



For each, their **OWN**

The strategic imperative of mass customization

BY FRANK PILLER AND ASHOK KUMAR

Many companies are flummoxed by an unprecedented trend toward individualization. While customization is a known strategy in many business-to-business markets, today's markets are also increasingly compelling consumer companies to offer customized products. In particular, consumers with great purchasing power are attempting to express their personality through 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.

A November 2005 article in *U.S. News & World Report* underscores the tremendous need for customer centricity. In the article, Wharton professor of marketing Barbara Kahn stresses the impact of customer centricity on consumer expectations over the past few years: "It used to be [that] consumers wanted something state-of-the-art. Now they want something tailored to them." 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 6 percent in 1997.

The proposition of mass customization starts exactly here: To make custom products achievable for large market segments and not only a few premium customers.

The roots of mass customization date back to the 1970s, when futurist Alvin Toffler described the opportunities that modern flexible manufacturing technologies would offer. According to him, in a production system in which switching costs are marginally small, high variety and individuality could come at almost no cost. It was more than three decades before the Internet provided the information structure to match flexible manufacturing capabilities with the customer demands in sales.

There is good reason for this time lag. 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 product specifications. In many cases, this elicitation process is much more than an exchange of information; it becomes an iterative act of co-creation and co-design between customer and seller, and it entails relatively high costs of communication. Only the recently acquired low-cost communication capabilities of the Internet provided opportunities for reduced transaction costs. This, in turn, enabled mass customization on a larger scale. There are several well-known mass customizers that have benefited from the application of mass customization: Dell, Land's End, Hertz, Amazon.com, LensCrafters, Cemex, Nike, Acumins, and Proctor and Gamble are a few of them. "Shining Examples" provides stories of recent mass customization success.

Modularity: A key principle

Apart from customer co-design, modular product design is an essential part of a mass customization strategy, specifically for fabricated products. 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 — 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 the conventional craft production system: In a craft production system, not only the products are engineered-to-order for each customer, but so are the resulting fulfillment processes. In a mass customization system, the processes are fixed within a given range: They are designed to yield output limited to a 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

SHINING EXAMPLES

In the context of mass customization, the successful model of computer manufacturer Dell is often named as a prime example. Many additional companies, however, have built sustained and lasting relationships with their customers through mass customization. Here are a few notable recent examples:

Sears has become one of the leading players in the customization and personalization business in the United States. 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 of each category are truly made-to-order. In its appliances business, Sears offers personalization through online tool kits by which consumers can design kitchens and other rooms.

Selve, a London and Munich-based manufacturer of custom women's shoes, is a fine example of a company's highly effective interaction with customers in its conventional stores as well as online. Selve enables customers to create their own shoes by choosing from a variety of materials and designs, and it offers a true custom fit based on a 3-D scan of customers' 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 \$180 to \$285.

Time121 produces Swiss-made watches with almost infinite customization options. The company offers one of the best online configuration tool kits available today and enables customers to become real co-designers of their watches. In addition, the company takes advantage of a well-designed modular pricing approach. Various components are priced differently, and by creating a product that matches each customer's personal willingness to pay, the economist's dream of individual price discrimination is fulfilled.



OPERATIONAL EFFECTIVENESS

Mass customization practice	Strategic priorities affected	Mechanisms or enablers of strategic advantage
Modular design	Customization, cost, speed	Complexity reduction, ease of planning, economies of scale, demand variance reduction, and lead-time reduction through delayed differentiation
Delayed design, fabrication, assembly (postponement)	Cost, speed, customization	Reduction in demand variability, safety stocks, cycle times, and lead-times
Cellular or flexible processes	Cost, quality, speed	Cell efficiency, recurrent problem-solving skills, process stability and flexibility, reduced setup costs and times, quick learning efficiencies, complexity reduction, planning efficiencies
Customer co-design	Customers' satisfaction	Product fit, customer perception of design ownership, reduced cost of warranty, returns, and product liability, reduced risk of obsolescence

Figure 1: Several factors influence operations-dependent strategic advantage in mass customization settings.

different performance level for the functions it is intended to serve. This principle shows that mass customization demands compromise: Not all notional customization options are being offered, only those that are consistent with the capabilities of the processes, the given product architecture, and the given degree of variety. “Modularity at Scania” illustrates how Swedish truck manufacturer Scania became the most profitable company in its industry by following this principle. Its modular product range enables the company to offer all customers a vehicle that fits their driving or transportation needs. But Scania has a strict policy to say no to customers when a demand cannot be fulfilled within the current modular product range. On the customer front end, all choice options are presented in a configuration system.

Operational effectiveness

When properly implemented, mass customization results in significantly increased 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 — quality, agility, and service. Figure 1 provides an overview of how the essential practices of mass customization yield strategic advantage under different priorities.

The primary challenge in pursuing mass customization from the perspective of operations strategy stems from two sources: increased complexity and increased uncertainty in business operations, which by implication result in higher operational costs. A higher level of product customization requires greater

product variety, which entails a 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 business from raw material procurement to production and eventually to distribution. Furthermore, an increase in product variety introduces greater uncertainty in

MODULARITY AT SCANIA

Sweden-based Scania 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 example to illustrate that there is no contradiction in delivering a customized product and at the same time obtaining high efficiency and profitability.

The company's main characteristic is a modular product range and a value chain based on the production of modules. Scania's modular structure dates back to about 1980 and has been continuously improved over the years. This stability has allowed the company to develop a set of extremely efficient business processes for sales, configuration, production, delivery, and after sales service. The modular system provides a carefully balanced number of main components with great flexibility. This allows considerably longer production runs than what were possible with a conventional product system, but at the same time, technological innovations can be introduced much easier in the products since just one module has to be updated while the rest of the architecture remains stable.

demand realizations, increases manufacturing cycle times, and increases shipment lead-times.

Increased system complexity and uncertainties (in demand and lead-time) drive the operational cost upward due to more complex planning, greater hedging, increased resource usage, more complex production setups, use of agile and flexible manufacturing technologies, the need for highly skilled labor consistent with the advanced and computerized processes and technologies, devolved economies of batch size, diseconomies of scope, increased safety stocks of inventory to meet higher demand and lead-time variances, and higher distribution costs spread throughout the supply chain. Furthermore, there is a sizeable increase in costs to support the customer co-design interface on a Web site or in a physical store that is integral to a mass customization strategy.

These additional costs can be counterbalanced by a number of new profit or cost saving potentials. First, customers often are willing to pay a premium for customization, at least to an extent. Second, a well-formulated and well-designed mass customization strategy could significantly offset the cost overruns through a number of strategic and tactical mechanisms. Two primary mechanisms of cost and time reduction in mass customization are delayed product differentiation (postponement) and customer integration.

The concept of delayed product differentiation (DPD) refers to partitioning the supply chain into two stages: a standardized portion of the product is made during the first stage while the “differentiated” portion is made in the second stage, based on customer preference expressed in an order (Figure 2). The success of DPD is a direct manifestation of the fact that most companies offer a portfolio of products that consists of families of closely related products that differ from each other in a limited number of features. The examples of this can be readily observed in many industries making products as varied as apparel, appliances, automobiles, PCs, groceries, dry foods, and ice creams. An example of delayed product differentiation in the auto industry would be to send a standard version of a car (a stripped or partially equipped version) to dealerships and then allow the dealership to install,

based on specific customer requests, CD/DVD players, rear fins, interior leather, cruise control systems, and the like.

The economies from DPD emanate through at least two factors: component or product standardization and modularization of product design. In addition, a third factor — customer co-design — acts as a long-term relationship-builder between the customer and the business to improve profits significantly.

Component or product standardization: Prior to the point of differentiation, product parts are re-engineered so that as many parts or components of the products are common to each configuration as possible. The cost savings result from the risk pooling effect and reduction in inventory stocking costs.

Modularization of product design: Mass customization requires modular product design for fabricated products that are not custom fit. Each module has several variants, with each variant performing the assigned function at a different performance level, allowing “indexing” of the performance to suit specific customer preference for this option. The assembly of each variant of the module with the standardized product is essentially a simple process and is, by and large, identical across variants. The power of modularity to deliver high customization levels can be judged from the fact that 20 computer components, such as motherboard, RAM, hard disk speed, and hard disk size, can result in an astronomical 8.8 trillion configurations of a PC. In combination, these two factors allow for cost reduction accomplished through several means:

- Economies of scale: As common performance levels of functionalities are selected by a number of customers, economies of scale kick in at modular level for each version of the module,

DELAYED PRODUCT DIFFERENTIATION

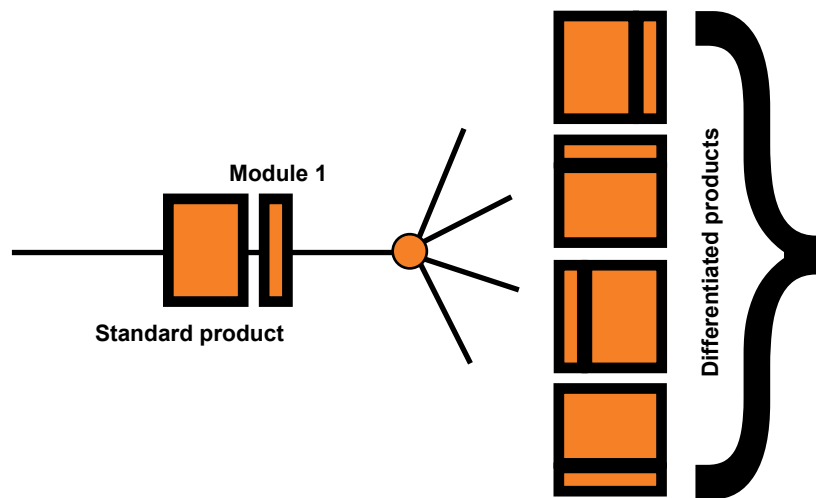


Figure 2. Delayed product differentiation allows manufacturers to produce standardized components and deliver customized products.

for each, their own

generating cost savings not available in pure customization-oriented production systems.

- Economies in product design: Dedicated algorithms and software packages (sometimes referred to as product configurators) that employ special design rules are used to exploit commonality and modularity to identify the right combination of modules that corresponds to specific customer orders.
- Economies in process selection: Good mass customization practices require deployment of cellular process structure. The process cellularity should be consistent with product modularity, quite often in one-to-one correspondence. Specialized firmware or software packages can be used to identify the optimal set of processes that correspond to the modular combination identified. The generation of the right set of concatenated processes through firmware leads to gross reduction in complexity and therefore in cost of planning.

Customer co-design for product configuration: The customer co-design process that matches each customer's specific needs with a product configuration is an integral feature of mass customization and one that extends this strategy from conventional approaches of DPD. This activity instills a sense of design ownership in the customer mind and aligns the customer with the company's strategic goals psychologically. Indeed, a customer delighted with the product often becomes its brand ambassador and engenders high loyalty. The information acquired during the co-design process allows firms to cut back on pools of fixed costs that came about due to the necessity of maintaining a high level of operational flexibility. Resulting cost saving potentials are substantially based on the better access to knowledge about the needs and demands of the customer base. This knowledge may translate into significant cost reductions: reduced or eliminated need for forecasting product demand, reduced product returns, reduced obsolescence or antiquated fashion risks, reduced warranty and field failure costs, reduced product liability risks, and reduced staffing to deal with post-sales product failures, complaints, liabilities, and loss of reputation.

The savings from these effects can be huge. Forrester Research estimated that the U.S. automotive industry can save up to \$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 up to 30 percent are estimated when moving to an on-demand system. Estimates for the apparel industry indicate that almost \$300 billion is wasted annually

due to erroneous forecasting, heavy inventory, fashion risks, and lost profits as a result of necessary discounts.

Marketing effectiveness

Co-design as the core element of mass customization establishes an interaction between the manufacturer and customer that also offers possibilities for building up a lasting relationship, thereby improving customer retention — a key strategic variable for success. Once a customer has purchased an individual item, the knowledge acquired by the manufacturer can be used to create a huge barrier against switching suppliers.

Consider the case of Adidas, a large manufacturer of sports goods. The company introduced in 2001 its mass customization program, "Mi Adidas," offering custom sports footwear with regard to fit, functionality, and aesthetic design. The process starts with a customer who wants to buy personalized running shoes for around \$150. The more the customer tells the vendor about his or her likes and dislikes during the integration process, the better chance there is of a product being created that meets the customer's 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 (which for many customers who train intensively, 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 or her integration into the process results in the successful 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 therefore become an enabling strategy for mass production.

Conclusion and caution

We have argued that mass customization, when properly implemented, brings 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, economies of customer integration, and learning relationships.

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. A recent survey by FedEx Corp. in the apparel industry found that more than 90 percent of respondents agreed that mass customization will play a significant role in the next five years. Yet all performance outcomes related to mass customization implementation are not necessarily positive (including Levi's Original Spin and Proctor and Gamble's Reflect). An abundance of caution is necessary prior to embarking on a mass customization strategy. Many in-depth studies conclude that an optimal strategy is neither mass customization nor mass production but somewhere in between on this continuum.

Customization may also lead to new complexity from the customer perspective. More customization does not necessarily mean greater delight, and therefore greater value, for the customer. Barry Schwartz noted this aspect of human nature in his study and concluded that freedom of (too much) choice could be a form of tyranny for the customer. Customer satisfaction may not only plateau after a certain customization level of the product, it may decrease because of the frustration a customer feels due to excessive choice or variety. Setting the right degree of customization and carefully selecting the options for customization are crucial for mass customization success.

Finally and perhaps most important, mass customization

MORE ON MASS CUSTOMIZATION

Authors Frank Piller and Ashok Kumar have organized a conference exclusively dedicated to mass customization. The second International Conference on Mass Customization will be held Sept. 27-28 at Amway Grand Plaza, Grand Rapids, Michigan.

Visit www.ashok-kumar.org/icmcus2006 for details.

demands strong change management capabilities. Business managers and their employees often get accustomed to a dominant logic that is shaped by the attitudes, behaviors, and assumptions 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. However, the genus of mass customization is a co-design process of co-creation of value in collaboration with the business. Firms must 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 customers. Introducing mass customization must always be preceded with a well-conceived and well-deliberated change management process that will make the organization more customer centric.

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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