

# Mass customization: providing custom products and services with mass production efficiency

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## Abstract

Mass customization is designed to deliver highly customized products with mass production efficiency. While discussed in the literature for more than a decade, mass customization has only recently been introduced to a large extent. Using a number of case examples from the automotive, sports equipment, and credit card industry, we will discuss in this paper how mass customization supports and enhances operational and market effectiveness and review the success factors of making mass customization work.

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Many companies are faced today by an unprecedented trend towards individualization of demand. While customization is a known strategy in many business-to-business markets, today's buyer's markets are also compelling consumer companies to increasingly offer customized products. In particular, consumers with great purchasing power are attempting to express their personality through personalized or customized product choices. As a result, manufacturers are forced to build production systems with an increasing number of variants, right down to the production of units of one. An article in the U.S. News & World Report (November 21, 2005) underscores the tremendous need for customer-centricity. In this article, Barbara Kahn, Wharton Professor of Marketing, stresses its impact on customer expectations over the last few years: "It used to be [that] consumers wanted something state-of-the-art. Now they want something tailored to them." Indeed, Brand Keys, a research firm that studies customer loyalty, found that customization is 30 percent of what draws a person to a brand today, as opposed to only six percent in 1997. A recent Forrester report ("Who buys custom consumer products?" June 22, 2006) confirmed the attractiveness of customers purchasing customized products. They are better educated (thus less likely to compromise), have a higher income level, and are trendsetters in their group of peers: "These beliefs carry over into action, with [custom product] buyers more likely to tell others about products that interest them and e-mail products that interest them to others," the report concludes.

The proposition of mass customization is to capture these opportunities by bringing custom products within reach of the masses [Piller (2006)]. The common perception is that custom comes with a huge price premium, think Bow Lane instead of H&M. But the objective of mass customization is to overcome this perception and to make custom products achievable for large market segments, and not only for a few premium customers. Coined by Stan Davis in 1987 and made popular by Joseph Pine in 1993, the term mass customization has picked up significant momentum in recent years. Its origins, however, can be traced back to the 1970s, when the futurist Alvin Toffler described the opportunities which mod-

ern flexible manufacturing technologies will offer. According to Toffler, in a production system where switching costs are marginally small, high variety and individuality would come at almost no cost. It, however, took over three decades until the Internet provided the information structure to match the flexible manufacturing capabilities (envisioned by Toffler) with customer demands in sales efficiently.

The reason for this time lag is that, compared to a mass production system, mass customization is characterized by a high intensity of interaction. The manufacturer has to interact with all customers individually to obtain specific information in order to define and translate their needs and desires into a definite product specifications. This elicitation process is, in many cases, much more than an exchange of information. It becomes an iterative act of co-creation and co-design between the customer and seller, incurring rather high costs of communication. Only the recently acquired low-cost communication capabilities of the Internet have made it possible to reduce transaction costs. This, in turn, enabled mass customization on a larger scale. Today, there are several well-known mass producers that have benefited from the application of mass customization, including Land's End, Hertz, Lenscarfter, Cemex, Nike, Toyota, and Proctor & Gamble, just to name a few. Box 1 provides some recent examples of mass customization.

### Box 1: Recent examples of mass customization

In the context of mass customization, the successful model of computer manufacturer Dell is often named as a prime example. Many other companies, however, have built sustained and lasting relationships with their customers through mass customization. Here are a few notable recent examples (for more cases, refer to [www.mass-customization.de](http://www.mass-customization.de)):

**Selve**, a London and Munich-based manufacturer of custom women's shoes, is a fine example of a company's highly effective interaction with its customers in its conventional stores as well as online. Selve enables its customers to create their own shoes by choosing from a variety of

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materials and designs, on-top of a true custom fit based on a 3D-scan of the women's feet. Trained consultants provide advice in the company's stores, the online shop offers reorders. All shoes are made-to-order in Italy, delivered in about three weeks, and cost between U.S.\$180 and U.S.\$285 ([www.selve.co.uk](http://www.selve.co.uk)).

**miAdidas** is a business unit of Adidas AG, the sports goods company, which offers custom sports shoes. While mass customization is a ubiquitous offering for sports shoes (there is not one large brand that is not offering custom sneakers), Adidas is the only company offering more than just the possibility to select between color options for otherwise standard models. At miAdidas, customers get a shoe manufactured to their needs with regard to fit (measurements), performance (custom cushioning), and design (color options). Shoes sell for a premium of about 30 percent and are produced within two weeks in China ([www.miadidas.com](http://www.miadidas.com)).

**Time121** produces Swiss-made watches with almost infinite customization options. The company offers one of the best online configuration toolkits available today and enables its customers to become real co-designers of the watch. In addition, it takes advantage of a well designed modular pricing approach. Different components are differently priced, and by creating a product that matches each customer's personal willingness-to-pay, the economist's dream of individual price discrimination is fulfilled ([www.factory121.com](http://www.factory121.com)).

**Sears** has become one of the leading players in the customization and personalization business in the U.S. Its affiliate company Land's End was one of the first companies to offer mass customization of garments online and in large quantities. Today, up to 60 percent of all products in some categories are truly made-to-order. In its appliances business, the company offers personalization with online-toolkits where consumers can design their own kitchen and other rooms of their home ([www.sears.com](http://www.sears.com)).

### Mass customization principles

Mass customization, when properly implemented, results in significantly increased levels of operational effectiveness. Our analysis shows that mass customization could augment not only a company's performance on price and customization performance, but also on other competitive priorities, such as quality, agility, and service. The basic principles of a mass customization system determining its operational effectiveness and efficiency are discussed below.

### Modular product and process structures

Modularity is an essential part of every mass customization strategy [Duray et al. (2000), Gilmore and Pine (1997), Kumar (2004)]. A mass customization system is characterized by a low production cost per unit normally associated with mass production. To reach this objective, a mass customization system has a finite solution space, i.e., all processes are performed within a fixed product and process architecture characterized by flexible and responsive but stable processes. This is also the main difference between mass customization and conventional craft customization. In a craft production system, not only are the products engineered-to-order for each customer, but also the resulting fulfillment processes. In a mass customization system, however, the processes are fixed within a given range, i.e., designed to yield output limited to certain range of specifications, represented by a consequent modular product design. Each module serves one or more well-defined functions of the product and is available in several options that deliver a different performance level for the function(s) it is intended to serve. This principle shows that mass customization demands compromise. Not all notional customization options are being offered, but only those which are consistent with the capabilities of the processes, and the given product architecture and degree of variety.

Consider as an example of modularity for mass customization the Sweden-based Scania. The company today is the world's most profitable truck company and attributes this to the fact that its entire product offering is based on a clear mass customization structure. It is a good case to illustrate that there

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is no contradiction in delivering a customized product and at the same time obtaining high efficiency and profitability. Scania's main characteristic is a modular product range and a value chain that is based on the production of the modules. This modular product architecture enables the company to offer all of its customers a vehicle that really fits their driving or transportation needs. But Scania also has a strict policy to say 'no' to its customers when a demand cannot be fulfilled within the present modular product range. On the customer front end, all choice options are presented in a configuration system. The configuration system represents the modular solution space and 'translates' between the language of the customer and the modular design of the manufacturer. The modular system provides a carefully balanced number of main components with great flexibility (see Figure 1 below for the main components and options within its structure). This allows considerably longer production runs than were possible with a conventional product system. But at the same time, technological innovations can be introduced much easier in the products, as just one module has to be updated while keeping the rest of the architecture stable. Interestingly, Scania's present modular structure dates back to about 1980 and has been basically unchanged during this time, even if it has been continuously improved over the years. This stability has allowed

the company to match its modular product options with a set of extremely efficient business processes for sales, configuration, production, delivery, and after sales service.

### On-demand manufacturing

While mass customization systems are characterized on the level of components by prefabricated (standard) modules, final assembly only takes place after an order has been placed. This allows companies in markets with high product variety to move from a forecast-based planning system to a model where only those products that have already been ordered are being produced. The resulting cost-saving potentials are predominantly based on the better access to knowledge about the needs and demands of the customer base [Salvador & Forza (2004)]. This knowledge may translate into significant cost reductions, like the elimination of distribution inventory, less product returns, reduced obsolescence or antiquated-fashion risks, mitigated product liability risks, and reduced cost of staffing to deal with post-sales product failures, complaints, liabilities, and loss of reputation [Kumar (2004), Piller et al. (2004)]. The savings from these effects can be huge. Forrester Research estimated that the U.S. automotive industry can save up to U.S.\$3,500 per vehicle by moving from its recent build-to-stock model to a build-to-order system. Similarly, for the apparel industry, cost savings of up to 30 % are estimated to accrue from moving to an on-demand system [Sanders (2003)]. In this industry, almost U.S.\$300 bln are wasted annually due to erroneous forecasting, heavy inventory, fashion risks, and lost profits as a result of necessary discounts.

### Customer co-design process

From a strategic management perspective, mass customization is a differentiation strategy. Referring to Chamberlin's (1950, 1962) theory of monopolistic competition, customers gain from customization the increment of utility of a good that better fits to their needs than the best standard product attainable. The larger the heterogeneity of all customers' preferences, the larger is this gain in utility. As we have mentioned already in the introduction, each mass customization business starts with a co-design process between the manu-

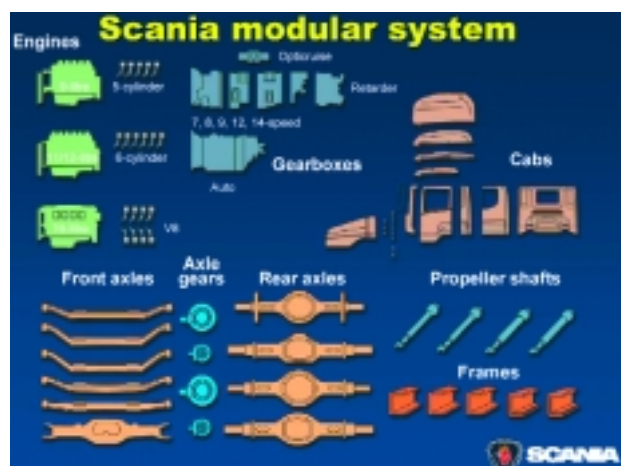


Figure 1: Modular truck components at Scania (picture courtesy of Scania AB, Södertälje, Sweden)

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facturer (or retailer) and the individual customer. This process is conducted with a dedicated system for customer co-design, known as configurator, user toolkit, or co-design-platform. Co-design toolkits 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 users, helping them to understand their own needs and demands. The number of firms operating with these toolkits is growing steadily in industrial as well as in consumer markets, along with a large number of software vendors offering standard toolkits for product configuration [Evans (2005)].

Co-design is the core element that differentiates mass customization from other agile manufacturing strategies. This principle of mass customization also provides new opportunities for marketing and customer relationship management. Recent research by Franke and Piller (2004) and Schreier (2006) has shown that up to 50% of the additional willingness-to-pay for customized (consumer) products can be explained by the positive perception of the co-design process itself. Co-creating customers experience a sense of design ownership (I did it myself) and feel aligned with the company's strategic goals psychologically. Co-design thus enables a company to increase the loyalty of its customers. Once a customer has purchased an individual item, the knowledge acquired by the manufacturer can be used to erect a huge barrier against switching suppliers.

Consider the case of Adidas, a large manufacturer of sports goods. In 2001 the company introduced its mass customization program 'miAdidas,' offering custom sports boots with regards to fit, functionality, and aesthetic design. The process starts with a customer who wants to buy personalized running shoes for around U.S.\$150. The more the customer tells the vendor about his/her likes and dislikes during the integration process, the better chance there is of a product being created that meets his/her exact needs on the first try. After delivery of the customized product, feedback from the shoe-wearer consolidates Adidas' knowledge of the customer. The

manufacturer can draw on detailed information about the customer for the next sale, ensuring that the service provided becomes quicker, simpler, and more focused. The state of information is increased and fine-tuned with each additional sale. This data is also used to propose subsequent purchases automatically once the life of the training shoes is over (for many Adidas customers who train intensively, this can be every couple of months).

When Adidas enters a learning relationship with its customers, it increases the revenues from each customer because, in addition to the actual product benefits, it simplifies the purchasing decision, so the customer keeps coming back. Why would a customer switch to a competitor – even one that can deliver a comparable customized product – if Adidas already has all the information necessary to supply the product? A new supplier would need to repeat the initial process of gathering data from the customer. Moreover, the customer has now learned how his/her integration into the process successfully results in the creation of a product. Such learning relationships boost loyalty. In many relationship marketing initiatives only the communication with the customer is personalized – and often just through advertising materials. Such initiatives do not reach far enough and are usually unsuccessful. By collecting and aggregating information from a segment of customers, Adidas also gains valuable market research knowledge that is similar to panel data but without the usual effects of panel surveys. As a result, new products for the mass market segment can be planned more efficiently and market research is more effective because of unfiltered access to data on market trends and customers' needs. This is of special benefit to companies that unite large-scale make-to-stock production with tailored services. Mass customization can thus become an enabling strategy for mass production.

### Mass customization in the financial services industry

In the financial services industry, to our knowledge, only a few companies have pursued/implemented mass customization (in the consumer market). Banking products are either char-

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acterized by a high-degree of personal service and customization, delivered, however, only to a few rich individuals with deep pockets, or based on standardized packages in the broad consumer retail business. Some institutions have started to use (online) toolkits to better match clients to existing offerings, but there is very little customization on the product level.

A good example of applying the ideas of mass customization to the banking industry is Turkey's Garanti Bank. Its 'Flexi Card' product allows every cardholder to create a Visa card with the interest rate, reward system, card fee, and even the card design of their choice. Introduced in Spring of 2006, the card involves the customer in the process of card creation, giving them total control over about 9,000 different financial combination possibilities. In a press statement, Mehmet Sezgin, CEO of Garanti Payment Systems, stressed, "We believed that the ideal credit card for any given person could only be developed by that customer him/herself. Every cardholder has different spending and payment preferences. To answer each different need, we designed Flexi Card, which enables customers to create their ideal credit card."

During the application process on the company's website ([www.flexicard.com](http://www.flexicard.com)), applicants can manipulate over ten parameters, such as the reward rate and type, interest rate, or the card fee to create their preferred combination. Interest rate, bonus rate, and card fees are selected by sliding bars that render various combinations of rates and fees. Card fees, for example, can be pushed back to zero by committing to a monthly spending minimum. A lower interest rate leads to a lower bonus rate, etc. Lastly, after making decisions about financial terms, customers can personalize their own card, choosing from different colors and a gallery of images, or uploading their own image on the front cover.

This product provides a good indication of where mass customization could start in consumer financial markets. Instead of conducting market research, clustering customers into segments based on predefined categories, and targeting these segments with predefined product variants, Garanti has

no need for expensive market research on this level. Customers easily create their own segments of one. And while customers appreciate being in control and are feeling smart about creating a tailor-made card, the bank is able to test various value propositions, gaining valuable insights into which customer segments choose which options. This, in turn, can lead to the introduction of better preconfigured products for segments of consumers who do not want this degree of choice.

### Conclusion and a word of caution

In this article, we have argued that mass customization, when properly implemented, brings about across-the-board improvements in all dimensions of operations strategy – customization, responsiveness, price, quality, and service – and therefore improves the operational effectiveness of a company. We also established its capabilities as an enabler of marketing effectiveness through such mechanisms as customer co-design and the access to customer knowledge.

But there are also a number of critical observations. Mass customization is neither a 'one size fits all' approach nor is it the right strategy in all contexts. Mass customization also does not come without cost. The primary challenge in pursuing mass customization stems from increased complexity and increased uncertainty in business operations. A higher level of product customization requires greater product variety, which, in turn, entails greater number of parts, processes, suppliers, retailers, and distribution channels. A direct consequence of such proliferations is an increased complexity in managing all aspects of the business from raw material procurement to production and eventually to distribution. Furthermore, increase in product variety has the effect of introducing greater uncertainty in demand realizations, increase in manufacturing cycle times, and increase in shipment lead-times. Furthermore, there is a sizeable increase in costs to support the customer co-design interface on a website or in a physical store that is integral to a mass customization strategy. Also, a company's IT infrastructure has to be highly flexible [Zipkin (2001)]. Many financial institutions are today not able to deliver a fully flexible

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credit-card product, such as Garanti's Flexi Card, due to restrictions in the structure of their ERP systems. Introducing mass customization here demands often larger investments.

But mass customization may also lead to new complexities from the customer's perspective. More customization does not necessarily mean greater delight, and therefore, greater value, for the customer. Customer satisfaction may not only plateau after a certain customization level of the product, but also decrease because of the frustration a customer feels due to excessive choice or variety [Dellaert and Stremersch (2005)]. Thus, setting the right degree of customization and carefully selecting the options for customization is crucial for mass customization success.

Finally, and perhaps most important, mass customization demands strong change management capabilities [Berger et al. (2005)]. Business managers and their employees often get accustomed to a dominant logic, shaped by the attitudes, behaviors, and assumptions that they have witnessed in their environments for a long time. Today, the thinking of many managers is conditioned by managerial routines, systems, and incentives created under the mass production framework. The characteristic element of mass customization is the co-design process. Here, customers engage in a co-creation process with the company. Firms must, therefore, begin at the level of normative management with the challenge to change the old and adversarial perceptions of the customers and develop an attitude of listening to and aligning with them. Introducing mass customization must always be preceded with a well conceived and well deliberated change management process.

But despite these challenges, we believe that mass customization has great potential to be a source of sustainable financial and strategic advantage. Today's market characteristics and competitive challenges favor mass customization in many industries and market situations. We invite managers to learn more about this strategy and investigate how a customized mass customization approach can suit their businesses better.

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