Mass Customization Strategies

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Abstract:
In order to fully understand the implications of a \textit{mass customization} system, its characteristics and capabilities must be examined. Different companies adopt different methods or strategies for producing mass customized products, because every process is individual. Mass customizers can be classified based on different characteristics; one of them is the point of customer involvement in the design process. This involvement can happen in different ways and decisively depends on the manufacturing process. Some Products can be produced in stock, some only on demand. Customers can be involved in different production stages or products can be partly pre-fabricated and then be adapted to the customer’s wishes. Different models have been set up following these approaches. In the following, several of them will be briefly explained.
1.- Introduction

Recently, mass customization has become a strategy of increasing interest, because manufactures face the difficulty of serving individual customers’ needs while maintaining cost efficient production at the same time. Mass customization promises different benefits, which lots of companies want to use. But companies have experienced that it is not easy to implement a mass customization strategy within a business. Companies like Levi Strauss, for example, failed when trying to switch to mass customization. After all, companies need to see that with all the promising advantages mass customization brings along, manufacturers also face great difficulties when implementing such a strategy.

One decisive factor within mass customization is the involvement of the customer. This involvement needs to happen without disturbing a company’s process. There is no standard point of involvement, because every company faces other processes. Moreover, products might have a certain degree of pre-fabrication, an aspect that needs to be included while thinking about possible involvements. To solve the problems, several approaches have been made in literature, presenting different models for MC strategies. For reality has shown that there is not one master concept for a mass customization strategy, these models are supposed to help companies implementing their strategy.

It is the aim of this paper to illustrate different ways of classifying mass customization strategies. Therefore, this paper will discuss different models that have been discussed in literature. Their basic ideas and their way of working will be described and compared, before their meaning for companies will be concluded.

2.- Rudberg and Wikner’s Model

The decoupling point (DP), also known as the customer-order decoupling point (CODP) (Hoekstra, Romme et al. 1992), the demand penetration point (DPP) (Christopher 1998) or the order penetration point (OPP) (Olhager 2003), is the position within the value chain that separates those activities that are forecast-driven from those driven by customer orders.

The positioning of the CODP in mass customization involves identifying the optimal balance between the productivity and flexibility forces. The further downstream in the value-adding material flow that the CODP is positioned, the higher the degree of emphasis on productivity.

Figure 1: The productivity-flexibility trade-off and the positioning of the CODP. Source: Rudberg and Wikner (2004)
in operations, therefore price (cost) is normally the major competitive priority. On the contrary, by positioning the CODP further upstream a company can achieve a higher degree of flexibility meeting customers’ specific requirements. As such, CODP’s are used to classify value-adding activities in terms of customer demand information, which in turn highlights the need for different management approaches depending on whether the activities are upstream or downstream of the decoupling point (Rudberg and Wikner 2004).

A literature review by Rudberg and Wikner (2004) reveals that four CODP’s are most frequently used: Engineer-to-order (ETO), Make-to-order (MTO), Assemble-to-order (ATO) and Make-to-stock (MTS). The further downstream the CODP is positioned, the more of the value-adding activities must be carried out under customer order uncertainty (speculation), and the further upstream the CODP is positioned, the more activities can be based on customer order commitment, i.e. certain information.

![Diagram]

*Figure 2: The typical sequential approach to the CODP concept. Source: Rudberg and Wikner (2004)*

Rudberg and Wikner (2004) recognize that in the sequential approach, no difference is made between production- and engineering-related activities. In order to integrate engineering resources with operational processes, they developed an approach based on two dimensions: Engineering and Production. The production dimension covers the traditional CODP’s related to the material flow (MTO, ATO and MTS). The engineering dimension covers a continuum with two extremes. One extreme point in the engineering dimension is the situation when a new product (concept) is designed and engineered to order (ETO). The other extreme point in the engineering dimension depicts the situation when a product is designed before the enterprise faces actual customer demand, which could be interpreted as if the product design is already ‘in stock’.

In their model, several pairs [engineering, production] represent different levels of customer involvement either in the engineering dimension or in the production dimension. The authors (Rudberg and Wikner, 2004) mention an example that clarifies the interest of their approach: A typical mass customizer producing a modular product, most modules are standard units produced to forecast, but some modules are customer specific wherefore engineering activities must be performed before the final product is assembled to order. The
situation cannot be classified as traditional ETO since most of the products’ units are produced to forecast, and not as traditional ATO since engineering activities are involved. However, using a two-dimensional CODP makes the classification and analysis more straightforward and easier to communicate. In this case, the company can be classified as \([\text{ATO}_{\text{ED}}, \text{ATO}_{\text{PD}}]\) with, for example, \(\text{CODP}_{\text{ED}}=8\%\) and \(\text{CODP}_{\text{PD}}=20\%\) (the percentages represent the fraction of the lead-time being customer order driven in each respective dimension).

![Diagram of the two-dimensional CODP space](image)

*Figure 3: The two-dimensional CODP space. Source: Rudberg and Wikner (2004)*

The CODP pair \([\text{ETS}_{\text{ED}}, \text{MTS}_{\text{PD}}]\) is an extreme point where both engineering and production activities are carried out without customer involvement (i.e. pure standardization). At the other extreme is the \([\text{ETO}_{\text{ED}}, \text{MTO}_{\text{PD}}]\) where both engineering and production activities are performed according to customer specifications (i.e. pure customization).

Two-dimensional CODP makes the CODP a suitable tool for not only analyzing production, but also classifying enterprises performing engineering adaptations, especially those enterprises striving toward mass customization (Rudberg and Wikner 2004).
Figure 4: Traditional CODPs in terms of production and engineering CODPs. Source: Rudberg and Wikner (2004)

3.- Lampel and Mintzberg´s Model

The model by Lampel and Mintzberg distinguishes the moment of customer involvement by the customer order decoupling point, as the following figure shows.

![Diagram of Lampel and Mintzberg's Model]

There are three types of standardization and two types of customization shown. These processes differ in their degree and point of customer involvement. In pure standardization, the customer has no direct influence on any stages of value chain and the system can be classified as a push system. Typical example is Henry Ford’s choice of car color. In Segmented standardization, the customization takes place in distribution and targets only a small group of customers. It has better choices to offer than pure standardization; however the customer does not have direct control over design or production. A standardized customization strategy involves the customer at the point of assembly and delivery. Here, standard products are modified to customer specifications using a list of standardized options. So the customer has no direct, but indirect control, because he can choose the most fitting product for his needs. A tailored customization strategy involves the customer at the point of fabrication. With this strategy, standard products are modified or altered to meet specific needs of a particular customer. In this process, the customer is directly involved, because he has control over certain aspects of the product. A pure customized product is one that
includes the customer throughout the entire production cycle. This strategy provides products that are completely unique to individual customer specifications.

4.- Gilmore and Pine’s Model

Gilmore and Pine (1997) suggest four approaches to customization, namely collaborative, adaptive, cosmetic and transparent customization. On the abscissae is representation, which is further distinguished in change and no change. The ordinate represents the aspect of the product, which is also distinguished in change and no change. Changing products are such ones that are often changed and adapted to customer’s needs. Products that do not change are often standardized products. The representation of a product is the number of customers which feel represented by it. If representation is not changing, a lot of customers feel that their needs are satisfied by the same product and that needs do not change. If it is changing, customers do not feel represented by a single product, but wish for certain additional aspects to fulfill their needs more precisely. Based on these determinants, four categories can be distinguished:

![Figure 6: Four approaches to customization, Source: Gilmore and Pine (1997)](image)

**Collaborative customization** involves a dialogue with the customer in order to identify and fulfill customers’ needs. Gilmore and Pine (1997) use the example of Paris Miki eye glasses to illustrate this type of customization. The Mikissimes design system captures the face of a customer and analyzes various attributes and the customer’s choice of design and looks. The system then recommends different sizes and shapes of lens and the customer can collaborate with the optician in order to decide the desired lens. In this case, products need to be changed to fulfill certain customer needs. For both determinants are changing, the manufacturer should develop a product together with the customer.

**Adaptive customization** presents standard products that can be altered by the user according to his needs. Lutron Grafik (Gilmore and Pine, (1997)) lighting system is an example which allows user to have different light effects by merely changing the programmed settings. The customers want the same product, but it can be used in different
ways by changing only minor aspects. Therefore, the product is in a not changing environment and is useful for a broad customer base.

*Cosmetic customization* provides standard products differently to different customers. While the representation changes, the product does not change. Typically, customization is provided in the distribution and use stages. It is again similar to segmented customization that targets clusters of customers. Most common examples are T-shirts with special prints (Inala 2007).

*Transparent customization* fulfills the needs of customers in a way that the customer may not even know that the product has been customized. It is implemented by closely observing the customer requirements. Since the same product is offered to all the customers, it can be considered as pure standardization. Therefore, transparent customization is able to satisfy a broad customer basis by only modifying the product, without direct customer involvement.

5. - Amaro´s Model

Amaro et al. (1999) discuss a framework for classifying non Make-to-Stock (MTS) companies and the role of customization as a competitive advantage. The non MTS companies are classified into Assemble-to-order (ATO), Make-to-Order (MTO) and Engineer-to-order categories (ETO).

In ATO, a number of standardized parts are assembled in different variants according to the choice of the customer. It is similar to standardized customization suggested by Lampel and Mintzberg (1996). In MTO, an order is manufactured only after receiving a customer order. In this case, the degree of customization is considered greater than in an ATO. In ETO, each customer order is a unique set of bill of materials and part numbers. There is no pre-fabricating, for the product is not standardized, but fully developed due to customer needs. The degree of customization is higher than MTO.

This being a broad classification, Hill (1993) redefined the existing categories and added three new ones, making a total of six different MC types: Design-to-order (DTO), Make-to-Print (MTP), Engineer-to-Order (ETO), Make-to-Order (MTO), Assemble-to-Order (ATO) and Make-to-Stock (MTS).

DTO companies design and manufacture a product to meet the requirements of a customer. In MTP, products are produced in line with a given drawing. Lead time includes only raw materials purchase, supply and manufacturing, but not design. In ETO, changes to standard products are offered to customers and only made to order. Lead times include relevant elements of engineering design and all manufacturing. MTO manufactures a standard product only on receipt of a customer order. In ATO, components and sub assemblies are standardized; while the required parts are assembled to order. MTS is based on the sales forecast, goods are manufactured and it is equivalent to mass production.

Amaro et al. (1999) proposed a new taxonomy for non MTS companies on basis of three major dimensions and therefore enlarged their model. The first one being *product customization,* which covers pure customization, tailored customization, standard customization and non customization. The second dimension is the *company’s responsibility,* the third being *activities after receipt of order.* The company responsibility is discussed in terms of design, specification, purchasing and the activities after receipt of order consist of delivery, assemble, processing, purchasing, routing, specification and design. These three
Dimensions are used to develop 11 types of non MTS companies comprising of 4 types of ETO companies, 5 types of MTO and 2 types of ATO.

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*Figure 7: Framework for non make-to-stock companies. Source: Amaro, et al. (1999)*

6.- Duray’s Model

Duray et al. (2000) described a model that classifies mass customizers based on customer involvement and product modularity. This classification argues that production efficiency in mass customization cannot be achieved without modularity (Duray, Ward et al. 2000). Pine (1993) stated that achieving true mass customization needs modularity in production. Baldwin and Clark (1994) argued that modularity allows achieving economies of scale and scope across product lines. McCutcheon et al. (1994) suggested that modular product design would provide variety and speed up the process by reducing delivery times.

Modularity is the concept of decomposing a system into independent parts or modules that can be treated as logical units (Jiao and Tseng 1999). By using a modular approach, a product is designed in a way that parts of the product rely on standardized components. Customization is then achieved through a combination or modification of these modules. A range of modularity types can be considered for different mass customizers (Tezcanli 2006). Modularity is viewed by Ulrich and Tung (1991) as depending on two characteristics of a design: (1) Similarity between the physical and functional architecture of the design, and; (2) Minimization of incidental interactions between physical components. Figure 8 shows the customer involvement and modularity in the value chain used in Duray’s model.
Duray (2002) discusses that the types of manufacturing systems applied for mass customization would vary between traditional manufacturing and custom product manufacturing systems. Emphasis is given on the point that a standard manufacturer or a custom manufacturer can expand his/her product line with mass customization. However approaches to mass customization are different. DURAY’s framework (Duray, Ward et al. 2000; Duray 2002) presents four types of mass customizers: fabricators, involvers, modularizers and assemblers.

**Figure 8: Customer involvement and modularity in value chain. Source: Duray, et al. (2000)**

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**Figure 9: Four types of mass customizers. Source: Duray (2002)**

The first group is called the **fabricators**, which involves customers and modularity in the design and fabrication stages. This group resembles pure customization. The type of modularity involved is often cut to fit or component sharing.

Group 2 involves customers in design and fabrication stages but uses modularity in assembly and delivery stages. They are called the **involvers**. Modularity in assembly and delivery stages means that no new modules are fabricated for the customers. Involvers get hold of greater economies of scale than fabricators but maintain high customer involvement.
Group 3 involves the customers in assembly and delivery stages but applies modularity in design and fabrication stages. They are called the *modularizers*, most often component sharing occurs here.

Group 4 is called *assemblers*, they apply customer involvement and modularity in assembly and delivery stages. Assemblers closely operate as mass producers. But they provide more choice than mass producers which customers perceive as customization.

This model differs from Gilmore and Pine’s (1997) classification, as it has modularity as one of the dimensions and has not included service as a mass customization technique.

7. - Kok’s Model

The production information flow (customer order signal) initiates and controls the materials flow through the life-cycle phases (concept, design, construction). Winch (2003) determines the following four generic production strategies:

![Figure 10: Production strategies and process flows. Source: Winch (2003)](image)

The production information and material flow allow distinguishing four concepts of customer involvement, based on the production stage:

- Concept-to-order (CTO), where the customer (usually called a client in this context) enters at the start of the information flow – nothing happens until the client initiates production.
- Design-to-order (DTO), where the firm has already a basic product concept, but significant engineering design work is performed for that particular client/customer.
- Make-to-order (MTO), where there is a fully detailed design, which can be configured to suit a customer’s particular requirements (MTO/C) or where no additional design work needs to be done, but the materials flow does not start until the customer places an order.
- Make-to-forecast/stock (MTF), where the product is produced for stock and sold after it is manufactured or, sometimes, during manufacture.
Kok (2007) combined the approaches of Winch (2003) and Rudberg and Wikner (2004) in order to obtain the following CODP model. This model was developed in the context of the construction industry:

![CODP Model Diagram]

**Figure 11: Customer-order decoupling points in construction. Source: Kok (2007)**

### 8.- Conclusion

As can be seen in the descriptions of the different models presented above, the decision for a certain strategic approach to mass customization can have a significant impact on the success of the strategy. Especially the customer involvement is within the focus of this paper, since it can be regarded as one of the key factors for implementing mass customization. The different models point out that depending on the type of product and the desired degree of customer interaction, a model can be chosen, which offers optimal results in the process of offering mass customized products. Of course, these models rely on theories, this is why there are some weaknesses. Companies might have problems to distinguish their situation as stated in models. Most of them do not give any respect to mixed forms of product orders. Nevertheless, most of them are a helpful starting point for implementing a successful mass customization strategy. Companies can choose that MC model from their list that comes closest to the specific company situation.

As seen so far, the best point for customer involvement can vary and is often hard to determine. Although the models show different approaches for companies, some will not find a fitting strategy due to this presentation. In this paper, it was not possible to present all existing models in literature, because a lot of researchers have tried to set up useful models for companies, which are supposed to enable manufactures finding the right strategy. Nevertheless, this paper is supposed to enable companies to get an idea of the right approaches for their situation. The basic descriptions of their way of working should be sufficient to evaluate at first sight whether this model proposes a fitting solution for a company’s process.
As stated above, the decision towards one model relies heavily on the company’s process. The great range of choice makes it difficult for manufacturers to decide on one model and might prevent them from trying. Therefore, future research should focus on a basic model that represents a master strategy for each company. Such strategy is difficult to find, for there are different processes along companies. Moreover, the possibilities of a company to implement a process are dependent of its size. These factors will make it difficult to create such a model. Therefore, such a basic model would have to be very flexible and at the same time give some basic points which companies can follow when involving customers.
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