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Winning with Mass Customization and Electronic Commerce

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Facing extensive domestic and foreign competition, companies are looking for a long term business strategy to maintain persistent profitability. Mass customization, or massively producing customized goods and services, is indicated to be one of the potential new business strategies (Dertouzos et al., 1989; Standard & Poor, 1994; Russell, 1993; Kelley, 1993; Rice, 1992; Harding, 1995).

Some companies tried mass customization strategy and did extremely well, while other attempts seemed problematic (Pine, 1993; Kotler and Armstrong, 1994). For instance, companies retaining stock of every variety in order to satisfy customer orders may find inventory cost out of control. Turnaround time can be too lengthy to lose sales and cause customer dissatisfaction. Providing too many unimportant options only confuses customers and does not result in serious sales boost. In short, customization itself is not difficult; the true challenge is to provide the right personalized customization, timeliness, quality, and mass-production price, *all at once*.

Mass customization is not a new idea. It was predicted 25 years ago (Toffler, 1970) and the term coined in 1987 (David, 1987). Why only recently does it start to happen? How to make it more doable and successful? Actually, mass customization can be considered to be another conscious or unconscious reaction to the explosive adoption of information technology (IT). Specifically, the maturing of computer network applications have emerged to become something very close to the perfect partner of mass customization -- electronic commerce. Electronic commerce allows users to share information via electronic means (The Economist, July 9 1994). It allows images and CAD/CAM drawings to be transmitted to customers' home computers and customers can browse, select, and manipulate products through electronic catalogs. Dispersed designers and customers can communicate directly and co-design the customized product through interactive, multi-user software. Orders can be immediately routed to remote factories and being processed by EDI systems. A manufacturer can look for supplies, compare prices, place orders, pay bills, and schedule deliveries. Groupware and other applications can flexibly coordinate and schedule team tasks. Without these capabilities, a mass customizer cannot achieve the level of efficiency and timeliness which are equally valued by customers besides the customization of features.

The alignment of business and IT strategies is said to be a driver to profitability. How should the two strategies be aligned? More specifically, if a company decides to adopt a mass customization strategy to satisfy its customers, how should the IT strategy be "aligned" to achieve the best result? What are the factors that affect pricing decisions? From earlier analysis, it is intuitively evident that the value and profitability of a mass customization strategy is likely to be higher with proper use of electronic commerce. On the other hand, the investments on electronic commerce will be more valuable if such facilities are used to provide the basis for profitable customization. The two emerging trends -- mass customization and electronic commerce -- may have anticipated complementarity effect. Complementary effect between two things refers to the phenomenon when doing more of one increases the value of doing more of the other, which fits naturally with the nature of this problem.

The complementarity framework is advantageous in that it can handle a series of variables and provide the directions of optimal response should the value of any one variable change. By applying Lattice theory and supermodularity (Topkis, 1978), the differentiability assumption usually required by conventional

validation of complementarity is relaxed. Recently, Barua, Lee, and Whinston (1995) have depicted the complementarity existing among a firm's reengineering efforts, incentive design, and technology use. In this study, we build a stylized profit optimization model of a mass customizer and use complementarity to analyze the firm's optimal behavior in aligning business and information technology strategies.

Several highlights and rationale of the model are described in the following. First, demand no longer depends on price alone; rather, it depends on the value of the product, such as quality (the fineness and durability of the product), customization of features, and timeliness. Second, these attributes can be viewed as substitutes *or* complements of price in affecting demand. Price and quality are usually considered substitutes in that poor quality is often compensated by low price and high quality is associated with high price. In a world of mass customization, we suggest that high quality and low price may be viewed as complements with respect to increasing demand. That is, price cut is more effective in demand increase when the product is associated with higher, instead of lower, quality; quality improvement is more effective in increasing demand when the product is associated with lower, not higher, price. It is important that the mass customizer first understand the market condition then react accordingly. Third, since two consecutive products produced can require totally different raw materials from different suppliers, the traditional notion of economy of scale does not apply; rather, the internal and external coordination cost become the major cost consideration.

Suppose there is another competitor on the market. We hypothesize that the demand of the product (B) is determined upon exogenously how close the competitor's product is to the customer's actual preference (dyu), and endogenously how close the customer's actual preference is to the firm's estimated preference (dûu) and how close the firm's product is to the estimated preference (dxû). Demand is jointly influenced by price (p), quality (Q), customization (in terms of difference in features, Æz), and timeliness, which includes time to locate supplier (ts), time of delivery from supplier(td), and time of assembly (ta). The combining effect of quality, customization, and timeliness is denoted as the "value" of the product. The firm's decision variables include price movement, degree of customization through finer modularity design (d), investments in electronic commerce (including direct communication with customers (Ec), electronic bidding (Eb), electronic scheduling (Es), and internal electronic coordination facilities (Ei)), organizational structure variables (including incentive design (Oi), process redesign (Pi and Px)), and other variables such as quality control and manufacturing technology (Mq and Mp) and market research (Om). These decision variables will impact the demand, cost, and capital investment in different directions, and ultimately determine the firm's profit.

The objective of this paper is to derive predictions of optimal movements of the variables when any of the variables changes its value. That is, if the firm decides to make an investment in electronic commerce and thus increases the values of Ec, Eb, Es, and Ei, how should other variables be changed to reach the new optimum? Should the price be increased or decreased? Should the product be more customized or less? To answer these questions, three different models are developed in this paper. The first model deals with the situation when the mass customizer chooses demand expansion as its primary goal and maintains a fixed price. The mass customizer then faces the decisions of the degrees of adoption regarding mass customization, electronic commerce, and other organizational variables. Under this scenario, it is proven that the degrees of adoption are complementary. That is, in responding to the increased adoption of one strategy, it is more profitable for the organization to increase the adoption of other strategies. That is, if the firm should decide to move toward a mass customization strategy, it will be more profitable for the firm to also adopt electronic commerce; and vice versa.

In the second and the third models, in addition to all variables considered in the first model, price movement is also included as a decision variable. In the second model, market is such that value improvement is more effective when the price is lower (than higher), and price cut is more effective with higher-value goods (than lower-value). In other words, when it's cheap and good, it attracts more customers. Consider Figure 1(a). The firm is considering lowering p dollars on the product. If the product were higher-valued, the price reduction would attract more units of demand (+5, in the example) than if the product were lower-valued (+3). One example would be for the same $50.00 off, the department store will attract more business than a retailer store. Similarly, in Figure 1(b), the product is either priced high or low.

Now the firm decides to add a value improvement (such as a free express delivery or customized colors), such a value improvement would attract more customers if the price were lower (+4), than if the price were higher (+2). The major conclusion from this model is that higher value, more electronic commerce, and lower price should go together for this market.

In the third model, the market is one where price cut is more effective with low-quality goods, and quality improvement is more effective with high-priced items. In other words, customers are willing to suffer value if you lower the price. The major conclusion from this model is that higher value, more electronic commerce, and higher price should go together for this market.

The implication of this paper is that...

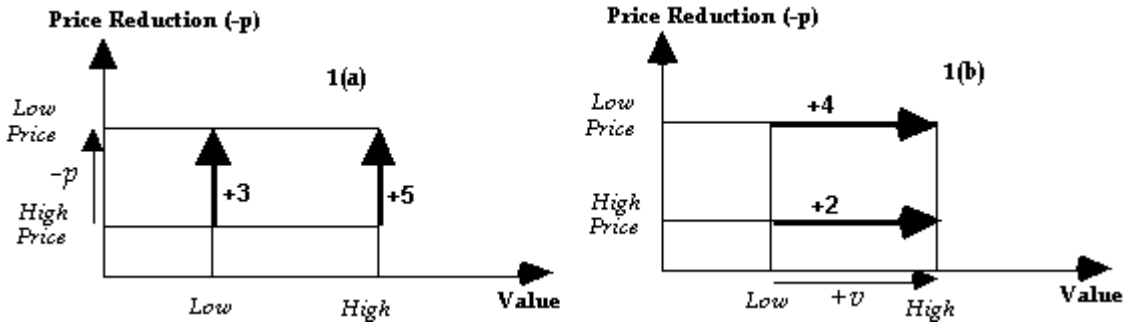

Figure 1. Second Model: Demand is supermodular in (-p,v).

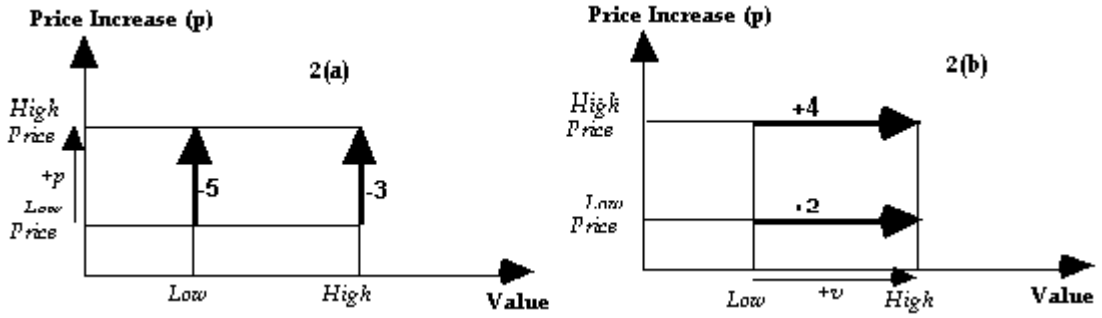

Figure 2. Third Model: Demand is supermodular in (p,v).

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