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### **From economies of scale towards economies of customer interaction: value creation in mass customization based electronic commerce**

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#### **Abstract**

*Mass customization is seen more and more as an application of electronic commerce rather than a manufacturing approach. The paper sets a framework for value generation in mass customization based business models. Traditionally, mass customization was argued to be possible due to the capabilities of modern manufacturing technology. We argue that these capabilities are supplemented by a new set of economies arising not from new possibilities in the fulfillment system, but from a better knowledge position and switching costs resulting from the direct interaction with each customer provided by innovative applications of electronic commerce. By examining and structuring the underlying economic principles of mass customization, not only the limits and constraints, but also the benefits of this competitive approach will be better understood. For better planning mechanisms, the value and costs of a single process have to be known. In this context, we want to provide a starting point for further exploration.*

*Keywords: customer integration, mass customization, customer relationship management, economies, cost and value drivers*

## 1. Mass customization and electronic commerce

Enterprises in all branches of industry are being forced to react to the growing individualization of demand, yet, at the same time, increasing competitive pressure dictates that costs must also continue to decrease. Companies have to adopt strategies which embrace both cost efficiency and a closer reaction to customers' needs. Strategies like agile manufacturing, focused factories, mass customization, flexible manufacturing, or customer relationship management are being seen as viable weapons in today's competitive landscape (Sahin, 2000). While these approaches are characterized by different manufacturing philosophies and/or fulfillment systems, they share a new, intense customer centric view. The consumer is seen as a partner in value creation, products and services are not being mass produced for an anonymous market but customized for each individual customer. In the following, we will concentrate on the concept of mass customization, which is gaining growing interest both from academia and business (see Da Silveira / Borenstein / Fogliatto, 2001; Piller, 2001; Tseng / Jiao, 2001 for an overview).

The objective of mass customization is to deliver goods and services which meet individual customer's needs with near mass production efficiency (Tseng and Jiao, 1996). Until today, mass customization has been closely connected to the potential offered by new manufacturing technologies (CIM, flexible manufacturing systems) reducing the trade-off between variety and productivity (Ahlström/Westbrook, 1999; Kotha, 1995; Pine, 1993; Victor/Boynton, 1998). But while the concept has already been discussed in the literature for more than a decade (e.g. Davis, 1987; Kotler, 1989; Pine, 1993; in fact, Toffler, 1970 described the basic idea), increased practical implementation of this strategy can be found in business only in the last few years. An explanation for that time lag may be found in the fact that information technologies capable of handling the information flows connected with mass customization have only existed for a couple of years. Especially as mass customization enters more and more consumer markets, new Internet technologies can be seen as its main enabler.

Information can be regarded as the most important factor for the implementation of mass customization. While product architectures and the range of possible variety are fixed during a preliminary design process, the second step takes place in close interaction between the customer and the supplier. The customer is integrated into the value creation of the supplier. Zipkin (2001, p. 82) calls this process the elicitation of mass customization systems, the mechanism for interacting with the customer and obtaining specific information in order to define and translate the customer's needs and desires into a concrete product specification. Elicitation is the major cost driver of mass customization. Thus, the costs arising from customization consist largely of information costs. They are accounted for by the investigation and specification of the customers' wishes, the configuration of individual products, the transfer of the specifications to manufacturing, an increased complexity in production planning and control, coordination with the suppliers, and the direct distribution system. All these activities are characterized by a high intensity of information compared to traditional mass production. Customer-related value added is produced on the information level.

While in business-to-business markets personal sale and configuration is common, in consumer markets the interaction often has to be carried out over the Internet. Web-based interaction tools like product configurators make it possible to „outsource“ the time- and cost-consuming configuration process to the customer. For low cost consumer goods extensive sales and configuration processes cannot be carried out by personal sales in a retail outlet – if keeping the cost option of mass customization in mind. Customized cosmetics like reflect.com with a retail value of 10 € cannot be sold in traditional channels. The same is true for many other mass customized products with a relatively small margin. Therefore, mass customization can be seen as closely related to e-business and new possibilities connected with the Internet economy. The use of the Internet as a communication medium facilitates the efficient production of customized goods as well as the personalization of customer relationships. Therefore, the vital role of information categorizes mass customization, from a conceptual point of view, as an application of electronic commerce (Duray et al. 2000; Fulkerson / Shank 2000; Lee / Barua / Whinston 2000; Piller / Reichwald / Moeslein 2000; Zerdick et al. 2000). In the course of the last few years, different mass customization based business models have been developed on the Internet and within multi

channel environments (for a structural approach of corresponding business models see Piller 2002).

In a mass customization system, the customer is integrated into the value creation of the supplier. Every transaction implies information and coordination about the customer specific product design and is based on a direct communication between the customer and supplier as the result of a divided construction process (Hibbard, 1999). This breaks with the traditional view of value creation in a firm (Ramirez, 1999). Industrial value production is most often conceptualized in terms of the value chain (Porter, 1980). In this concept, value creation is sequential. Value is added from one step to the other (as is also reflected in most of today's taxation systems). The customer is no part of the value chain. Value is finally realized only in the transaction between the customer and producer (purchasing of the final good).

In contrast, mass customization implies that value is mutually created among the actors on different levels. Customer integration can be defined as a form of industrial value creation where "the consumers take part in activities and processes which used to be seen as the domain of the companies" (Wikström, 1996: 360). The result is a system of co-production, i.e. a company-customer interaction (social exchange) and adaptation for the purpose of attaining added value (Milgrom and Roberts, 1990; Normann and Ramirez, 1994). The customer becomes a "co-producer" respectively "prosumer" (Toffler, 1970). While this view is not new (see Ramirez, 1999: 53-54 for an overview), only today we see a broader application of this principle in practice (and here especially in business-to-consumer markets and not only business-to-business markets). However, as the main part of the interaction with the customer takes place during the configuration and therefore design of the customer specific product, we want to call the customer more a co-designer than a co-producer.

Traditionally, customer integration was connected with the possibility of charging premium prices derived from the added value of a solution meeting the specific needs of a customer (Porter, 1980). But in order to meet today's competitive pressures, higher levels of differentiation can not afford to lead to much higher prices. Overcapacities and steadily increasing international competition leads to a growing market pressure which has transformed many sectors from sellers' to buyers' markets. Standards of technology and quality are constantly leveling out. The cost-benefit relation alters because buyers demand relatively high standards of quality, service, variety or functionality even when the sales price is favorable or, vice versa, suppliers have to meet additional requirements in pricing when a product is markedly differentiated.

The objective of this paper is to set a framework for value generation in mass customization based business models based on a strong integration of the customer. Therefore in the main part of the paper we will explore customer integration specific new cost saving potentials. Traditionally, mass customization was argued to be possible due to the capabilities of modern manufacturing technology like flexible manufacturing systems or modular product structures like platform strategies. Here, strongly reduced set-up costs made lot sizes of one economically feasible. We will argue that these capabilities are supplemented by a new set of economies arising not from new possibilities in the fulfillment system but from a better knowledge position and switching costs arising from the direct interaction with each customer provided by innovative applications of electronic commerce. These new economies, described as economies of interaction and economies of relationship in the following, will be discussed as new value drivers in a customer centric economy. Unlike economies of scale in a traditional industrial system, which involve making and moving volumes of products or services and then selling them often at ever decreasing margins, these new economies can generate increasing returns.

Our findings are based on a large scale case study research, which has been conducted since 1997. In order to cover a field characterized by a heterogeneous population of firms and strong growth rates, only research which combines an examination of a large group of cases with an in-depth study of some exceptional examples seems sufficient (Bettis, 1991; Kotha 1995). Therefore, we constructed a long-term exploratory study to identify best practices and success factors for mass customization. Data was gathered by secondary sources such as database and Internet research and primary sources such as interviews and company visits alike. In total, 240 cases were investigated (descriptive data of the sample is available upon request).

The organization of the remainder of the paper is as follows: First, we will briefly discuss the additional costs of customer intimacy. In the main part of the paper we will show how new kinds of economies complement traditional economies of scale and scope. We will further discuss some of the main factors which influence the extent to which the new economies can be realized. The paper concludes with implications and directions for management and further research.

## 2. Price premium versus additional costs

The individualization of product and service attributes to customer-specific needs and requirements holds the potential to increase customer satisfaction. The firm enters a quasi monopolistic status as its offer is unique and, at least to a certain degree, not comparable with the other products in the market segment. A firm could be able to charge prices representing the price sensibility of each single customer, capturing the whole consumer rent (Chamberlin, 1962). The extent of a price premium depends on the heterogeneity of customers with regard to specific attributes of a product. Products that require matching different physical dimensions have often a lower price sensibility than products that are customized just by the possibility of changing colors or design patterns. In the sport shoe market, *Adidas* can charge higher premiums (up to 50%) for its customized sport shoes brand “mi adidas” compared to the customized sneakers of *Nike* (NikeID brand, 5-10 % premium). *Adidas* makes it possible not only to choose between some colors and put a name on the shoe, but also customizes the shoes with regard to comfort, fit and functionality.

These additional premiums connected with customer centric value creation compared to traditional mass production and mass marketing are challenged by additional costs connected with this system. The major cost driver is the process of elicitation (i.e. costs accounted for by the investigation and specification of the customers’ wishes and the configuration), the transfer of the specifications to fulfillment, an increased complexity in production planning and control, coordination with the suppliers, and so on. All these activities are characterized by an high intense of information compared to traditional mass marketing and mass production (Duray et al., 2000; Lee, Barua and Whinston, 2000).

While the customer can be seen from the supplier’s perspective as a production factor fulfilling tasks that in a mass production system are done internally (Ramirez, 1999), the firm has to establish additional, cost driving mechanisms to minimize the burdens of customization for the customer. This includes investments in customer service centers, highly qualified staff, trust building promotion activities, and investments in configuration systems and other equipment, leading to additional costs, often seen as the “natural” costs of differentiation (Porter 1980). Further cost surpluses result from a loss of economies of specialization and economies of standardization. Higher set up costs, more complex and detailed quality control, costs for better qualified labor and the complex manufacturing planning increase the cost level. Additionally, inventory of components may rise and higher capital investments in more advanced flexible production units are needed (Agrawal, Kumaresh and Mercer, 2001; Zipkin, 2001).

The argumentation up to this point can be summarized as shown in Figure 1. As more and more customers express a desire for products or services which fit their needs exactly (including rather hedonistic motives of customization like the wish to express individuality), companies can charge a price premium which reflects the customers’ value added. However, competitive pressure and additional risks and efforts faced by the customers during the buying process reduce possible surpluses to a larger extent. From the firm’s perspective the possibility of gaining higher margins is also challenged by additional costs in fulfillment, on the elicitation level and the loss of economies of scale and standardization in comparison to mass manufacturing. Therefore a firm has to seek new economies to counterbalance the additional costs. These savings and benefits are not only connected directly with the customization process, but can be transferred often to other (mass) operations as well. This makes it necessary to survey the total costs and profits of customer centric value creation. The profits gained have to be partly reinvested in order to keep the relationship to the customers active and to gather feedback in-between sales in order to increase the amount of knowledge about the customer.

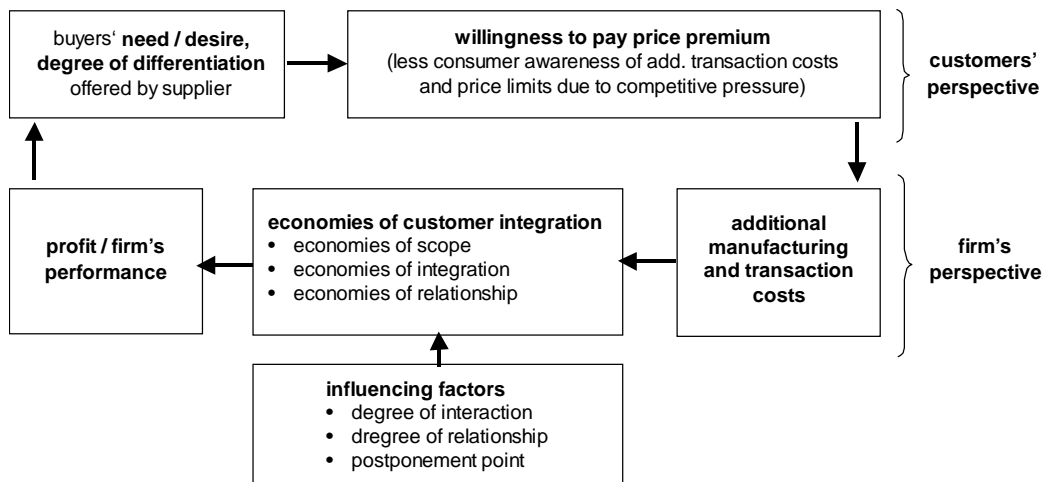


Fig. 1: A model of value creation of mass customization based e-business

### 3. Economies of integration

Economies of integration describe cost saving potentials as a result of the direct interaction between each customer and the firm. They go beyond the differentiation advantages of customized manufacturing which are expressed in the price premium. They represent the efficiency when a firm establishes value processes that eliminate waste on all levels. As customer interaction and integration is only possible due to low transaction cost provided by electronic commerce technologies, economies of integration can be seen as a premier cost saving potential within electronic business.

More concretely, economies of integration are formed by a bundle of cost saving potentials in two classes. Firstly, they are the result of the build-to-order approach connected to the newest system of customer centric manufacturing. Build to order means postponing some stages of fulfillment until the order has been placed. Here, economies of integration occur in the following categories:

- *inventory*: reduction / elimination of inventory in distribution chain; reduction of safety stock;
- *planning*: reduction of planning complexity, adaptation costs (of planning decisions), fashion risk and over stocks, development costs (product flops);
- *capacity utilization and stability*: no bull-whip-effect, stable processes, reduction of the over capacity required in made-to-stock systems to adopt to short-term changes of trends,
- *sales*: avoidance of lost sales in retail due to out-of-stock items, prevention of discount at the end of a season; opportunities for better channel management, reduction of error costs.

The savings from these effects can be huge. In the computer industry, network equipment provider *Cisco* reported a \$2.2 billion write-down in excess inventory in May, 2001, although the company is widely acclaimed for its lean manufacturing capabilities (Stewart, 2001). But given the precipitous drop in demand at that time, even the most flexible variant manufacturing system couldn't react fast enough along the supply chain. A pure build-to-order approach can hold enormous savings here.

The second class of economies of integration is based on the aggregation of customer knowledge in order to better perceive market information. Peppers and Rogers (1997) call this principle the "learning relationship" between a company and its customers. The self configuration by the buyer allows access to „sticky local information“ (v. Hippel, 1994, 1998). Sticky information rises when

the costs of information exchange between two different actors are higher than processing this information within one unit. They originate in location specific costs like technological and organizational activities of decoding, transmitting and diffusing the information. We can argue that often customer specific information is sticky in that sense. Tastes, design patterns, and even functionalities are rather subjective and difficult to describe objectively. Many customers are not able to describe their needs precisely and therefore to transfer their wishes into a concrete product specification that allows the company to build a customized product or deliver a customized service. By integrating the customer into the design of a product or service, economies of integration represent the saved costs of getting easier access to the sticky information. Note that this argument is only true as long as the information the customer needs from the supplier to execute the co-design has a low level of stickiness. This condition arises in systems where configuration engines or design tools and a modular product or service architecture provide an open and easy to understand platform for interaction and co-design. Using these tools, a customer can often specify her product implicitly.

By transferring customer needs and wishes into customized products, the company gains access to the sticky information and can transfer it to explicit knowledge usable within the firm. By aggregating this knowledge, a company can generate better market research information and more accurate forecasting concerning customer needs. This is especially true when the firm operates a mass production for anonymous markets alongside the customized business (still) (Kotha, 1995, p. 34; Peppers and Rogers, 1997, p. 233). This is the case for almost all large pioneering companies of the new customer-centric e-business models like *Adidas*, *Nike*, *Lego*, or *Procter&Gamble*, just to name a few. For the portion of business that is manufactured on inventory, the customized segment provides panel-like market research information without the common panel effects biasing the results. The information gained here can be used to plan and control improved existing variants of products made to inventory. Additionally, new product development and continuous improvement of existing products can benefit deeply from such user driven innovations. Note that this class of economies of integration results from the sheer possibility of interacting. The information gains are not based exclusively on actual sales but just on tracking the information gained by interacting with the users on a configuration tool.

*Reflect.com*, a sister company of *Procter&Gamble*, offering customized cosmetics on the Internet provides a premier example for these kinds of economies of integration. Using interactive software, visitors to the site can create their own cosmetic line, mix and match various options like colors, scents, and skin-care preferences to create a unique product. A P&G facility in upstate New York manufactures the product, and a "conciierge service" in Cincinnati handles follow-up interaction with customers. Reflect allows customers to redesign a product as many times as they want. The site acts as a "life panel" for all P&G cosmetics operations. Its customer base contains more than one million buyers creating their own cosmetics and thereby formulating dermatological needs, evaluating new scents, bundling products, choosing packages, and developing new products. The customized order specifications are matched with the socio-demographic profiling information of each customer and the feedback or change of specifications after the sale. For P&G, reflect.com is reported to be one of the most efficient market research tools (Warner, 2001).

#### **4. Economies of relationship**

Economies of relationship are closely connected with economies of integration and are based on the same source (degree of customer interaction). However, while economies of integration describe methods of improving the efficiency of fulfillment activities, and are based either on the postponement of value creating activities until a specific order is placed or on aggregated knowledge from fulfilling these orders and interacting with the customers, economies of relationship relate to cost savings connected with the loyalty of one specific customer. If one interprets the number of different customers of a firm as a cost driver, then a high customer loyalty not only decreases transaction costs during configuration, but also reduces marketing efforts and can eliminate inefficiency in advertising. Economies of relationship reflect, in this sense, the experience of a company with a customer (Vandermerwe, 2000).

Increasing customer loyalty is one of the most often quoted objectives by managers implementing mass customization. The prerequisite for economies of relationship is the ability to establish long lasting customer relationships. Riemer and Totz (2001) describe customer loyalty as a result of switching costs, opportunity costs, and sunk costs based on psychological obligations of the customer (other sources of switching costs are technological and contractual obligations, see Jackson, 1985). The major sources of switching costs are trust and investment specificity. Direct switching costs increase due to the established trust towards the supplier, vendor or service provider and its capability to meet promised quality levels. Finding alternatives is made difficult by specificity of products or services. Additionally, if customer satisfaction is positively influenced by personalization, then uncertainty and opportunity costs increase as a defecting customer risks losing the net-benefits of the current relationship. Relationship specific investments of the customers could be based on the experience of a customer with a configuration tool, the knowledge about the modular structures of an offering, or the familiarity with a visualization tool. If customers can be persuaded to invest significantly into a specific relationship, then sunk costs increase (Riemer and Totz, 2001). Once the customer has successfully purchased an individual item, the knowledge acquired by the supplier during the product configuration represents a considerable barrier against switching suppliers. Even if a competitor possesses the same customization skills and offers a lower price, a switching customer would have to go through the procedure of supplying information for product customization again. Also, she is once again faced with uncertainties with regard to the quality and the producer's behavior.

Once lock-on has been achieved, the enterprise can stretch its brand into other revenue-generating opportunities with relatively low cost. The company has no acquisition cost and low marginal cost, because information, knowledge and relationships have already been established (Vandermerwe, 2000, p. 35). Cost saving potentials arise additionally from using the information from a first sale for further sales. While the first sale process is often rather time consuming and involves a high level of information exchange, and is thus cost intensive, additional sales can be performed faster and with greater ease. The resulting cost saving potential of economies of relationship can be seen as a special form of economies of scope. They result from a better "utilization" of the customer base (versus a better utilization of manufacturing resources in the case of traditional economies of scope). Using new Internet technologies to keep expenses level, the firm can draw on its existing customer base to produce additional value for customers at little or no extra cost. The flexible capabilities and the enhanced knowledge of the needs and desires of every customer provide the possibility to serve existing customers by new activities (Vandermerwe, 2000). From a transaction cost perspective, the expenditures and efforts resulting from interacting and communicating with a customer during the first buy (configuration, gain of profiling information etc.) can be used for further sales as well.

However, as mentioned before in relation with economies of integration, economies of relationship can be achieved only in most cases only within a framework of electronic commerce. Otherwise, handling customer related information and especially using this information for increased customer interaction and personalized communications will be not possible in most business-to-consumer markets.

## **5. The optimal extent of customer integration**

Three major factors influence the ability of a firm to profit from economies of interaction and relationship: the degree of interaction between the firm and the customer (or the extent to which the customer is integrated into the value creating activities), the extent of the relationship between the firm and the customer, and the point of postponement. The factors are connected with each other and will be discussed briefly in the following.

(1) The *degree of interaction* depends on the firm's infrastructure and its ability to interact with the customer efficiently. This is influenced foremost by the configuration system available, but also by the degree of modularity offered and therefore the possibility of reacting to the customer's interaction. The higher the expenditures and risks of the customization and configuration perceived by the customer, the higher the required degree of interaction. The characteristics of the product or

service being individualized have to be taken into account. The degree of customer interaction required is influenced by the relative price of the products and services, the possibility of using instruments to prevent bad investments (e.g. warranties, exchange policy, time of delivery, screening possibilities), the customer's experience with a product (e.g. second buy, product specific knowledge), its complexity (customization possibilities; product structure), and, finally, to a large extent by the quality of the Internet configuration system.

(2) *Extent of relationship*: The better a company manages to build relationships with its customers, the greater its customer knowledge will become – resulting in better possibilities to use this knowledge to foster efficiency and plan new activities more purposefully. An important influencing factor is the ability of the company to establish switching costs for the customer. Practices for this purpose include the use of proprietary (non transferable) user profiles, the establishing of network effects, the capability to impart trust, the ability to react to new needs, or the use of marketing communications to express the benefit of that relationship.

(3) Defining the *point or degree of postponement* settles somehow the trade-off between the advantages and draw-backs of customer integration. The postponement point defines the transition between order specific activities and pre-fabrication and thus the point of customer integration. Postponement expresses the number of stages in development, production, and distribution/sales that are delayed until a customer specific order is received (Duray et al., 2000; Waller et al., 2000). Postponement is not restricted to manufacturing activities or product components, but includes all elements of the relationship between the buyer and the firm (Wind and Rangaswamy, 2001). In doing so, we can differentiate several archetypes of customization (see Figure 2; other approaches are described by Lampel and Mintzberg, 1996; Mintzberg, 1988). The capacity to meet customer's expectations increases with an early point of postponement. While economies of integration due to reduction of inventory, elimination of capacity redundancy, reduction of fashion risk and distinction of over stocks rise with an early point of postponement, economies of scale decrease, and additional costs of coordination, complexity, and transaction increase.

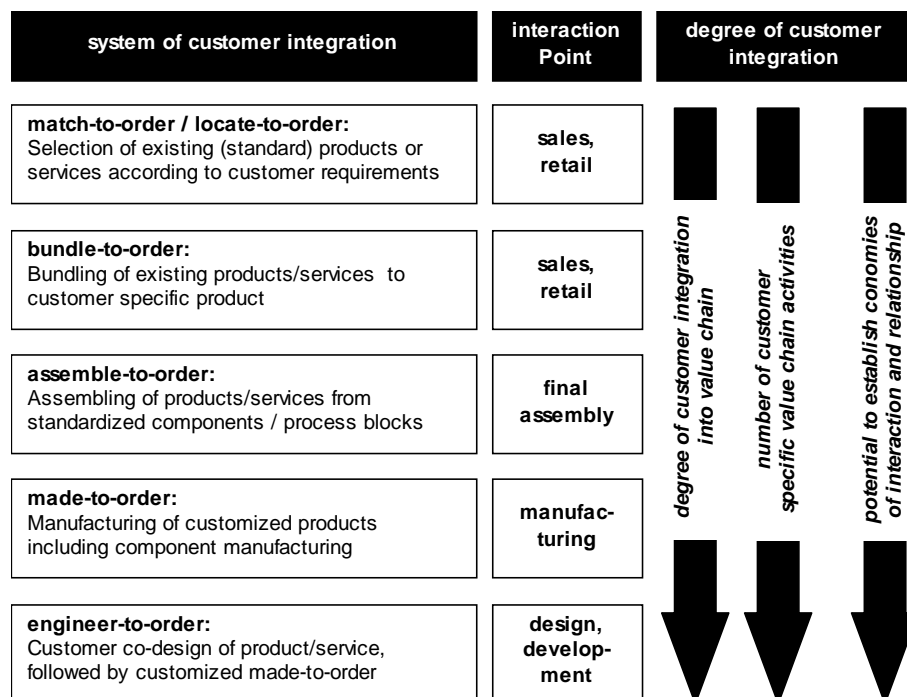


Fig. 2: Archetypes of customer integration

## 6. Implications for further research

While more and more companies are seeking competitive advantage by offering mass customized goods and services in order to get relief from price competition and the variety seeking behavior of customers, a more detailed assessment of the cost and value drivers of the connected business models is needed. In this paper we have deployed new kinds of economies connected with these new kinds of value creation. Economies of integration and economies of relationship complement traditional economies of scale and scope.

Many practitioners still think of customization and customer centric value creation only in terms of manufacturing and operations without considering the effects on the whole value chain. We agree with Wind and Rangaswamy (2001:17) that until now much attention has been given to the impact of customization on manufacturing. However, research into the impact of customization on other functions like marketing or design is just beginning. Knowledge about patterns, procedures and problems of consumers configuring goods and services on the Internet is limited, and best practices are not common in business. This should be a focal point for future research. There is also still a lot of research needed in order to transfer the tools and principles from the area of collective learning and knowledge management to a company that is no longer based on the manufacturing of products but on interacting with each single customer. Further attention has to be paid to establish tools and instruments to transfer the knowledge gained during the integration process into new competencies.

While mass customization is often discussed in connection with new manufacturing technologies, in this paper we have argued that it is information that is the main enabler and therefore that new information technologies are the major driver of mass customization. But new information technology is just an enabler. The real value drivers of mass customization are new kinds of economies. They are the principal factors when considering implementing a concept of mass customization based electronic commerce.

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