intervention within the customization process, requiring time and resources, and leaving significant scope for errors. According to the study, most engineers believe that product complexity is not the primary barrier to customization. They cite lack of knowledge of options by the customer (67%) as the primary barrier to customization efforts. The implication is that the knowledge required to effectively sell customized products is not being effectively transferred to the customer. This study proposes that many companies in the business-to-business sphere are still more in the state of a traditional craft customizer (engineer-to-order), but far away from the principle of mass customization of stable processes (Pine, 1997). There are huge opportunities for improvement in sales and operational effectiveness to be gained by addressing this issue.

The state of mass customization application in industry, as demonstrated in Wilson (2007), however does not correspond to today's level of research in the field. Within the last 2 years, a significant new body of research on mass customization has appeared in leading journals in engineering, marketing, and management. The papers accepted for publication in this special issue of the *International Journal of Flexible Manufacturing Systems* provide further support to this notion. In addition, several large conferences on mass customization assembled hundreds of scholars and managers at Hong Kong, Hamburg, Ypsilanti, Copenhagen, Grand Rapids, Salzburg, Boston, and Montreal. The prime example of such a conference was the MCPC 2007 in Boston in October 2007 (mcpc2007.com), organized by the MIT Smart Customization Group, Massachusetts Institute of Technology. More than 130 academic lectures and many business presentations demonstrated that today the state of knowledge on mass customization is rather extensive. Many of the open propositions I put forth in Piller (2005) have been addressed by dedicated research since the publication. Once this research is adopted by managers, we may see more sustainable mass customization applications in industry.

There is yet another trend worth of note that is driving the application of mass customization in industry. Modern information technology is helping managers to collate and analyze voluminous amounts of data to make smarter decisions based on the use of growing pools of information-intensive data (Davenport and Harris 2007; Manyika et al. 2007). Leading companies are exploiting this information to obtain strategic superiority with a diverse set of management techniques. Intel, for instance, integrates a "prediction market" with regular short-term forecasting processes to build more accurate and less volatile estimates of demand. The cement manufacturer Cemex optimizes loads and routes by combining complex analytic tools with a wireless tracking and communications network for its trucks (Davenport and Harris 2007). In a report on main technology trends that will drive businesses in 2008, McKinsey, a leading management consultancy company concluded that these information-driven business processes are not restricted to internal processes, but also for customer retention and attraction. They state:

> The more a company knows about [their customers], the better it is able to create offerings they want, to target them with messages that get a response,

> and to extract the value that an offering gives them. The holy grail of deep customer insight—more granular segmentation, low-cost experimentation, and mass customization—becomes increasingly accessible through technological innovations in data collection and processing and in manufacturing. (Manyika et al. 2007:7)

This development has a strong bearing on a strategy that is closely connected with mass customization: *personalization*. While customization relates to changing, assembling, or modifying product or service components according to customers' needs and desires, personalization is about selecting or filtering information objects for an individual by using information about the individual (the customer profile) and then negotiating the selection with the individual. Thus, personalization is accomplished through a set of recommendations that are consistent with: from a large set of possibilities, customer-specific choices/options are recommended; from a technical point of view, automatic personalization or recommendation means matching meta-information of products or information objects to meta-information of customers (stored in the customer profile). Personalization is increasingly considered to be an important ingredient of web applications. In most cases personalization techniques are used for tailoring information services to personal user needs. Examples are emerging across a wide range of industries. Amazon.com stands at the forefront of advanced personalization. Its recommendation engine correlates the purchase histories of each individual customer with those of others who made similar purchases to come up with suggestions for things that he or she might buy. Although the jury is still out on the true value of recommendation engines, the techniques seem to be paying off: CleverSet, a pure-play recommendation-engine provider, claims that the 75 online retailers using the engine are averaging a 22% increase in revenue per visitor (Manyika et al. 2007).

My Virtual Model (mvm.com), a provider of a similar service for fashion retailers and the appliance industry, reports a 15–45% increase in conversion rate, and an increase in the average order value of a web shopper of up to 165%. MVM enables consumers, either on its own site or on the sites of its clients, to build themselves a virtual model (an avatar) by selecting different body types, hair styles, facial characteristics, etc. Consumers also type in their basic measurements so that the virtual model represents their body measurement. In addition, customers can specify what kind of fit they prefer (loose, comfort, tight, etc.) so that the recommendations provided do not only fit the customer in terms of sizes and appearance, but also in terms of how they feel inside the garment. After they have built their virtual self, consumers can then virtually try on clothes of various Internet retailers and see how an item suits their demands. When MVM started offering virtual avatars in 1999, they looked more like a curious oddity, but now their avatars are used by more than 12 millions individual users. Companies such as Adidas, Best Buy, Levis, Sears, and H&M are using these virtual models to generate business and stronger ties to their customers, lured by the increase in such metrics as average order value and conversion. These positive effects of recommendation systems can be seen as the positive effect of assortment productivity (Salvador and Piller 2007). Assortment productivity can be thought of as the return on the investment a

company makes in designing and marketing a product assortment. Until recently, retail value systems were mostly designed and operated under the implicit assumption that assortment productivity was maximized by having the right products on the shelf or in the warehouse. To achieve this, many methods and concepts like quick-response management or fast replenishment have been developed. However, personalization based on recommendation systems takes another approach: instead of creating assortments that fit to a changing demand, the idea is to navigate better the existing assortment in a supply chain, increasing at the same time both the efficiency of the provider and the service experience of the customer.

A recent example of such personalization service is Zafu.com, a start-up company in the apparel industry. Finding the right size of a pair of jeans is a challenge for many women. The answer of mass customization is taking a customer's measurements and making a custom pair of jeans for them. Zafu offers a different approach. From the customer perspective, the experience starts similarly. Zafu asks women shoppers 11 questions about how they prefer jeans to sit on their hips or waist to create a body profile. In addition, they ask for some basic body measurements. But instead of using this information to create a custom cut, they match this information with a large database of proprietary fitting information about the jeans of more than 30 major jeans brands. This database contains hundreds of styles, from broadly marketed Gap to pricey designer labels. The consumer then gets a list of ranked results, linked with the brand's website to purchase. While the service is free for consumers, Zafu gets its revenue not by selling any products but by receiving a commission from any referral of a consumer to a retail website. To build their proprietary database of styles, the company invited hundreds of women who had to try on 32 different jeans. This gave them both information about women's shapes and figures and information about the cuts and fitting secrets of dozens of different jeans brands. To update this information, Zafu has created a streamlined process so that new models can easily be integrated into their database and assortment.

Zafu's personalization service is an alternative model to conventional mass customization. It may not have the inventory advantages and value propositions of mass customization, but is much easier to implement and is a much faster scalable system. For consumers, such a matching service also implies less waiting time as well as no price premiums associated with custom products. However, the two models supplement each other: for most consumers, a better matching service like MVM or Zafu will provide sufficient value, while for others the ultimate product will still be the truly custom jean, providing not only perfect fit, but also the hedonistic satisfaction connected with a custom product. Zafu is well positioned to profit from this trend. The company is owned by Archtetype, a major enabler of true mass customization for the clothing industry. Thus, they can easily refer a customer finding no fitting piece in Zafu's database of the existing assortment of standard products to the custom clothing offerings of their partners like Land's End or Tony Hilfinger. I predict that we will see many more examples of these personalization techniques as they offer companies the opportunity to profit more from what they already have: vast assortments of existing goods. Using personalization and recommendation services to match individual customers' preferences with existing assortments along the entire supply and retail chain could become a boost for both

productivity and customer satisfaction in mature industries. The result may be a new understanding of mass customization, beyond its roots in manufacturing and product design (Piller 2005): mass customization, in essence, is to efficiently serve individual customers uniquely (Pine 2007). In the end, it is the customer who drives the business, and customers are not differentiating between personalized, customized, or standardized offerings; they just want to get what they want.

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