Seasons of Mass Customization, Winter or Spring?

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Abstract:

This paper is written to discuss the future of mass customization as a manufacturing technique by examining the development in the past three decades. Will mass customization become a mainstream production strategy? Or will it be just another hype fading away? There were 72 reviewed academic papers on this topic between 1991 and 2001, but the number doubled in the next decade (Folliatto 2012). However, it will be too simplistic to draw the conclusion based on the intensity of academic research. Along the same vein, we can also see some companies that started the mass customization practices have failed to attract the customers, withdrew and faded away. In the meantime, some young companies continue to find new ways to succeed by offering customer unique products through mass customization. One example is a US company, CafePress, which leverages mass customization in T-shirt as the main product and becomes a listed public company.

It is hard to say it is the spring or winter of mass customization, because it depends on our answer to the question: how to adapt the strategy proposed decades ago for current new fast-moving trend in such a social networking era. For example, an early example of mass customization application is computer configuration. The hardware configuration propagates through industry with different implication with

differentiation of PC and hand held devices. But nowadays, the configuration in handheld devices has been shifted to software. Mass customization as Dell's computer customization became no longer effective in current market. In the meantime, a large number of promising business models leverage the fundamental concept of mass customization to better satisfy consumer's needs in self-identity expression and other more experience related needs through customized products. Mass customization is not an only strategy to manufacture unique products to differentiate from competitors', but also a business model of offering more value in helping consumers differentiate themselves through using the customized product. Fortunately, a number of young companies have become driving forces of innovation with new approaches. With the maturity of advanced manufacturing technology, such as 3D printer and internet communication systems, especially the increasing proliferation of internet of the things, we can predict there will be significantly more innovative business models based on mass customization in the near future. From this perspective, we may predict that: it will be a spring for the next generation of mass customization!

Keywords: Mass customization, personalization, customer requirements

1. Introduction to Mass Customization

Mass customization aims to deliver products and services that best meet individual customers' needs with near mass production efficiency (Tseng and Jiao 1996). It's a production paradigm that attempts to combine the responsiveness to individual needs in craft production and the efficiency of mass production of the industrial economies. This is particularly important for certain segments of products and services that are increasingly with diversified, fragmented, and competitive marketplace. Though it is

seemingly facing conflicting, the advent of enabling technologies to facilitate the realization of mass customization has become more accessible in recent years, including information technology, flexible manufacturing systems, fast prototyping, product configuration and recommendation system etc. (Pine et al. 1993; Pine 1993; Kotha 1995; Wang et al., 2007, 2011a, and 2012).

Toffler, in book *Future Shock*, introduce the concept of mass customization in 1970s. He predicted that future manufacturing enabled by information technology would be able to provide customized products to meet diverse needs in a large scale with little or no extra cost (Toffler 1970). Davis first coined the term 'mass customization' in his book *Future Perfect* (Davis 1987). He described a trend where companies sought to micro-segment markets and offer unique products and services to customers. It is Pine *et al.*'s *Harvard Business Review* article (Pine et al. 1993) and Pine's book (Pine 1993) that popularized the concept of mass customization and ignited a wave of academic research and industrial experimentation. In their work, mass customization was defined as the ability to provide individually designed products and services to every customer through process agility, flexibility, and integration. Later, many authors propose more practical definitions by describing mass customization as a system that uses information technology, flexible processes, and organizational structures to deliver a wide range of products and services that meet specific needs of individual customers with mass production efficiency and cost (e.g. Hart 1995; Tseng and Jiao 1996; Silveria et al. 2001). A brief summary about the basic properties of mass customization is in table 1 as follows.

	Mass Customization

Goal	Delivering affordable goods and services with enough variety and customization that nearly everyone finds exactly what they want
Economics	Economies of scope and customer integration
Focus	Variety and customization through flexibility and responsiveness
Product	Standardized modules assembled based on customer needs
Key Features	▪ Fragmented demand ▪ Heterogeneous niches ▪ Low-cost, high-quality, customized goods and services ▪ Short product development cycles ▪ Short product life cycles
Organization	Organic and flexible
Customer Involvement	Customers are actively integrated into the value chain.

Table 1: Properties of mass customization (adapted from Chen et al. 2009)

It is worth noting that mass customization is not mass production with batch size of one. Mass customization is fundamentally different from mass production as it attempts to maximize customer value with efficiency. It requires different values and roles, systems, learning methods, and ways of relating to customers (Pine et al. 1993; Pine 1993; Kotha 1995; Piller et al. 2004). One essential feature that differentiates mass customization from mass production is that customer needs should be well understood at the beginning of product design and manufacturing. This can be achieved through active involvement of customers in the value creation process in mass customization (Duray 2002; Piller et al. 2004; Chen et al. 2009; Wang et al. 2011b, 2013a, 2013b). In mass production, customers are subjects to be observed,

their demand is to be aggregated and forecasted, and their attention and purchasing decisions are to be studied, influenced or even manipulated as manufacturers strive to push their products of popular choice into the market. In mass customization, customers are no longer passive recipients of products or services that are designed and produced for a nominal customer. Instead, each customer has his/her individual identity and provides key inputs to design, produce, and deliver the product or service based on a priori understanding of his/her individual preferences.

2. Spring or winter

Mass customization has attracted attention from both academia and industry in the last two decades (Silveria et al. 2001; Tseng and Piller 2003), and has been widely recognized as a viable strategy for companies to gain competitive advantage. Federal Reserve Bank of Dallas published an annual report on mass customization and claimed mass customization is the right stuff for U.S. manufacturing (Federal Reserve Bank of Dallas，1998). More industries in America, such as personal computer, clothing, entertainment and healthcare are moving to mass customization gradually. The key factor for mass customization is to tailor products to customer requirements at low cost. Mass customization is optimal in the condition that fixed and marginal costs are low. They claimed that information age technologies can revolutionize the calculus of production cost and it is the right timing to move towards mass customization. Currently, the focus of research in mass customization is shifting from its strategic viability to operational feasibility, i.e. from what and why to how (McCarthy 2004).

Since the term of the mass customization is coined, many companies and entrepreneurs have been striving to implement mass customization for competitive

advantage. Some of these initiatives were very successful. One of the most cited cases is in computer industry, particular low end computers. They claimed that their ability to deliver customized personal computers and notebooks within one week with prices lower than its mass producing competitors. By adopting mass customization, computer manufacturing has gained the so-called first-mover advantage and maintained high profitability and growth in a hyper-competitive industry for a long period (Magretta 1998). Other prominent cases include Motorola's customized pagers, Adidas Mi customized shoes, Hewlett Packard's printers. (Feitzinger and Lee 1997; Selladurai 2004), Lands' End that produces custom-made apparels etc. In 2011, the MC500 study conducted by Prof. Walcher and Prof. Piller listed 500 startup companies that apply mass customization as the core strategy to differentiate their product (Walcher and Piller 2011). In China's largest online B2C platform, Taobao, there are also more than 3000 items are found. The popularity of mass customization and personalization as a differentiation approach exist in China as well.

However, several mass customization programs were folded and large amounts of investment had to be written off. Some pioneering companies, notably Levi Strauss & Co., and P&G, have retreated from their mass customization initiatives. In 1997, Levi's introduced a program called Original Spin, which actually originates from an earlier Mass Customization program "Personal Pair" that launched in 1994. Original Spin intended to create a production, marketing, and sales strategy to deliver customized jeans on a mass scale, giving consumers not only a pair of customized jeans, but also a memorable shopping experience. This program ran seemingly well at the beginning and earned some good press reputation. However, Levi's ultimately closed this program in 2003. Though there are no official comments about the termination, the true reasons have not been publicized. Piller (2004) summarized his

observation with several possible reasons leading to the close. First, bad business situation of Levi's in general drove the company returned to its core of mass produced jeans. Second, the Original Spin essentially is not a true and complete Mass Customization system, and it is more like a marketing and public relation gimmick. Third, the interaction between the company and customers was superficial, which made repeat orders never easily possible and customer relationship was poorly managed. Other recent examples of firms that gave up Mass Customization initiatives or went out of business selling customized products include Reflect.com (a P&G subsidiary sold customized cosmetics), Mattel, and CMax.com etc. (Parlaktürk 2009).

Toyota learned the hard way that mass customization requires very different customer relations and organizational structures to manage customer values with better defined roles in sales and support systems. In general, mass customization is not the natural next-stage of mass production via incremental change. Instead, it requires a system-wise overhaul of traditional paradigm of organizing production and doing business. It challenges the traditional dichotomy of combining *mass* with *customization*, while in the meantime it submerges itself into a flood of conflicts that need to be carefully and innovatively handled for its own salvation.

Among the 500 startup companies analyzed in the MC500 study, it is not surprise to find that 20% have already stopped the service, within less than 2 years (Piller 2012). It shows that the mass customization marketing alone, offering a personally unique product for each individual consumer, is far away from efficient to survive in current competitive market. It is considered "that a well-built configurator and a nice business idea alone are no guarantee for a successful mass customization venture." (Piller 2012) Then, what can be learned from the failure of mass customization to draw lessons for the future development of mass customization?

3. Future development needs for robust mass customization

In current academic research in mass customization, most of the discussion focus is on the operational conflicts between the production efficiency and individually tailored products. However, many business practices have shown that they would still face problems even if they can overcome the production difficulty. We argue that many designers may neglect the importance of understanding consumer's value perception for making purchase decision to buy customized and personalized product at the first place.

Strategically, there's an inherent conflict within mass customization as its name suggests and as many critics rightly claim: *Mass* implies aggregation and repetition, while *customization* means individual and *one-of-a-kind*. Traditionally, companies compete either on *mass* via high efficiency and low cost, or on *customization* by best satisfying solutions and charging monopoly premiums. Combining *mass* and *customization* into a single strategy risks saddling the company in a dilemma where competitive advantage gets lost on both ends.

Operationally, there're conflicts between different performance objectives in mass customization. Under the customer-centric philosophy, individual customers' *pull* is the driving force for mass customization to function (Tseng and Piller 2003). However, customers' needs are usually diverse and irregular. The diversity of customer needs requires manufactures and supply chain to offer high product variety, which often leads to high component variety, large numbers of suppliers, logistics network complication and high administrative complexity. The irregularity of individual customers' needs means demand unpredictability and instability. As a result, production planning becomes very difficult and ineffective, leading to either resource

under-utilization or shortage, and eventually drives up cost. Furthermore, as the value chain in mass customization is driven by customers' *pull* instead of manufacturers' *push*, delivery lead time becomes part of customers' waiting time. Customers' increasing demand for responsiveness and time-based competition further aggravate the difficulty to achieve high efficiency and high differentiation in mass customization simultaneously.

The difficulty in production efficiency is indeed a barrier to apply mass customization, but many practices have found ways to escape the barrier by applying the flexibility or responsiveness in modern manufacturing system to overcome it. An often cited example in the MC500 study is personalized printing, on "standard" mass produced products like T-shirt, cups, photo books, and etc. Obviously, the customization process is all postponed into the last step of the product realization process while all other common processes are standard for mass production, so that the marginal cost of the mass customization is minimized. In other words, for some products, it is relatively easy and fast to add some decorative features to customize mass products without substantial cost. However, not every product can be decorated easily or the customers may want to go far beyond decoration. The MC business model should include finding suitable types of products.

Fundamentally, a product has the value because it is able to address customer's needs. Thus, value is created by meeting the unique customer needs. There are different levels of needs, which can form a hierarchy, such as Maslow's hierarchy of need theory (Maslow 1954). Higher level needs are usually long-term in nature, and usually they cannot be recognized or verbally described by a customer (Burchill and Brodie 1997).

For the product purchased mainly for the utility purpose, such as refrigerator, TV and Hifi system, the product function is the fundamental factor used to evaluate a product. On the other hand, for the product mainly for hedonic purpose, such as T-shirt, bags and jewelry accessories, how more beautiful the product makes the consumer appear, called product aesthetics, are essential evaluation factor. In many cases, those two factors are combined in the consumer's purchasing decision making. The superior utility/appearance refers to the extra benefits brought by the customization beyond the expectation of the consumer. The expectation and evaluation can be both very subjective and personal, since each consumer has an almost "unique" evaluation system of her own preference fit. If a product can perform beyond the expectation of a specific consumer not the others, the product should obtain a special meaning to the person that leads to the development of an emotional bond, and it becomes irreplaceable among other products in the same category. That is exactly the logic that is employed in many practices of personalization, especially in products that reflect personal choices and styles such as footwear and clothing (Boër and Dulio 2007). Therefore, it is logically fair to suggest that a personalized product that has beyond-averaging performing can satisfy customer's needs for the functional fit and the aesthetics fit in a product.

On the other hand, there is a growing interest in personalization. In essence, value can be augmented by enhancing consumer's perception to the product as "My own", which stems from mainly two high-level human needs, self-identity and self-efficacy.

The self-identity is considered as a major part comprising the self-concept domain (Avey, Avolio et al. 2009). Numerous scholars have suggested that possessions can serve as symbolic expressions of self strongly associated with self-identity and individuality (Belk 1988, Dittmar 1992). The product can express who we are, what

we do, and who or what we might become (Rochberg-Halton 1980). For instance, to the hardcore Harley drivers, a Harley can reflect all about their independence, freedom and power, so the ownership of a Harley renews their spirits and announces their independence (Kotler and Armstrong 2010). Thus, a personalized product can assist the consumer to establish the self-identity as she wishes. In addition, people also need possessions to serve as a way to achieve continuity of the self (Price, Arnould et al. 2000). The idea of personalization can be extended to most personalized products. For example, people usually regard some old items as personal treasure not because of its utilitarian value but the episodic memories embedded in the product. The memories provide people with feeling of comfort, an emotional connection between themselves and their past (Pierce, Kostova et al. 2003). Since the memories related to events that are exclusively personal, the old product becomes an unique product to the owner, and preserving such products allows her to maintain a sense of continuity through product that have become symbolic extension of the self (Pierce, Kostova et al. 2003). Even though the item may be very ordinary or even no value at other's view, the owner would definitely claim that the product is priceless.

The self-efficacy relates to people's belief that they can implement action and be successful with a specific task (Bandura 1997). It is derived from the motivation to produce desired outcomes in the environment, which can lead to extrinsic satisfaction as certain desirable objects are acquired, and consequently the feelings of self-efficacy and competence can further produce intrinsic pleasure, stemming from "being the cause" and having altered the environment through one's control or action (Pierce, Kostova et al. 2003).

The value of self-efficacy may challenge conventional design approaches that maximize the utilitarian value. The effect of self-efficacy depends on the effort

investment in the process instead of the final product utility. For instance, an amateur painter may appropriate her painting very much, which she spent several days to complete, but the painting may be valueless in a professional view. Thus, in some personalization approaches, the product becomes open to the customer's co-design in order to increase her investment of effort to the product development process. The high involvement of end user and the positive design result, usually may not be the best, in the co-design process may increase the product value by satisfying consumer's self-efficacy.

Thus, the essence of mass customization and personalization is to make the consumer perceive the product as their exclusively own products. However, a common mistake is that the business provider focusing too much on the capability to offer physically unique products to each individual while neglecting how the value would be perceived by the consumer. People act on their perception of reality, not on the fact of reality. Then, if we view mass customization through a boarder perspective, there are many more opportunities for the business provider to explore the perception from customer perspective. In that sense, the customization with efficiency may open up a new spring of the next generation of mass customization.

4. Spring of the next generation of MC

Defining customer requirement is the key to customization. Customer participation in the design procedure has shown to be the most promising way of getting the requirements efficiently and effectively. Currently the whole process was mainly controlled by the designer and the product was finally manufactured and delivered by the producer. However, with the new computer graphics technology, it is possible for consumers to control and dominate the process in virtual environment. Thus, the role

of the designer will be shifted to product platforms with sufficient supports to assist the process. It means that the product can be customized at any time when the consumer thinks it is necessary to do so, even after the product has been purchased. Such freedom would offer significant opportunities for consumers to dynamically adapt the product for their new needs as well as reflecting their identity and efficacy through the creative design and modifications, throughout the lifespan of the product. Meanwhile, designers would be decoupled from the process, but it does not mean they are no longer needed. Even though some lead users can customize and personalize the product whatever they want, it may still rely on the necessary support or the ecosystem provided from the designer to make possible for every users to customize and personalize the product. That is the essence of the next generation of mass customization. Then, what would lead us to the spring of the next generation of mass customization?

Furthermore, technologies may change the delivery of the physical goods. For example, 3D printing technology may significantly stimulate the development of new MC. Two recent reports in *Economist* demonstrate the potential of 3D printing and manufacturing changing the world. It is the manufacturing flexibility that constrained consumers within a limited freedom to customize. Given time, consumers will be able to really produce some physical components with machining systems. Thus, consumers can participate in the assembly of physical components, such as IKEA furniture, but rarely produce them. On the other hand, in order to achieve the production efficiency, the provider has to rely on product family concept to keep balance between the component commonality and variety. The product modularity and platform will still be needed to navigate usage to describe their requirements. With technology, the consumer would feel free to produce any component, or even a

whole product, as they want. Everyone could be a designer as well as a producer. Then, what will the designer do?

Product designers can take the smartphone system as a reference. Current smart devices have already been such open product available for almost anyone to modify. For instance, both iOS from Apple and Android system from Google offer the toolkit for developers to program an exclusively personalized application and then install it to the smart device to satisfy their unique needs. Theoretically, almost everyone can program their own apps with the sufficient support provided by iOS or Android system provider, but it does not happen. Why? Not everyone has sufficient knowledge to do so. Programming is a technical skill that not everyone is capable. In addition, even with programming capability, not everyone has brilliant ideas to design an app. However, the provider offers most of the users another options, to download their apps shared, either free or not free, to the public through an apps ecosystem, iOS app store or Android Google Play. With such ecosystems and technical supports provided by the smart device provider, it is then possible for every user to enjoy the unlimited freedom to participate in modifying their own product to satisfy their own needs in utility, self-identity and self-efficacy. Obviously, physical product designers can follow the same logic.

Looking forward, with the entry barrier reduced in both customer requirements acquisition at the front end and product delivery at the back end, we can thus extrapolate mass customization to open customization, along with the similar concepts as open system and open innovation. Open customization, still a working definition, is a paradigm that motivates people to participate, to create, to learn, to acquire, and to recover in providing goods and services to fulfill individual needs, not only products, but also the process of producing, with fair competition.

5. Conclusion and outlook

Mass customization defies the contradiction between mass and customization and aims to deliver products and services that best meet individual customers' needs with near mass production efficiency. A novel and ambitious concept as it is, mass customization is also exposed to various conflicts, both strategically and operationally. This paper reviews relevant works across a wide spectrum to discuss where we are standing in mass customization arena. It appears that there is a mutually reinforcing linkage between mass customization, newly emerging technology and foreseeable openness in manufacturing. There's great potential for creating new knowledge for advancing the subject. This paper serves as initial identification of possibilities and hopes to attract attention for future research in this potentially rich field of study.

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