Knowledge Management in E-commerce Mass Customization

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Abstract

Mass customization is one of the leading strategies in satisfying customers and assuring companies survival in today's markets. From the point of view of lifecycle management, it includes knowledge of customer requirement, customer preference, raw material purchasing, customization manufacturing process, product price which reflects satisfaction of both sides of bargain. This paper proposes a knowledge management model in E-commerce mass customization, which is consisted of three parts: the customer information gathering model, the purchasing and manufacturing model and the pricing model. The modeling process and further analysis show that the model efficiently integrates different knowledge in mass customization lifecycle and can serve as a useful platform in E-commerce.

Keywords

Knowledge management, Mass customization, modeling

1. Introduction

In this era characterized by constantly changing environment, rapid technology progress and fierce market competition, knowledge is recognized as a manageable key resource for enterprises to survive and develop (Grover and Davenport, 2001; Bernard and Tichkiewitch, 2008). Knowledge, also known as intellectual capital, has been regarded as one of the sustainable assets, so people are paying more and more attention in knowledge management issues (Xu et al., 2011). Knowledge can add value to products/services so as to help enterprise make profit, and knowledge management aims at figuring out how to add value as much as possible within a given cost (Xu and Bernard, 2010). Although the strategic value of knowledge is clear, in most cases people have not mastered the art of managing knowledge. Thus, it is quite useful to make a profound study on knowledge management in a given business model, for example, mass customization.

Mass customization (MC) is usually referred as a term as an oxymoron of mass production and customized goods (Kaplan and Haenlein, 2006), and it has become an undisputable reality that MC is one of the leading strategies in satisfy-

ing customers and assuring companies survival in today's markets (Daaboul et al., 2011). Mass customization makes high value-added products/services, and enhances profitability by reducing the costs of production and logistics and better satisfying the customer personalized requirements (Jian et al., 2003; Grenci and Watts, 2007). When an enterprise is able to offer personalized or customized products, customer is then involved in the product design process, which may increase the value of the product – customer perceived value (CPV) (Gautam and Singh, 2008). One of the most distinguished features of mass customization is to provide customers with the possibility to co-design products/services according to their personalized preferences and interests. Providing customers with the ability to co-design products/services based on their own preferences has been considered one of the most distinctive features of mass customization (Ogawa and Piller, 2006). Products/services can be considered to be an integration of different modules, and different features of these modules can satisfy customers' needs and provide value. From this point of view, mass customization can be regarded as a method to provide customers with a choice menu based on market segmentation (Fogliatto and da Silveira, 2008).

Implementing mass customization in pure traditional manufacturing industrial is quite difficult, so it is usually integrated with information technology (IT) systems to form E-commerce solutions. E-commerce can provide the linkage to capture external information and it is regarded as a possible solution for mass customization (Helms et al., 2008). E-commerce uses computer and networks to do business, such as buy and sell products/services, transmit information, etc. With the rapid progress of information technology, people are award of the fact that when a business model is created, built and applied properly, E-commerce would facilitate mass customization in many aspects (Turowski, 2002; Helander and Jiao, 2002). Meanwhile, E-commerce based on the rapid progress of advanced Information and Communication Technologies (ICT) should be linked with effective knowledge management strategies. Knowledge gained and managed via e-business can enhance customer relationship management, supply chain management, product development, etc. (Fahey et al., 2001)

In order to better explain the proposed theoretical model, this paper takes mass customization on food menu in E-commerce as example. With the rapid growth of people' requirement on food, people do not only care about nutrition and safety issues but also need more customized menu. There exists "special supplied food" which can be ordered by customers to fit their personalized requirements, but they are quite expensive because there is a lack of mass production. Scale effect is one of the primary means to reduce costs (Easton and Sommers, 2003), so mass customization should be applied to balance the two sides of scale effect and customized requirements. As a result, the main problem to be solved is that, to what extent the benefit brought by customization can compensate the increased cost caused by quantity reduction, in other words, what to customize and how to customize.

This paper mainly focuses on knowledge management issues in E-commerce mass customization and proposed a model for real case implementation.

2. Modeling process

Mass customization is applied by more and more enterprises to attract customers and make more profits. A survey based on market investigation (Xu et al., 2012) shows that customers are willing to pay about 50% more to get a customized diet menu (different collocations of the food materials, to what extent the food is cooked, flavors, etc. can be determined by customers) rather than homogeneous fast food supply. Another results got from the investigation is that customers are willing to pay more for personalized requirements but they would like to pay extra fees as little as possible. Consequently, an obvious conclusion can be made: enterprises which can apply mass customization to provide customized product and/or service with a lower price will win in the fierce market competition.

The integrated model is consists of three parts: the customer information gathering model, the purchasing and manufacturing model and the pricing model. Figure 1 shows the framework of the mass customization lifecycle management model.

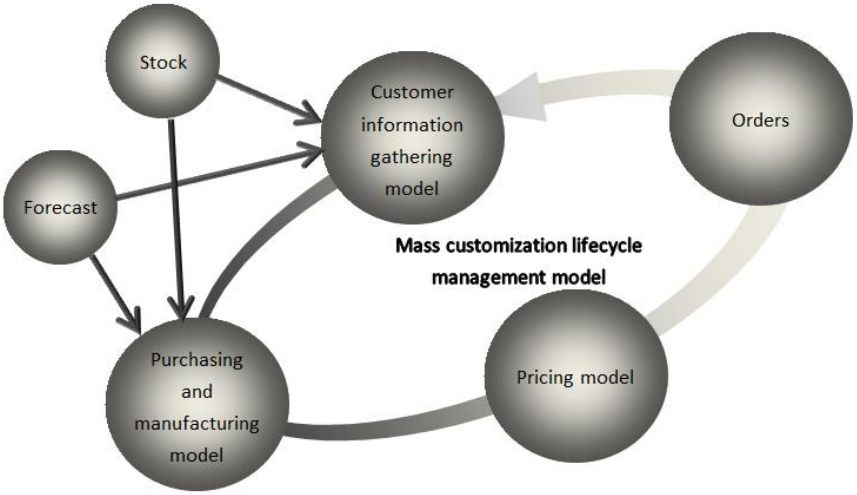

Figure 1. Framework of the mass customization lifecycle management model

3. Customer information gathering model

In the phase of customer information gathering, seven modules are constructed as follows.

1) Information announcement on the official website. The company announces the types of food that it will accept to be ordered in the next time period, for example, in the next month. Customers may choose one or some of

them according to their preferences, determine possible attributes of the food they will order, and illustrate customized package. This module may integrate official website announcement, channel marketing, email pushing, etc.

2) Customer account management. Each customer may have an account, which will be a base of the customer's information. This module may include registration, login, logout, edit, administrator management, etc.
3) Customized design by the customer himself/herself. Customers choose the foods they need for their menu according to the choices given by the company website, and determine the possible combination. For example, if a customer choices milk as a part of the menu, he may determine its value: sugar percentage, fat percentage, etc. In order to control the complexity of customization, attribute values can be restricted if needed, for example, for the possible value of fat percentage of milk, only whole milk, skim milk and half skim milk are available.
4) Weight assignment. The customer should assign different weight values to each customized choice according to their preference. To facilitate later processes, the sum of all weight values is 1. These weights reflect the priorities of customers' preferences.
5) Customer order processing. This module will be discussed in detail in the following sections.
6) Customer feedback. This module enables customers to give some feedbacks to the company, which are valuable information.
7) After sales service. This module can be regarded as the end of the mass customization lifecycle. Like product lifecycle management, mass customization management has also an end, but it can also be treated as the beginning of a new lifecycle.

These seven modules fundamentally consists a whole lifecycle of customer information gathering process, c.f. Figure 2. During its implementation in the real world, companies are expected to realize customer relationship management in order to encourage new orders from the existing customers, so as to form a virtuous lifecycle of mass customization.

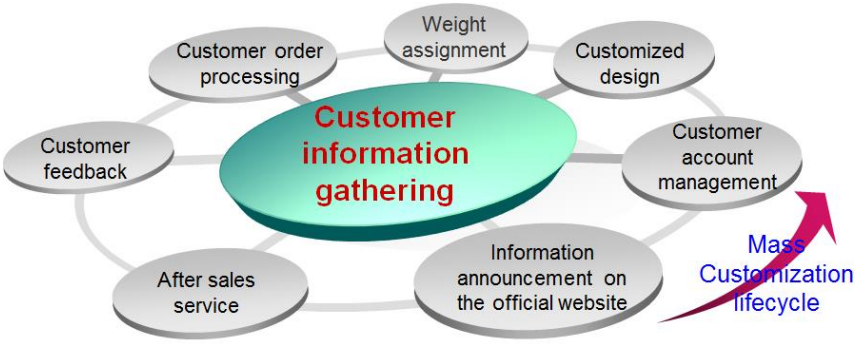

Figure 2. Customer information gathering sub-model

4. Purchasing and manufacturing model

In the phase of purchasing and processing, three modules are constructed as follows.

1) Purchasing general components based on prediction. General components refer to foods in their original status, such as pure milk with any skimming treatment. General components are obtained directly from raw materials. In this phase, the purchasing amount are forecasted based on existing stock, order data of the same period in the past years, etc.
2) Purchasing customized components based on customer orders. After receiving orders from customers, the company will purchase customized components.
3) Semi-manufactured food processing. Semi-manufactured foods are made according to the customer order and purchased material. For example, 100L of calcium-fortified milk are produced with pure milk (purchased in phase 1) and calcium additive (purchased in phase 2). The amount of semi-manufactured food is determined by orders.
4) Customized manufacturing process. After producing all kinds of semi-manufactured food, the company assembles them for a customized menu ordered by customers.

Figure 3 shows the purchasing and manufacturing sub-model.

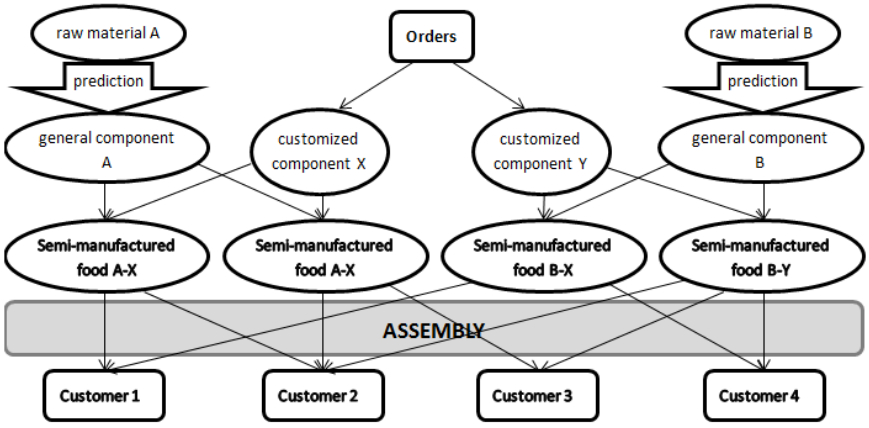

Figure 3. Purchasing and manufacturing sub-model

5. Pricing model

Pricing issue is crucial for mass customization (Aron et al., 2006). Unsuitable pricing strategy will prevent companies to gain their maximum profit and customers are not willing to pay an unreasonable price for the customized goods either. In our model, four parts form the pricing strategy for the customized orders:

1) The fundamental price. This part is determined by the minimum costs of all raw materials.

2) Price for customization. Customization needs extra cost compared to homogeneous order.
3) Price reduction to compensate the unaccomplished parts of the customized order. When the customers required a customized order and are willing to pay a high price, they deserve a complete product/service. If the company could not accomplish the task, they should be punished. In other words, the company should take the risk brought by mass customization as well as the profit brought by it.
4) Extra cost caused by order revision. Customers may not be satisfied with their order or the price matching their order. As customer orders have impacts on the mass customization process, such as purchasing processes and the pricing processes, some costs will happen each time a customer order is processed. As a result, for the customer side, they should undertake a higher price if they adjust their customized orders.

Here are some parameters used in the pricing sub-model.

- α_i $(1 \leq i \leq c, \sum_{i=1}^{c} \alpha_i = 100)$. This is the will point that customers assigned to each customized need. c is the number of customized needs. It is reasonable that when the customer has a high requirement in some aspects, he/she should reduce his/her expectations in some others. Mass customization does not mean all customer requirements have to be satisfied, which is unreasonable in the real world where everything has a budget.
- L_i. This is the lowest purchasing cost of each raw material.
- P_{ij}. This is the cost of each possible component of an order. For example, for a customized order for a breakfast menu, there is i different components and the i^{th} component has j different options. According to different requirements, different options of a given components may have different costs.
- M. If any customized requirement cannot be satisfied, the price should be reduced to compensate the customers. M is the amount reduced for each will point. For example, if a customer has an personalized requirement for the sugar percentage of the coffee and gives it 10 will points, but the company cannot satisfy (or feel it worth not to be satisfied), the price of the order should reduce $10 \times M$.
- N. This is the number of order matching round. For example, when a customer proposes a customized order for the first time, $N = 1$. If the customer is not satisfied and choose to adjust the order for a second round, $N = 2$.
- F. If the customer adjusts his/her customized order, there will be an additional cost, which is F. For example, when the customer adjusts his/her order and resubmits it for the N^{th} time, there is an addition of $(N - 1)F$ on the price he/she will pay.
- X_i. This is a 0-1 variable, which is used to judge whether a given customized requirement has been realized.

$$X_i = \begin{cases} 1, the\ i^{th}\ customized\ requirement\ has\ been\ realized \\ 0, the\ i^{th}\ customized\ requirement\ hasn't\ been\ realized \end{cases}$$

- r. This is the expected interest of the customized order. r can be obtained by statistical and/or forecasting method using historical data of the company.

As a result, the customized price is calculated as follows.

$$\text{Price} = \left[\sum_{i=1}^{C} L_i + \sum_{i=1}^{C} (P_{ij} - L_i) \cdot X_i\right](1 + r) - \sum_{i=1}^{C} (1 - x_i) \cdot \alpha_i \cdot M + (N - 1) \cdot F$$

Pricing procedure is shown in Figure 4.

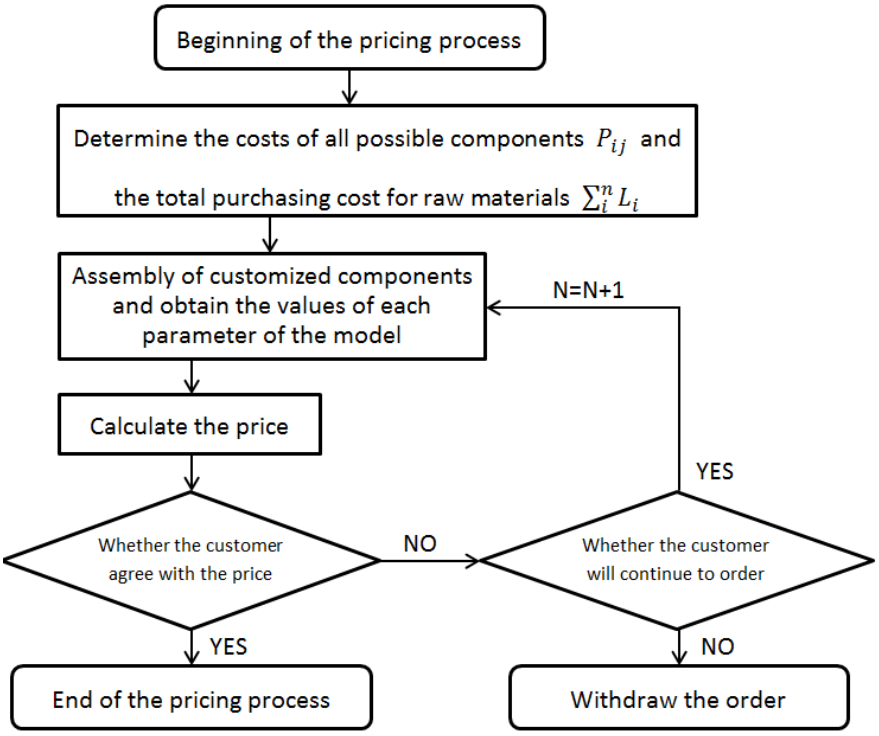

Figure 4. Pricing procedure

Figure 4 shows that the pricing procedure firstly figures out the lowest cost of all raw materials used for the order, i.e. L_i. The addition of L_i is the fundamental price of the order. Then, in the assembly process, the model records what is actually used to form the menu order and thus determine all parameters to calculate the price. Using the proposed calculation equation, the price is calculated. At the same time, the difference between the menu provided and the original order of the customer is sending back to the customer, and ask the customer whether he/she agrees with the menu provided and the correspondent price. If the cus-

tomer agrees, the procedure arrives to a happy ending. If the customer does not agree and does not want to continue the order, the order will be canceled automatically. If the customer does not agree with the menu provided and its price, but would like to make a customized order for a second round, the parameter N will be adjusted to $\mathrm{N}+1$, and a new process will begin.

6. Discussions

One of the key issues in the proposed E-commerce mass customization model is how to design the choice menu for the customer. Customization does not mean to satisfy all customer requirements without any constraint. Not only the production cost or manufacturing activities should be controlled, but the customer requirements should also be controlled. In other words, customization in our model does not refer to original creativity of customer, and the range of customization is controlled by the company, so as to make the E-commerce platform realizable and efficient. The design of customized choice menu should take former orders into account and consider current stock situation as well. Once a customer order is processed, it will have impacts on the following purchasing activities and the design of choice menu. During the modeling process, the purchasing of general components is determined by the forecasting and the stock, and the purchasing of semi-manufactured components is determined by orders. In fact, orders reflect to what extent the choice menu satisfy customer satisfaction. As not all customer requirements are satisfied, online choice menu can be adjusted according to the feedback reports from the pricing model. Furthermore, the design of choice menu should also take current stock situation into account, so as to reduce the stock. For example, if the company has some overstock beefsteaks, some options providing menu with beefsteak could be added to the choice menu, so as to increase the probability of consumption of those overstock materials.

Another crucial issue processed by the model is how to customize the product price. According to the model, production costs of each order are not the same, so as for the purchasing strategies. The pricing model takes the fundamental costs, costs for customization and the degree of customization satisfaction into account. As a result, different choices made by different customers at different times vary a lot, so the product prices are customized.

In order to increase the impacts of customers' preference and control customers' requirements in a reasonable range, customers are required to weight to their different options during the customer information gathering model. On one hand, companies may have a deeper understanding of customers' preferences which can help companies to adjust their commercial activities; on the other hand, customers' preferences are better respected. For example, if an important preference (given a relatively high weight) of a customer cannot be satisfied, more compensation are given to the customer by reducing the customized price.

7. Conclusions

This paper has proposed a knowledge management model in E-commerce mass customization. The proposed model is consisted of three parts, the customer information gathering model, the purchasing and manufacturing model and the pricing model. The model integrates knowledge about customers' requirements and preferences, customization processes and product prices, so as to provide reasonable products/service with a suitable price. The model also analyzes knowledge management issues in mass customization from the point of view of lifecycle management, from information gathering, material purchasing, customization manufacturing and feedbacks. In this integrated process, not only the company but also customers are involved, especially performed in the pricing model.

Further research opportunities could include more consideration on customer relationship management and supply chain management so as to integrate more knowledge related to the mass customization lifecycle.

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