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Does mass customization pay? An economic approach to evaluate customer integration

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Keywords Mass customization, flexible manufacturing, customer integration, economies, cost and profit drivers

Abstract. The paper provides an integrated view of value creation in mass customization-based production models. While flexible manufacturing technologies are often seen as the main enabler of mass customization, we argue that modern information technologies play a similar important role. Their significance is based on enabling a distinctive principle of mass customization efficiently: customer integration into the production processes. The customer is integrated into value creation during the course of configuration, product specification and co-design. Customer integration is often seen as a necessity and source of additional costs of customization. However, we argue in this paper that customer integration may also be an important asset to increase efficiency and could pave the way for a new set of cost-saving potentials. We coin the term 'economies of integration' to sum up these saving potentials. Economies of integration arise from three sources: (1) from postponing some activities until an order is placed, (2) from more

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precise information about market demands and (3) from the ability to increase loyalty by directly interacting with each customer. By examining and structuring the economic principles of mass customization the paper will give insights into the benefits, but also the constraints of a mass customization strategy.

1. New models of industrial value creation and methodological background

Agile manufacturing, focused factories, lean manufacturing, customer relationship management and mass customization are strategies that have enjoyed increasing attention in the literature during the last decade (for further details on these approaches see Milgrom and Roberts 1990, Sahin 2000, Piller 2003). Despite different backgrounds and foci, these new concepts of industrial value creation share a common objective. They want to provide ways of enabling companies to increase cost efficiency continuously along the value chain while simultaneously increasing the ability to react to changing customers' needs stemming from heterogeneous market demands. In all of these approaches customers are seen as partners (and not only addressees) of value creation and are integrated into some of the firm's value-creating processes. According to the focus of this special issue of *Production Planning & Control*, we will concentrate on value creation in mass customization systems. Our intention is to present a model of value creation in mass customization systems. We will focus our analysis on the economic impact of customer integration. As we will discuss in more detail in the course of this paper, customer integration can be seen as a fundamental principle of mass customization. Our objective is to discuss how customer integration supports and enables the major promise of mass customization, which is to deliver goods and services that meet an individual customer's needs with near mass-production efficiency (Tseng and Piller 2003). We will present a structural approach to assess the economic impact of customer integration which is seen as a main principle of mass customization.

The background of our research is twofold. First, we conducted an intensive literature review of various areas of knowledge about mass customization, namely literature on customer interaction and configuration systems, literature on IT systems for mass customization, and literature on mass customization manufacturing. In addition, literature describing mass customization as a unique strategic approach or business model has been evaluated. We will quote the corresponding references to all areas within the discussion of the following section (see also Piller 2002, 2003, Franke and Piller 2003). Second, we used an extensive database covering information on more than 200 mass customization cases from industry to generate input for our structural approach. For the course of this paper, we have studied especially the business models and value-creating mechanisms of the 14 companies listed in table 1. As our objective is to assess the economic impact of mass customization, we concentrated on firms that are often referred to as a leading example, or chose companies that have been successfully carrying out mass customization operations for a longer period of time.

Table 1. Mass customization examples covered in case study research.

Company	Products	Markets
(1) Creo (www.creo-shoes.com)*	Fashion shoes	Worldwide (but mainly Germany and USA)
(2) Cmax (www.cmax.com)*	Fashion shoes	USA
(3) Dell Computers (www.dell.com)	PCs	Worldwide
(4) Dolzer (www.dolzer.de)	Men's (formal) wear	Germany
(5) Interactive Custom Clothes Company Designs (www.ic3d.com)	Jeans	USA
(6) Lands' End (www.landsend.com)	Khakis (trousers)	USA
(7) Lego (www.lego.com)	Comics, special toy kits (Mosaic product line)	Worldwide (major markets are USA, Canada and Germany)
(8) miAdidas (www.miadidas.com)	Sports shoes (soccer, running, basketball)	Germany, UK, Netherlands, Italy, Japan, Korea, USA
(9) NikeID (www.nike.com)	Sports shoes (design)	USA, Germany, Japan
(10) Reflect.com (www.reflect.com)	Cosmetics and body care	USA
(11) Selve AG (www.selve.net)	Women's footwear	Germany
(12) Sovital (www.sovital.de)	Vitamin products	Germany
(13) Timbuk2 (www.timbuk2.com)	Bags and luggage	USA, Canada (minor markets are Europe)
(14) Westbury by C&A (www.CundA.de)	Men's (formal) wear	Germany

*Ceased operation.

For each case, we interviewed managers in charge of the customization programme (often the CEO), and, if available, the managers in charge of manufacturing and customer interaction or customer service. The interviews were semi-structured and conducted in most cases face-to-face (otherwise by telephone). Our analysis is focused on business-to-consumer markets. However, many of our conclusions can be transferred also to business-to-business markets.

The remainder of the paper is structured as follows. In the next section we will discuss customer integration as a major principle of mass customization in more detail. After defining a common ground, we will present a model of value creation in mass customization systems in section 3. Economies of integration as a major part of this model and their sources are explored deeper in section 4. We will also discuss some of the main factors influencing the extent to which economies of integration can be realized in this section. The paper concludes with some implications for further research.

2. Mass customization and customer integration

Today's consumer markets are changing faster and consumers are more demanding than ever (Cox and Alm 1998). Thus, mass customization has emerged in the last decade as a solution for addressing the new market realities while still enabling firms to capture the efficiency advantages of mass-production (Pine 1993, Tseng and Jiao 2001, Piller 2003). Until today, mass customization was argued to be possible explicitly due to the capabilities of modern manufacturing technologies like flexible manufacturing systems and modular product structures, reducing the tradeoff between variety and productivity (Jiao and Tseng 1996, Åhlström and Westbrook 1999). However, flexible manufacturing systems are a necessary but not sufficient condition to offer customer variety without compromising on profitability (Forza and Salvador 2002). Manufacturing systems should be supplemented by information technologies (Dietrich *et al*. 2003) capable of handling the information flows and transaction costs connected to mass customization.

Compared to mass-production, mass customization is characterized by a high intensity of information (Piller 2002). Every transaction implies information and coordination about the customer-specific product design and is based on a direct communication between the customer and the supplier. Here, the capabilities of the supplier's solution space are turned into a specific customer order by using adequate configuration tools. Zipkin (2001) calls this process the 'elicitation' of a mass customization system. The supplier has to interact with the customer to obtain specific information in order to define and translate the customers' needs and desires into a definite product specification. This elicitation process is in many cases much more than an exchange of information but an act of joint cooperation and co-creation. Elicitation in mass customization systems is resulting in customer integration. 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 customer becomes a 'co-producer' respectively a 'prosumer' (Toffler 1970). The result is a system of co-creation, i.e. a company–customer interaction (social exchange) and adaptation for the purpose of attaining added value for both the supplier and the customer (Milgrom and Roberts 1990, Normann and Ramirez 1993). From a supplier's perspective, the customer is seen as a production factor fulfilling tasks that in a mass-production system are done internally (Ramirez 1999). However, within mass customization co-production goes beyond traditional approaches like getting clients to clean up their table in a fast-food restaurant or leaving the final assembly of goods up to the customer as is the case at furniture retailer Ikea. In a mass customization system, the main part of customer integration happens during the configuration or even design phase of a product. The extent of this integration may vary from the simple configuration of a computer from a set of predefined options, as is the case at Dell, to real co-design of products as Cmax offers, for example, in the footwear industry.

Customer–firm co-creation in the course of the elicitation process demands information systems being able to handle the intensity and complexity of interaction efficiently (Lee *et al*. 2000). In consumer markets, systems which are able to handle the increasing intensity of information in mass customization systems only became available with the advent of the internet. Flexible manufacturing machinery for efficient fabrication of a high variety of goods is, however accessible for many industries, already much longer. This discrepancy between the availability of sufficient information systems and systems capable to manufacture a relatively high variety at low costs may also explain the time lag between the long discussion of mass customization in the literature and its late implementation in practice. While the concept has been described in literature for decades (e.g. Toffler 1970, Davis 1987, Pine 1993), increased implementation of mass customization principles can only be found in the last few years. This observation is the starting point for our remaining discussion: mass customization is only possible if customer integration and co-creation processes are supported by adequate systems being able to reduce the high transaction costs

resulting from deep customer–firm interaction (Dellaert and Syam 2002, Duray 2002). However, customer integration is not only a major source of additional costs of mass customization, but at the same time also the source of additional cost-saving and cost-efficiency potentials along the value chain. We will explore the cost and value drivers of mass customization in more detail in the following section. Our idea is to oppose the additional costs of mass customization with mechanisms to counterbalance them, leading to a model of value creation in mass customization systems.

3. A model of value creation in mass customization systems

3.1. *Increasing willingness to pay*

Traditionally, customization is connected to the possibility of charging premium prices because of the added value of a customized solution meeting the specific needs of a customer, i.e. the increment of utility a customer gains from a product that better fits to his or her needs than the best standard product available (Chamberlin 1962). Products that require matching physical dimensions often allow a higher price premium than products that customize just on design patterns (Berger and Piller 2003). In the sports shoe market, for example, Adidas can charge higher premiums for its customized sports shoe brand 'mi adidas' (up to 50%) compared to the customized shoes of Nike (between 5% and 10%). Adidas not only offers a choice of numerous colours, but also to customize the shoes with regard to comfort, fit (exact measurements) and functionality (cushioning etc.). In contrast, Nike limits customization to the design (selection of colour options).

In this context it is important to note that 'mass customization' is not equal to 'customization'. To distinguish mass customization from (craft) customization, we emphasize the possible extent of the additional willingness to pay: only if the premiums asked for the customized solution do *not* lead to a change of market segments compared to providing the product in a mass-production system we will refer to mass customization. Mass customization implies '... that the same large number of customers can be reached as in mass markets of the industrial economy, and simultaneously they can be treated individually as in the customized markets of pre-industrial economies' (Davis 1987: 169). This is not the case with traditional customization approaches which are often leading to such a magnitude of additional costs that the corresponding premiums imply a change of customer segments. If we take as a defining element of mass customization that customer segments of former standard (mass) products have to be retained, management of the additional costs of customization becomes a strategically crucial element in mass customization.

3.2. *Additional costs of mass customization*

The additional premiums of mass customization (compared to traditional mass-production) are challenged by additional costs associated with this system. Basically, higher costs occur both in sales and customer interaction as well as in manufacturing. As discussed before, higher costs in sales stem from the elicitation and interaction with the customers. This includes not only investments in configuration systems and other information-handling equipment, but a firm has also to establish mechanisms to minimize the burdens of customization from the customers' point of view. 'If customers become frustrated or dissatisfied with the complexity, a ... customization strategy obviously would not be a competitive advantage ...' (Huffmann and Kahn 1998: 492). Corresponding actions demand investments in customer service centres, highly qualified staff, or trust-building promotion activities – leading to additional costs. Also, distribution costs are higher due to smaller lot sizes in delivery.

In manufacturing, costs increase due to a loss of economies of scale (specialization and standardization) in comparison to mass manufacturing. Higher set-up costs, costs for better qualified labour, an increased complexity in production planning and control, and more complex and detailed quality control are escalating the cost level. Additionally, inventory of components may rise, and higher capital investments in advanced flexible production units and appropriate information systems often result in additional machinery costs (the additional cost drivers of mass customization manufacturing are described in detail in the existing literature; see, e.g., Agrawal *et al*. 2001, Zipkin 2001, Piller and Stotko 2003, Reichwald *et al*. 2003).

3.3. *Mechanisms to counterbalance the costs of mass customization*

Due to high competitive pressures in many industries, even high levels of differentiation (i.e. customization) rarely justify *much* higher prices. Over-capacities and steadily increasing international competition lead to a growing market pressure which has transformed many sectors from sellers' into buyers' markets. Standards of technology and quality are constantly levelling out. To counterbalance the additional costs, various approaches are described in the literature on mass customization.

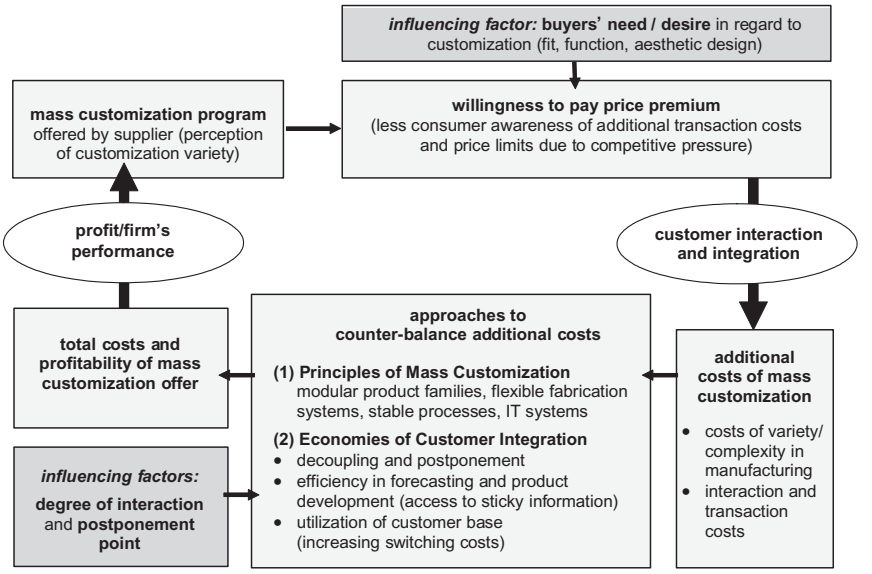


Figure 1. A model of value creation in mass customization systems.

They include an appropriate design for variety, product line planning (Morgan *et al*. 2001) and the use of a modular product family architecture (Jiao and Tseng 1996, Sahin 2000, Du and Tseng 2001). Mass customization is further characterized by defining stable processes, high variety production planning and control (Martinez *et al*. 2000) and postponement strategies (Feitzinger and Lee 1997, Van Hoeck *et al*. 1998). Finally, specialized information systems are used for configuration, manufacturing planning, order tracking, and relationship management (Lee *et al*. 2000). All these approaches aim to either reduce or handle the complexity of products, processes and information resulting from customized manufacturing and interaction with individual customers.

However, in addition to balance the additional costs by either implementing these principles of mass customization or by just asking higher prices (the traditional reaction to cope with customization-related costs), a third, supplementary, possibility exists. Integrating the customer during the course of elicitation in the value-creation process is not only a driver of costs, but at the same time also the source of new cost-saving potentials. We will call these cost-saving potentials 'economies of integration'. They are based on three different sources to reduce costs: (i) on postponing some activities until an order is placed, (ii) on more precise information about market demands and (iii) on the ability to increase loyalty by directly interacting with each customer. The extent of economies of integration is influenced by two main factors, namely (a) the setting of the postponement point and (b) the degree of customer interaction. These factors and the sources of economies of integration will be discussed in more detail in the next section. Figure 1 summarizes our reasoning up to this point.

4. Sources and drivers of economies of integration

We have coined the expression 'economies of integration' before to describe cost-saving potentials stemming from the direct interaction between a supplier and its customers. Economies of integration go beyond the differentiation advantages of customized manufacturing which are expressed in the price premium. They represent the efficiency when a firm gains deeper knowledge about its environment and establishes value processes that eliminate waste on all levels. 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, economies of integration can generate increasing returns. They are formed by a bundle of cost-saving potentials consisting of three major sources:

(1) By decoupling the value chain into an order-specific and a customer-neutral part, cost-savings arise from the postponement of activities until an order is placed. By doing so, a firm wins certainty and prevents costs of misplacement of activities due to imprecise planning information (see subsection 4.1 for further details).
(2) By integrating the customer into value creation, a firm gets access to so-called 'sticky information' (von Hippel 1994). The aggregation of this

customer information to more precise market knowledge increases the efficiency of market research and product development activities (subsection 4.2).

(3) By using the course of customization to increase switching costs for the customer, a firm builds stable relationships with its clients, allowing a better utilization of its customer base ('re-use' of existing customers for additional sales). Thus, costs for marketing activities and customer acquisition can decrease (subsection 4.3).

We will analyse and describe these three fields in more detail in the following. In the last paragraph of this section (4.4), we will also give some indications on factors influencing the possible extent of economies of integration.

4.1. *Decoupling and postponement*

First, economies of integration are the result of the build-to-order approach connected to mass customization. Build-to-order means postponing some stages of fulfilment until the order has been placed (manufacturing on demand). 'Postponement means that companies delay production, assembly, or even design until after customer orders have been received, which increases the ability to fine tune products to specific customer wishes' (Van Hoeck *et al*. 1998: 33). This implies splitting the fulfilment system into a standardized and customer-specific part (Feitzinger and Lee 1997, Van Hoeck *et al*. 1998, Duray *et al*. 2000). The so-called decoupling or postponement point expresses the number of stages in development, production and distribution/sales that are delayed until customers specify their individual product configuration and place a corresponding order. Information on the output of the configuration (elicitation) process is the planning input for the following customized manufacturing, assembly and delivery steps. While these processes are cost drivers as discussed above, they are also the basis for economies of integration in regard to decoupling and postponement. If manufacturing and assembly are performed on-demand instead of on-stock, savings may be possible in various fields:

- *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 development costs (product flops).
- *Capacity utilization and stability*: no bullwhip-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 discounts at the end of a season; opportunities for better channel management, reduction of error costs.

The savings from these effects can be huge. For the apparel industry, cost-savings up to 30% are reported. These result from the prevention of discounts and overstocks on the one hand and the reduction of the forecasting (fashion) risk on the other. Sanders (2001) calculates that in the apparel industry today almost US$300 billion are wasted annually due to erroneous forecasting, heavy inventory, fashion risks and lost profits as a result of necessary discounts. This amount provides an enormous opportunity to counterbalance additional costs of mass customization.

4.2. *Access to sticky information and generation of customer knowledge*

While the first source of economies of integration is recognized rather widely as a beneficial effect of mass customization, a second source is less well known. It is based on the aggregation of customer information in order to get access to more precise market information. The self-configuration by the buyer allows access to 'sticky local information' (von Hippel 1994, 1998):

> We define the stickiness of a given unit of information in a given instance as the incremental expenditure required to transfer that unit of information to a specified locus in a form usable by a given information seeker. When this cost is low, information stickiness is low; when it is high, stickiness is high.
>
> (von Hippel 1994: 430)

Sticky information originates in location-specific costs like technological and organizational activities of decoding, transmitting and diffusing 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. Many customers are not able to describe their needs precisely and are therefore unable to transfer their wishes into a product specification that allows the company to build a customized product or to 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 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. Modern interaction and communication technology is a major enabler of this

condition. Design tools and configurators should be able not only to design a customized product from a functional point of view but also have mechanisms to explore a customer's demand set. Using these tools, customers can often specify their products implicitly (von Hippel 2001).

By transferring customer needs and wishes into customized products, a company gains access to the sticky information and can transfer it to explicit knowledge. By aggregating this knowledge, the company can generate better market research information and more accurate forecasting concerning customer needs.

This is especially true when the firm (still) serves mass markets additionally (Kotha 1995). For the portion of business that is (still) manufactured on stock, 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 improve forecasting accuracy of products made to stock. In regard to this source, economies of integration are represented by reducing (traditional) market research costs, the prevention of market research biases (like panel effects) and the gain in information quality due to the access to implicit information. Additionally, new product development and continuous improvement can benefit substantially from such user information.

One firm that has installed mechanisms to explicitly harvest this information on a regular basis is Reflect, a Procter & Gamble subsidiary. Reflect is offering customized cosmetics both on the internet and in its retail outlets. Using interactive software, customers create their own cosmetic line, mix and match various options like colours, scents and skin-care preferences to create a unique product. For P&G, Reflect was reported in interviews between its management and one author of this paper to be a very efficient market research tool–saving the mother company a large sum of investments in traditional market research. Reflect acts as a 'life panel' for all P&G cosmetics operations. 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. Reflect's customer base contains more than a million profiles of customers creating their own cosmetics and thereby formulating dermatological needs, evaluating new scents, bundling variants, choosing packages and, thus, eventually co-creating new products.

4.3. *Efficient utilization of the customer base*

Economies of integration can further be based on cost-savings connected to increasing customer loyalty resulting from customization. If one interprets the number of different customers of a firm as a cost driver, then high customer loyalty not only decreases transaction costs during configuration, but can also reduce marketing efforts and eliminate inefficiency in advertising. From a transaction-cost perspective, the expenditures and efforts resulting from interacting and communicating with a customer during the first purchase (configuration) can be used for further sales of the same and additional products as well (Vandermerwe 2000). Economies of integration are, in this sense, a special form of economies of scope (Peters and Saidin 2000), resulting from a better 'utilization' of the customer base (versus a better utilization of manufacturing resources in the case of traditional economies of scope). Once a customer has logged onto a supplier, the enterprise can stretch its offerings into other revenue-generating opportunities with this customer at comparatively low cost. The company has no further acquisition costs and low marginal costs, because information, knowledge and relationships have already been established (Pine *et al*. 1995, Vandermerwe 2000).

While this effect is not mass customization specific but the intention of every effort to stimulate customer loyalty (e.g. frequent-flyer programmes), we argue that customer integration as a result of mass customization has special capabilities to intensify the relationship between a supplier and its customers and, thus, to increase customer loyalty. Customer loyalty can be seen as a result of switching costs, opportunity costs and sunk costs based on technological, contractual and psychological obligations faced by a customer (Jackson 1985, Riemer and Totz 2003). All sources of switching, sunk and opportunity costs are based within a mass customization system on the interaction with a customer during the course of integration: *switching costs* increase due to the established trust towards the supplier and its capability to meet promised quality levels. Finding alternatives is made difficult for the customer by the specificity of individualized products or services. Switching costs can further be facilitated by the use of proprietary user profiles that cannot be transferred to an alternative supplier, the establishment of network effects, the capability to convey trust, the ability to react to new needs, or the use of marketing communications to express the benefit of that relationship. *Sunk costs* (relationship-specific investments of a customer) could be based on the experience of a customer with a configuration tool, or the knowledge about the modular structures of an offering. If customers can be persuaded to invest significantly in a specific relationship, then sunk costs increase. Additionally, if customer satisfaction is positively influenced by customization, then a customer's *opportunity costs* increase as a defecting customer risks losing the net benefits of the current relationship (Riemer and Totz 2003). Concluding, due to customer integration a mass customizer may find it easier

to build customer loyalty and to increase its revenue per customer than a mass producer and may also have a higher efficiency when doing so.

4.4. *The optimal extent of customer integration*

Economies of integration arise from different sources as discussed in the previous paragraphs. However, not all companies will be able to draw profits from these saving potentials to a similar extent, regardless of whether they have already realized the existence of these effects. Companies that are interacting intensively with their customers and are offering them a wide range of integration possibilities may have better possibilities to realize economies of integration, but may also suffer from higher transaction and manufacturing costs.

The comparison of the sports shoe manufacturers Adidas and Nike provides a good example for this tradeoff. Both companies have entered mass customization; however, they follow a quite different approach (Berger and Piller 2003). Adidas is offering a full range of customization options in regard to fit, functionality and aesthetic design. On the contrary, Nike limits customer integration and feedback as much as possible by just offering the choice between different colours of a shoe's components. As a result, the degree of product, process and information complexity – and thus costs – is much higher at Adidas compared to Nike. However, Adidas is able to capture important market trend information from their individual customers and has much higher retention rates for the customized products than Nike. Also, the consumer's willingness to pay is significantly higher at Adidas. So what is the optimal extent of customer integration? Customer integration – and thus also the ability of a firm to profit from economies of integration – is influenced by two related factors: (1) the degree of interaction between a customer and the supplier, and (2) the degree of postponement.

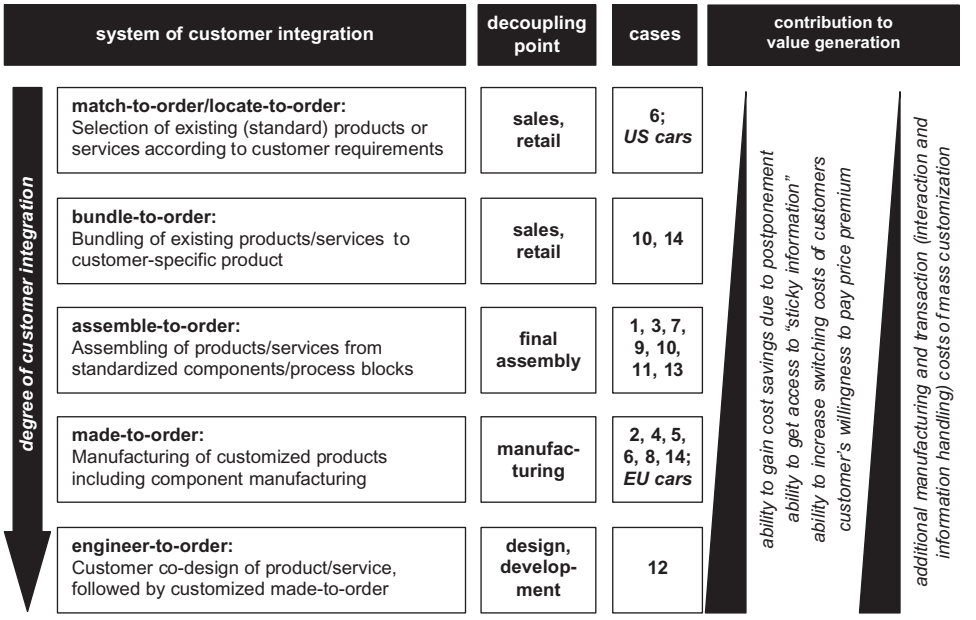
The degree of customer interaction is influenced by the characteristics of the good being individualized: one characteristic is its complexity, which can be divided into the technical (objective) variety. This includes customization possibilities and the product structure – and the perceived complexity by the customers. The latter is influenced by the customers' experiences with the customization process (e.g. straight re-buy, product-specific knowledge). Other important characteristics are the expenditures and the risks of the customization process from the customers' point of view. Especially in consumer markets, customers often do not have sufficient knowledge for the definition of the product specification which corresponds to their needs. As a result, the configuration process may last too long and customers may experience an increasing uncertainty during the transaction process. Implementing adequate instruments to build trust of prospective customers like warranties, customer care centres or brand reputation is a major driver of additional costs connected with mass customization (see also subsection 3.2 above).

Defining the degree of postponement somehow settles the tradeoff between the advantages and drawbacks of customer integration. Bringing the degree of interaction and the degree of postponement together, we can differentiate several archetypes of customization, as shown in figure 2 (similar approaches are described in Lampel and Mintzberg 1996, Duray *et al*. 2000). The archetypes of figure 2 can be illustrated by our case examples as presented in table 1 above. In a match-, locate- and bundle-to-order system, manufacturing operations are not involved in mass customization ('virtual build to order'; Brabazon and MacCarthy 2003). Customization is delivered by sales and retail activities. It is important to remember that postponement is not restricted to manufacturing activities or product components but includes all elements of the relationship between the buyer and the firm (Wikström 1996, Wind and Ramaswamy 2001).

An example can be drawn from comparing the US and continental European car industry. The US car industry is still dominated by mass-production. Most cars are made-to-stock and picked from customers just 'off the lot' at a dealership. Thus, locating a car that matches exactly the desires of one particular customer within a network of dealers is already considered customization in the US automotive retailing industry (Agrawal *et al*. 2001). Contrariwise in continental Europe, where most cars are made-to-order after a customer specified his or her new vehicle at a dealership. While US car manufacturers benefit from economies of scale and stability within production, they carry heavy costs due to inventory and discounts to reduce over-stocks. The European car industry does profit from economies of integration here. European manufacturers also have better access to customer (driver) data and, thus, access to 'sticky' information. However, interaction systems and information integration between retailers and manufacturers have to be much more advanced in Europe. And European customers have to wait several weeks or even months for their new car to be delivered – unacceptable to most US customers.

5. Conclusion

In the long run only those mass customization systems will be successful that manage the tradeoff between the benefits and costs of customer integration sufficiently. In this paper we have presented an approach for a



Position of mass customization case examples from table 1: (1) Creo, (2) Customatix, (3) Dell, (4) Dolzer, (5) IC3D, (6) Lands' End, (7) Lego, (8) miAdidas, (9) NikeID, (10) Reflect, (11) Selve AG, (12) Sovital, (13) Timbuk2, (14) Westbury by C&A.
Note: Companies quoted more than once follow different customization programmes simultaneously.

Figure 2. Archetypes of mass customization.

better understanding of this challenge. We coined the term 'economies of integration' to provide a measure for the benefits of customer integration as a major principle of mass customization. Understanding the sources and possible extent of economies of integration can contribute to counterbalance the additional costs of customization. From a managerial perspective, economies of integration urge managers to conceptualize and implement strategy in new ways. It is very important, though, to remember that economies of integration express cost-saving *potentials* but are not given perse. Managers therefore have to understand the processes and try to identify these cost-saving potentials.

For mass customization researchers economies of integration open the field to an important area of future research: the quantitative empirical evaluation of mass customization and customer integration. Empirical research in the field of mass customization is dominated by case studies and small samples, or very broad approaches including all kinds of flexible manufacturing systems. With the growing interest in mass customization and its implementation in various industries, sufficient data should be available in the near future to embark upon research which quantifies the cost and value drivers of mass customization. However, before doing so, companies have to establish measures and ratios to report the different outcomes of a mass customization system. This task is extremely urgent as no accounting system has thus for been able to show the economic benefits of customer integration (and thus to motivate managers to take mass customization into account).

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