

Doctoral Thesis

Mass Customization

Masová Kustomizace

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ABSTRAKT

V dnešní době vstupují firmy do digitálního věku. Informace jsou sdíleny po celém světě a nové výrobní strategie musí být implementovány za účelem zvýšení šance přežití v turbulentní době, kdy poptávka zákazníků se jen těžce odhaduje.

Masová kustomizace je strategií, která integruje zákazníka do dodavatelského řetězce za účelem výroby dle požadavků zákazníka. Tato strategie má vliv na celý výrobní podnik. Výrobní procesy jsou spouštěny, dle požadavku zákazníka. Firma si musí vybudovat a udržovat vztah s jejím každým zákazníkem kvůli identifikaci zákazníka a jeho požadavků na výrobek.

Vznikají potřeby po nových informačních systémech, které umožní integraci zákazníka do dodavatelského řetězce a budou ho podporovat při návrhu a objednání jejich produktů. Další systémy umožňují sledování produkce a identifikaci každého produktu uvnitř nebo vně výrobního zařízení.

Tato práce definuje nový pohled na problematiku masové kustomizace podle bodu zásahu zákazníka (Customer Intervention Point – CPI) do výrobního procesu. 366 firem z 11 odvětví bylo analyzováno za účelem nalezení specifického CPI pro každé odvětví.

Klíčová slova: CPI, masová kustomizace, self-service, aktivní výroba, flexibilní dodavatelský řetězec

ABSTRACT

Nowadays companies are entering the digital age. Information is shared over the globe and new manufacturing strategies have to be deployed in order to survive in turbulent time, when the customer's demand is hard to predict.

Mass customization is strategy that integrates customer into the supply chain in order to precisely produce what customer wants. This strategy has an influence on the entire company. Every customer now triggers the entire production processes. The company has to build and maintain relation with every customer in order to identify his or her needs and product requirements.

There is a need for new types of information systems. Those systems allow integration of the customers into the supply chain and support them to design and order their products. Other systems allow tracking of the production and identify every product inside or outside production facility.

This thesis defines a new point of view to the mass customization based on Customer Intervention Point (CPI) of the production process. 366 companies from 11 different industries were analyzed in order to identify a specific CIP for each industry.

Keywords: customer intervention point, CIP, mass customization, self-service, agile manufacturing, flexible supply chain

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1 INTRODUCTION

Global economy is changing the way how people are living. We are living in a special time of a shift to a new paradigm, where totally new customer's requirements have to be fulfilled in order to maintain old customers or gain new customers. New legislation allows global competition and there are hardly any borders for global competition. A small local chinese company is a global competitor to a traditional american producer. Nowadays there are no geographical barriers. The only barrier is how to fulfill customers' requirements. Proactive and dynamic companies stay in a business.

Same as in the nature, where most adaptable species survive, in global competition only the most adaptable companies have a chance to survive. Since the global competition is cruel, no mistakes are tolerated and even one single mistake could destroy a traditional company, which was in business for years.

The customer is again placed in the middle of interest of the company. In the last the few decade's new production strategies were implemented to satisfy customer's needs. Since late 18th century there are new production approaches in the United States in direction to specialization in order to speed up and increase quality of production. Those days the US is becoming the leading manufacturing nation. This first place was then even improved by the implementation of assembly lines.

Deployment of assembly lines and the right management style allowed for example to grow a Bat'a company in Zlín from a two men company to a global leader in the shoe industry. Assembly lines became a good practice and were implemented worldwide. Since almost every company used an assembly line no competitive advantage was created and dynamic companies were searching for new trends. During the end of the last century companies focused on quality and process optimization. JIT, Kanban, TQM, Process Re-engineering were new methods implemented by the new global production leaders from Asia.

According to current business models, companies are able to produce a huge quantity of products for a low price (and a low match of real customer's needs) or produce a custom high quality product for a high price. What is the next stage? Better quality? Cheaper product? Fast delivery time? The modern customer does not allow any compromises. He / She requires a combination of both approaches. High quality, custom made products, sold for a low price with a fast delivery time. This thesis describes mass customization as an answer to new customer's need.

This strategy will allow companies to be competitive in a global market and gain new local and global customers.

2 ACTUAL STATE OF RESEARCHED TOPIC

Researches are aware of the changes in the global competition. Mass customization, the term that was first time mentioned in the literature in late 80's, is becoming a common term for today. Although the customers are not aware of this term, many producers allow the customers to enjoy benefits of this new production strategy.

Mass customization depends on several criteria, which have to be fulfilled in order to implement mass customization strategy and integrate the customer to the supply chain, which is changed to a demand chain → chain driven by the customers. New global management paradigm, digital economy, information systems and the change of the behavior between customer and producer create a perfect condition for mass customization.

2.1 Global Management Paradigm

Prof. Zelený [25] defines ten dimensions of Global management paradigm: Horizontal corporations, Reengineering of the processes, Mass customization, Autonomous Team or cell, Customer integration, Intracompany markets, Supplier integration & co-location, Elimination of trade-offs, Open book management and Corporate kinetics.

Mass customization as mentioned in this thesis will describe a new markets, where the entire supply chain is integrated in order to serve a single customer with its unique needs. Prerequisite of a modern company is the integration of customers [Figure 2-1]. Therefore internal processes of a company as well as external processes with suppliers need to be adapted.

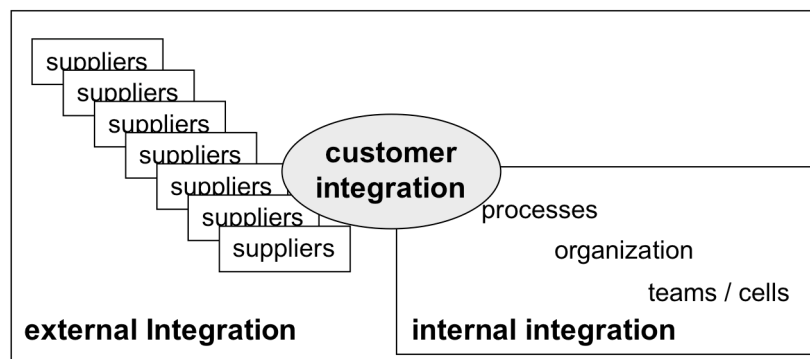


Figure 2-1 Internal, External and Customer integration

The integration of customers requires changes over the entire supply chain or network. Changes are necessary inside and outside the company. All connections between the suppliers, logistic partners and all together working companies have to be solid and tuned in order to be able satisfy the customer's needs and compete with other companies or networks on the market. External and internal integration is necessary step forwards mass customization.

2.2 Digital Economy

The economy for the age of networked intelligence is a digital economy. In the old economy, information flow was physical: paper documents, cash, checks, invoices, bills, reports, face-to-face meetings or telephone calls.

In the digital economy information in all forms becomes digital, reduced to bits stored in computers and moving at the speed of light across networks. The factory of today is as different from the industrial factory of the old economy as the old factory from the craft production that preceded it.

Products themselves have knowledge content and they are self-aware (modern hi-tech use RFID technology to communicate). There are smart clothes with chips in the collars; smart maps that tell a trucker's location and automatically change tire pressure according to the weather, smart houses to manage energy. Products communicate with other products, even with the customer.

Tapscott [23] defines twelve themes of digital economy: knowledge, digitization, virtualization, molecularization, integration/internetworking, disintermediation, convergence, innovation, presumption, immediacy, globalization, and discordance. These twelve themes describe well the new conditions and challenges. New economy is driven by its own flexibility, pressure on new innovation and management techniques. New management approaches have to be able to handle new global competition benefiting from the global digital age, where virtually every company could be connected to another one and only the one breaking element is the physical move of the product.

Digital Economy created necessary conditions for perfect competition. Atomicity, homogeneity, perfect and complete information, equal access and free entry to the market are fulfilled. In the digital age all information is shared around the globe, and no hiding is possible. All ideas, processes and products are reverse-engineered in order to compete with competitors. The product's live cycle is dramatically shorter and predictions of customer's needs are difficult. There is only one possibility to fulfill customer needs → incorporate the customer into the production process and let him decide what will be produced.

In order to include the customer in the production process, the company and its customer have to enter the age of digital economy where fast and efficient communication and flexible production is possible.

2.2.1 Networking

A modern company is not alone in the supply chain and doesn't satisfy customer's needs alone. Every company is part of a network and the network is as strong as the weakest part – the weakest company. Knowledge is not anymore stored inside by one company but is shared over the entire network [18]. Some companies like Honda focus their effort to enhance their performance not only of their internal processes, but they improve the performance of their suppliers by implementing Hondas BP (Best practices, Best process, Best Performance). Honda's experience shows that improving the entire network has benefits for every company connected to this network.

Virtualization moved the entire production process to the next stage. Each process is separated in logical parts, which can be performed by different companies. Networks of cooperating companies focusing on their core businesses allow high performing networks, which gain competitive advantages and thus more market shares. Those networks are built strictly to perform activities for specific product and each company could be a member of more networks.

2.2.2 Internet

The Internet [32] is the worldwide, publicly accessible network of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). Former military network (ARPANET) later university network (NSFNet) reached the current commercial state with second generation of Internet-based services - such as social networking sites, wikis and communication tools. Those services support the principle of mass customization and offer technological feasibility for mass customization.

Internet enables communications Business-to-Business (B2B), Business-to-Employee (B2E) and Business-to-Customer (B2C).

Implementation of new Internet Protocol IPv6 allows addressing more independent units. IPv6 created new digital world where smart products could be connected and communicate over the Internet. Internet provides a company with a new way of communication. Each employee, product, or part of infrastructure could communicate and create an environment with added value.

Internet is a phenomenon of the year 2000, many startup companies went bankrupt (due to high expectations which were not fulfill), and many are successful (for example DELL). Ignoring the power of Internet might lead to the loss of competitive advantages. Internet should be rationally implemented into each and every communication system, where it make sense in order to support the communication inside the entire company and even the entire supply chain. Internet is a future communication tool und should be treated with respect.

2.3 Information Systems

During the last years information systems gained importance and now you cannot find a company, which could be managed without them. In the age of mass customization a company has to store and process information of every component, configuration and the customer. Information technology allows the customer to enter the design phase of the product and to specify the product requirements. According to this requirement the entire production process is adjusted to process orders in the most efficient way.

Carr [7] predicts that IT doesn't create any competitive advantage in digital economy, where IT is an infrastructure technology freely available. Infrastructural technologies offer far more when they are shared and operate more efficiently. There is no need for the company to develop their own operation system and application, which would cost millions of dollar each company. Companies could purchase those commodities.

When IT doesn't matter, what exactly does create competitive advantage? It's not any more the IT but the use of IT to support the company's internal and external processes. IT systems for mass customization require internal efficiency and optimization, external flexibility and cooperation as well as a user-friendly approach to the customers.

Nowadays a large number of ready-to-use information systems exist, including their integration (interfaces) to other systems and transport medium. Many software development companies produce frameworks to enable rapid development and integration of the information systems. Internet with its transportation protocols supports unlimited cooperation in the digital world.

The ability to manage information becomes one of the corporate advantages. Companies are implementing information systems to provide better service to the customers. DW, OLAP, DSS, MIS, EIS, etc. are the abbreviations of information systems, which support the company's processes. A company implements Data Warehouse (DW) to store huge amount of data, which are static and provide company information about past results. DW provides several views of data within a decent respond time. On-Line Analytical Processing (OLAP) converts static data to strategic information and provides analysis of stored data in DW [15].

Decision Support Systems are applications which provide opportunity to model specific not only manufacturing situations. DSS combines company data stored in DW with mathematical models to provide answers for specific questions. Management Information System (MIS) provides middle management with necessary data for decisions in real time. MIS is customized for the needs of groups of special users and allows managers to plan, coordinate, manage and control. Executive Information System (EIS) as well as MIS provide a view of the company information. However, the level of aggregation is higher and the main user of EIS is the top management.

In mass customization a company allows its customers to take an active part during the design phase, during the production and delivery of the product. Customers are connected to the information system of the company in order to enter the necessary requirements of their product. They are able to track the production progress and delivery.

There is a need for new communication channels in order to integrate the customer in the value chain. Self-service solutions allow customers to communicate the product specification. Advisory systems support customers to translate their wishes and needs in technical specifications. Virtual design and testing systems ensure the quality of customer designed products.

2.3.1 Implementations strategies

Information systems are implemented according to company requirements. Information systems support established processes and provide them with efficiency. Proper information systems provide the company the information basis for decision-making and future optimizing.

Traditional companies implement ERP (Enterprise Resource Planning) systems in order to focus their processes and their information systems to themselves. Only internal information are collected and elaborated. Internal processes and production is optimized and almost perfect. But there is missing link to the suppliers and customers.

Modern companies implement additional CRM (Customer Relationship Management) systems, in order to connect the customer information with the company's database and processes. These companies coordinate the customer information with company's information and optimize the production and related processes accordingly. Modern companies gain a competitive advantage due to knowledge of the customer and his needs. Close connection to the rest of the supply chain is missing.

Another approach is the implementation of SCM (Supply Chain Management) systems. This approach gives competitive advantage due to mastering of the supply chain processes and delivering products fast and in a low price. Therefore the close connection to the customer is missing.

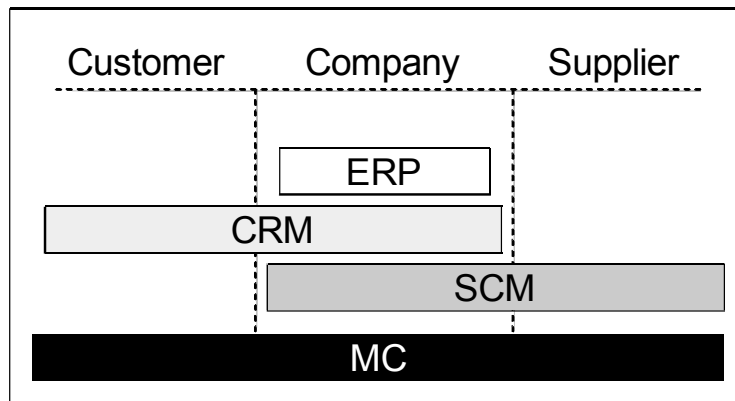


Figure 2-2 Mass customization strategy – connecting customers and suppliers

Future companies do focus their strategies to every piece of competitive environment. Customer information, supplier information and company-specific information are put together in order to optimize all processes in this particular supply chain. Every member of the supply chain has now the same access to the information and could take appropriate action based on that information. This strategy is a strategy of Mass Customization (MC) [Figure 2-2].

2.3.2 Configuration & Advisory Systems

Current available information systems are not able to integrate the customer into the value chain. Therefore, there is a need for a new kind of information systems. These systems should provide a customer with a framework to design, test and order products, which will satisfy their specific needs.

Blecker [3] describes several classifications of configurators. Configuration & advisory systems support customers to “translate” their needs into a product specification. In addition, the customer’s design, availability of production parts, production capacity and delivery possibilities are tested. During the configuration phase the entire supply chain (capacity & supply availability) has to be checked in order to confirm the order, price and delivery time.

The integration of those systems is necessary for successful implementation of mass customization. Configuration and advisory systems are enablers of mass customization as they allow direct interaction between customer and company [22]

The configuration processes require new tracking solutions. In the modern company every movement of inventory have to be tracked. RFID is a state of the art technology for mass customization.

2.3.3 Computer design, testing and manufacturing

Modern technologies, such as CAD (Computer-aided design) systems, CAE (Computer-aided engineering) allow specialists to design new products. These products are designed, optimized, validated and tested in the virtual world. Those systems generate a product specification and manufacturing steps necessary for CNC machines to produce those products. Those powerful tools can be delivered to the customer in order to design his special customized solution.

2.3.4 RFID

RFID technology, the successor of bar codes, enables total control of every product movement everywhere. RFID technology is used widely across almost every industry. Usage of RFID varies; it is for example used for access & security systems, for item tracking and inventory management. RFID provides physical objects with an intelligence that allows them to communicate with new generations of business applications that manage supply and demand in real-time. RFID revolutionize how we manufacture, buy and sell products. RFID enables producers to meet customers' needs more quickly and directly [29].

Implementation of RFID over the entire supply chain will increase the awareness of the product and staff movements. This monitoring provides necessary data for future analysis and process optimization.

2.4 Change of behavior Producer - Customer

Nowadays the customer is not anymore a passive recipient of the services or products. Customers communicate their requirements and require production based on their design in short time for a reasonable price. "Following Joe" is not anymore part of the customers' culture. Customers require special products and communicate their wishes.

Modern companies take care about their customers. CRM solutions gather all information about them. Companies realized that focusing on production processes without knowing the customer does not help the company to succeed in the long term.

The communication channels between producer and customer are changing. Traditional stores are almost history. There are no personal assistants serving and helping the customer. All this communication is supported by the communication technology. Phone call centers, ATMs, automated kiosks, mobile-based solutions and communication over the Internet are in place. New communication is based on new technology.

2.4.1 Self-service

The term Self-service is used when a customer communicates directly with a company's system without any interaction with employees. Researchers have only recently begun to explore the role of the computer technology in the delivery of services. Some have suggested that the traditional interaction between customer and employee is replaced by a virtual interaction between customer and information system, where the physical presence of seller and buyer is not anymore required.

MEUTER [17] presents self-service technology usage. The most common are Internet information search, Automated Teller Machines (ATM), automated phone banking, Internet shopping, package tracking, automated hotel check-out, automated car rental, automated airline ticket and many more.

The main reason for using self-service systems is to reduce the costs of the respective service as many of the processes are fully automated. This automation was possible only by implementing modern information systems. Modern technology triggers the processes based on the customer interaction.

2.4.2 Self-service channels

Telephone Self-service has been around since 1970's, when the first Interactive Voice Response (IVR) systems were introduced. They guide customers through the system and provide them with necessary information.

Nowadays new Internet based self-service solutions are introduced, which allow customers directly interact with the company's information system over the Internet interface. Due to the good Internet connectivity customers can ask for the service from any place at any time. Self-service [31, 17] provides 24/7 services at lower cost.

Several communication channels can be used [Figure 2-3]:

- via telephone, by typing in numbers on a touchtone phone or speaking to the system directly
- via new generation mobile devices, which are capable of Internet connection
- through a company's website, which can allow customers to enter directly they orders
- through SMS messaging
- through a kiosk, which is providing specific services.

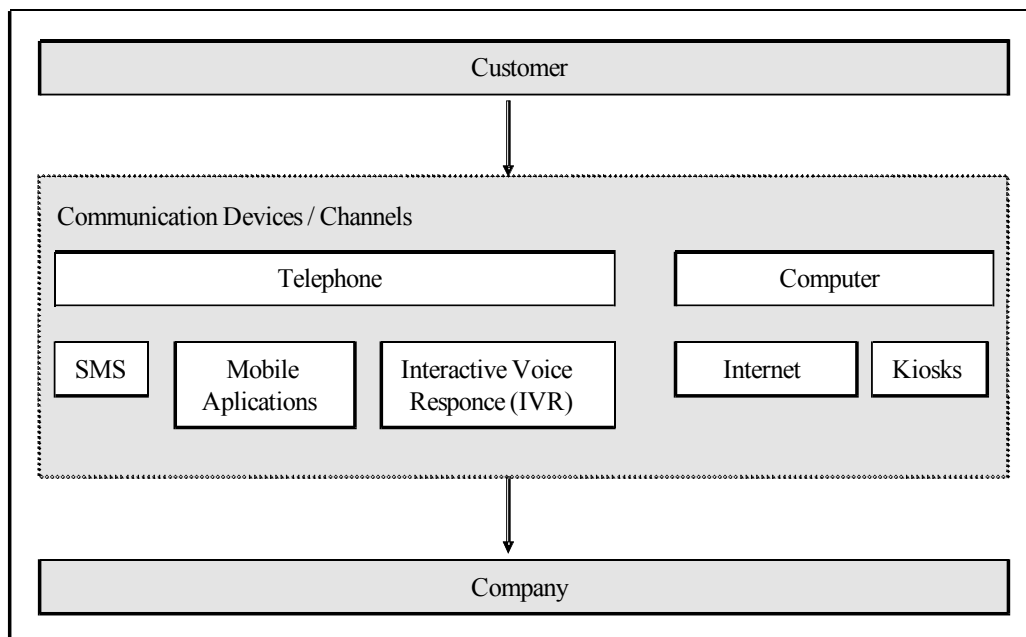


Figure 2-3 Communication channels for Self-service

Figure 2-3 describes the self-service channels. The network (telephone / Internet) is used to transfer the customer's requirements into the company's information system and to trigger the processes. Mobile phones provide connection to manage bank accounts, get travel information, news and so on. Mobile interaction could be SMS based or full-featured applications for mobile phones could be used. More difficult self-service operation like advanced e-banking operations, shopping, flight booking are done over the computer connected to the Internet.

2.4.3 Interaction between customer and company

Self-service integrates customers into the supply chain (where all product specification is done). Digital economy, e-commerce and self-service provide necessary bases for mass customization.

All communication between the customer and company is unique. The interaction allows to build a 1:1 relation in order to better understand and satisfy the customer's needs.

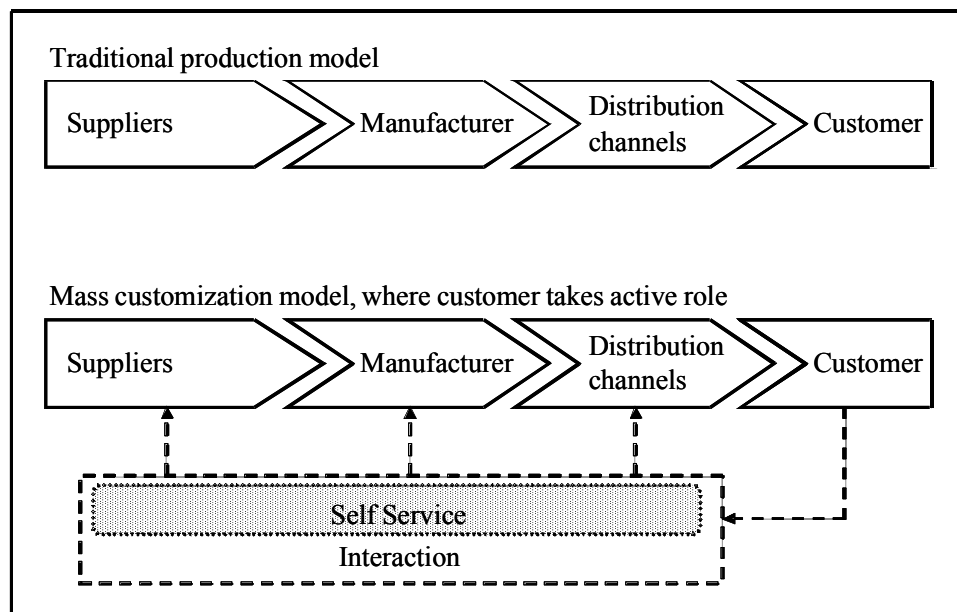


Figure 2-4 Self-service as an interface between customer and company

The level of customer involvement is adequate to the level of mass customization, e.g. E-commerce (B2C) systems, allow customers to interact in distribution channels area, but for an effective implementation of mass customization self-service interaction over entire supply chain is necessary as described in Figure 2-4.

2.4.4 Global competition to satisfy customer's needs

The difference between local and global competitors is slowly fading. A small local producer is having global customers and can be a competitor to a traditional well-established big company. Customers have different desires and they are looking for a company to satisfy them. Many customers require a “perfect fit” between their requirements and products or services. Many of those customers are willing to invest time and pay something extra in order to receive “perfect” products.

Our environment is changing constantly and supports the globalization. The following factors are enhancing global competition:

- **Global logistic services:** DHL, UPS, and many more logistic companies created a global delivery channel suitable for global competition. The products can be shipped through these logistic partners for a decent price and fast delivery. There is no need for own global logistic services since those are already in place.
- **Global trading platforms:** Virtual market places like E-bay or Alibaba created new trading places where producers are able to present their products. These market places include payment and feedback systems to support sellers and buyers. These market places are the substitution for traditional market places. There are payment instruments like major credit cards, Pay Pal, Money bookers, NETeller, click&buy, Click2Pay or other payment methods in place.
- **Global communication systems:** Internet is a new medium for global communication. VoIP, Web 2.0 (weblogs, social bookmarking, wikis, podcasts and RSS feeds), are the new global communication channels, which inform and gather information from customers. These systems make the business local, always in touch over the Internet.

2.5 Mass Customization

There are two common approaches to customize products. The first approach is to design the products according to the customer's specifications. Those products are designed and produced from scratch and for every individual customer. This is a traditional craftwork, which is known for high quality and high price. The second approach is to produce individualized products with near mass production efficiency and price. Mass customization is new production strategy, which makes the company very flexible to fulfill customer's requirements [1].

2.5.1 Definition of mass customization

Several researchers already defined mass customization. There are several points of view of classifications or definitions of mass customization. Following chapters describe mass customization by another researches.

Mass customization is in thesis defined as following: Intervention of production process by the customer in order to design perfect fit products without functionality tradeoffs. The customer intervention point [Chapter 5.3] and the level of customization [Table 6-1] play in this process main role.

2.5.1.1 Mass customization framework by Product and Representation

The main objective of mass customization is to produce in response to a partial customer's desire. The authors introduce the notion of customer sacrifice that is defined as "the difference between what a customer accepts and what he really needs, even if the customer doesn't know what that is or can't articulate it".

Pine and Gilmore [12], [Figure 2-5] introduce classification by Product and Representation. They define four different types of mass customization: Adaptive, Cosmetic, Transparent and Collaboration.

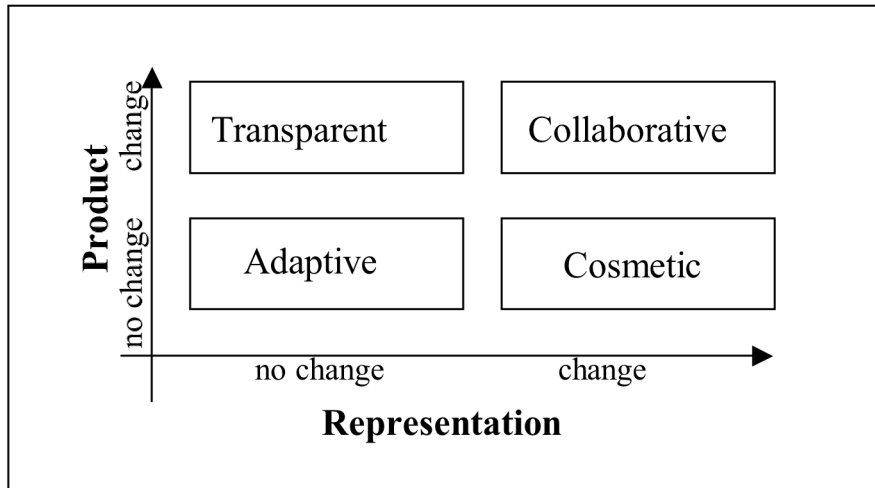


Figure 2-5 Pine, Gilmore: The four approaches to mass customization

Adaptive customization: the outcome of this type of customizations is an adaptive product, which could be adapted for or by the customers themselves.

Cosmetic customization: The standard product satisfies almost every customer and only the product's form needs to be customized.

Transparent customization: representation of the product doesn't change, but the functionalities are adapted to particular requirements.

Collaborative customization: Product and its representation are changed to satisfy needs of customer.

2.5.1.2 Mass customization framework by the party which executes customization

Frank Piller [19] defines mass customization as differentiation of products through customization. Mass customization has to provide the customer with an achievement potential by developing a wide product solution space from which customers can select or self-configure the product variant that meets individual requirements.

Piller describes two types of mass customization: Hard and Soft customization. Soft customized products could be individualized by the customers themselves (self customization) or by the retailers. Hard customization starts within the manufacturing process, when the customer specifications are expected.

2.5.1.3 Mass customization framework by the operation perspective

Classification described by Duray [10], [Figure 2-6] and her team rather focuses on an operation perspective. Their model is described by two dimensions namely the point of customer involvement and the modularity. The modularity dimension is essential, because it enables companies to put a “mass” in customization. Duray describes following four types of customer involvement in mass customization: Fabricators, Involvers, Modularizers and Assemblers. Fabricators involve customers early on the production cycle. Involvers use modularity in late stage of production. Modularizers are those manufactures, who use modularization at first stages of production but involve customers during assembly and use only. Assemblers pursue an assembly-to-order strategy and involve customers in late production stages.

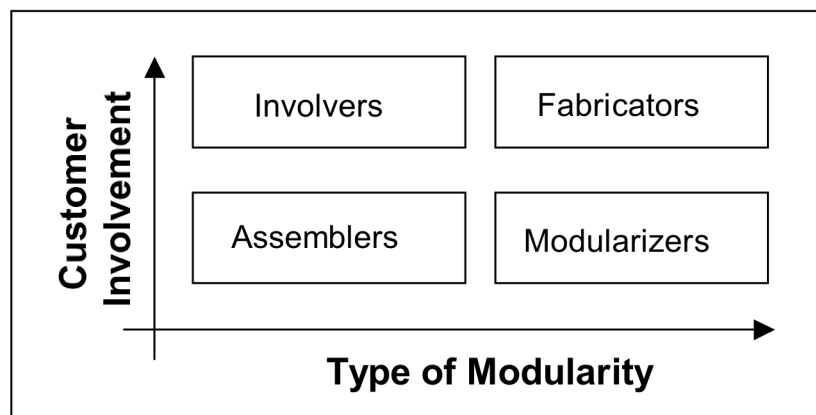


Figure 2-6 Grouping of mass customization by Duray et al.

2.5.1.4 Mass customization framework by mass customization levels

Da Silva et al. [9] introduced a classification framework for mass customization levels: Design, Fabrication, Assembly, Additional customer work, Additional custom service, Package and distribution, Usage and standardization. This framework reflects published use cases for mass customization starting from example Level 7 (Fabrication) where manufacturing of customer-tailored products follow basic, predefined designs to the lowest Level 1 (Standardization) which refers to pure standardization, a strategy that can still be useful in many industrial segments.

2.5.2 Economical implication of mass customization

Mass customization relates to the ability to provide individually designed products and services to every customer. Mass customization is recognized as a strategy by an increasing number of companies. The concept of mass customization was presented in the late 1980s and is considered as a natural evolution from the age of mass production.

Mass Customization is a good strategy for the companies, which want to satisfy the needs of individual customers. Thanks to the mass customization, companies are able to gain additional market shares and attract customers with specific needs. Companies, which have implemented the strategy of mass customization, are able to produce even small amounts of goods for prices, which are only a little bit more expensive than products generated by mass production. In consequence, this flexibility to the market changes and fast adaptation of the supply chain are important competitive advantages.

When the product price exceeds approximately 15% of a standard product, Blecker [3] doesn't recognize this production as mass customization.

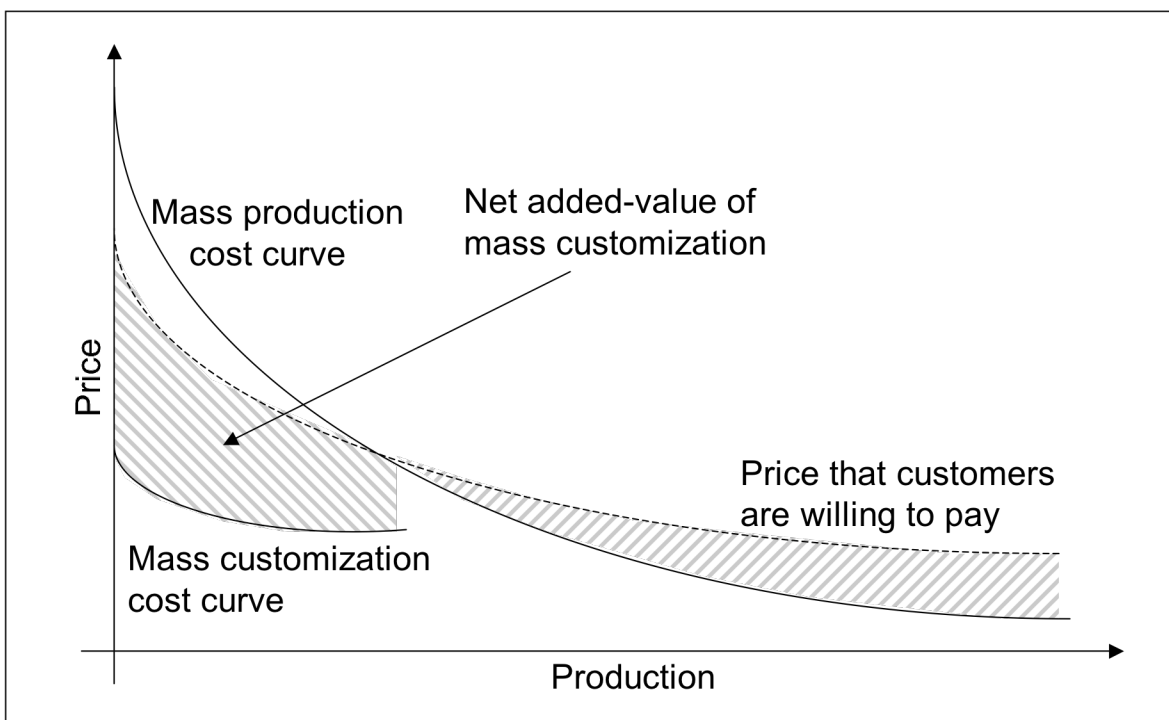


Figure 2-7 Economic implication of Mass Customization

Figure 2-7 describes the economic implication of mass customization [24], where the net added value by mass customization is illustrated. Mass production offers low production cost only by high production volume due to inflexible manufacturing. The mass customization approach allows the company to react flexible to the customers demand and produce the customized product in prices close to the mass production prices.

2.5.3 Manufacturing flexibility for mass customization

Flexibility allows the company to survive on turbulent markets, where the demand forecast doesn't deliver reliable prognosis. Only a flexible company, which is able to react fast to the customer's change of demand, can survive global competition. In recent years there are several well-established companies, which have to redefine their production philosophy in order to keep up with their competitors. Several "old" companies went bankruptcy and many new dynamic companies were set up.

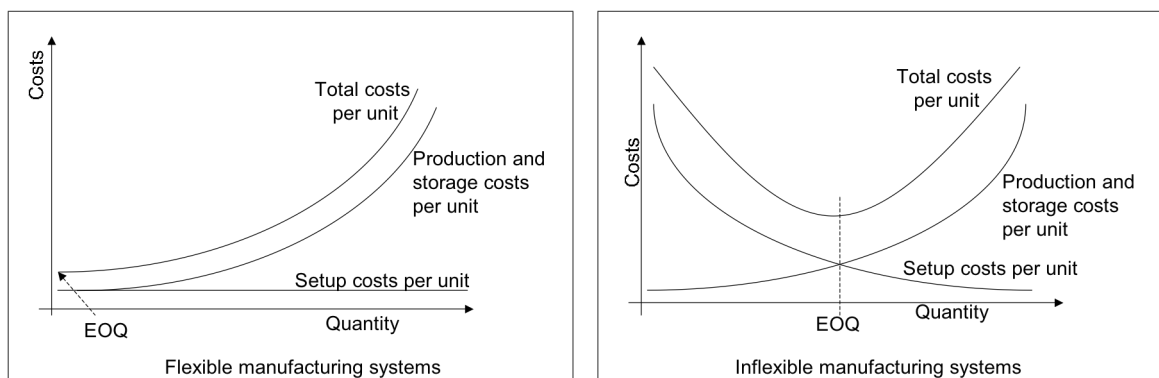


Figure 2-8 Production with flexible and inflexible manufacturing systems

Mass customization provides flexibility of the entire production process [20]. Total production cost (PC) is defined as aggregation of variable (VC) and fixed costs (FC). Average values of variable costs, fixed and total costs are illustrated on Figure 2-8. Economic Order Quantity (EOQ) is the optimal quantity produced with inflexible manufacturing systems, where the significant part of total cost is based on the fixed costs.

The manufacturing flexibility is based on three main dimensions:

- The range of possible production combination
- The cost of migration from one configuration to another
- Necessary time for migration

Flexible manufacturing systems decrease all three dimensions in order to minimize the total production costs. Since their fixed costs are minimal even small production quantities create profit and allow companies to compete in turbulent markets. They are powered by information systems, which produce efficiently customized products.

2.5.4 Approach to the mass customization

Pine defines several demand and structural factors and postulates that a competitive advantage can be attained if a company replaces completely mass production with mass customization. In contrast Kotha [16] points out the possibility of coexistence of mass production and mass customization. He described that the awareness of the customer needs during the mass customization could be efficiently transferred to mass-produced production in order to increase the customer satisfaction and product quality.

2.5.5 Success Factors for Mass Customization

Kotha differentiates between external (industry level) and internal (corporate level) conditions. Hart [13] defines four key factors to be examined in order to attain successful implementation of mass customization: Customer customization sensitivity, process amenability, competitive environment and organization readiness. Da Silva et al. [9] discuss six factors in order to successfully achieve mass customization: Customer's demand for variety and customization, appropriateness of market conditions, readiness of value chain, availability of technology, customizability of products and knowledge sharing. Broekhuizen and Alsten [5] define their theoretical basis for mass customization as: Customer factors, Products factors, Market factors, Industry factors and Organization factors. Blecker [4] defines market conditions, customizing ability and internal abilities of the mass customizing system as necessary conditions for achieving mass customization. Chandra and Grabis [8] define key success factors as customer sensitivity, process amenability, competitive environment and organization readiness.

There is no common framework according to which success factors for mass customization are classified. Researches described several conditions and factors for successful implementation of mass customization. In order to succeed with mass customization customers have to be ready to accept mass customized products and the company or better the whole supply chain on the other hand have to be capable to implement mass customization strategy.

Mass customization is not a production strategy for every industry in every time. Every implementation of mass customization is unique. Mass customization strategy has to be supported by every part of the entire supply chain. Information systems for product customization, configuration, customer care and enterprise resource planning are an integral part of successfully implemented strategies.

2.5.6 Characteristic of mass customization

Mass customization is a new production model. The mature of the mass customization changes the traditional company into a modern, customer oriented company, where the customers drive all the actions inside the company. Mass customization has its specific characteristic, which will be described in following chapters.

2.5.6.1 First sell, then produce

Companies do not start any production without a direct order. This means no waste of the production resources to produce unwanted goods. Since the sold goods are paid during the order, the company receives payment for the goods before the payment to the suppliers. Mass customization brings more financial security to the production.

2.5.6.2 No unsold goods

Each produced goods have a buyer, there are no unsold goods that have to be stored in the stocks, waiting for their buyer or distribution to retail stores. Mass customization brings efficiency the production.

2.5.6.3 No finished products inventory

Goods are produced based on the direct customer order and shipped directly after the production. Mass customization saves money connected to the management of the inventory of finished products.

2.5.6.4 Customer pays for production: no tied up capital

Mass customization changes the cash flow of the company. There is no need for a tied up capital in production resources since the customer pays before the production start and creates a condition for a bought offer of services.

2.5.6.5 *No anonymous customer*

Customers are entering the production processes to co-operate with the producer. This co-operation is done via self-service. Self-service remove the anonymity between the customer and producer.

2.5.6.6 *Integrated and aware customer*

Customers are integrated into the production process and they are informed about this process. Customers in mass customization are aware about the product design (they are co-designers) and they know the production and delivery conditions which they choose via self-service configurator.

2.5.6.7 *No dealers, No retail space needed*

Direct connection between the customer and producer allows removing the dealers and offering the customers more attractive conditions. No dealers means as well better feedback for the producer and better communication. No retail shops bring new challenges to the marketing and promotion. The company should focus their afford to the customer-care.

2.5.6.8 *Just-in-time system of production (small inputs inventory)*

JIT systems are used in modern companies. Mass customization makes a good use of this strategy, but JIT has to be adapted for mass customization. Mass customization challenges a JIT since there are no long terms or middle terms planes. Mass customization allows predicting future needs, but the customers' orders confirm the final required material for production.

2.5.6.9 *Dynamic production demand chains*

Dynamic, but with a high potential to predict the future demand are mass customization companies. The company “lost the control” of the produced goods. The main role play the customers, with their orders

2.5.6.10 Products oriented supply chain networks

Modern companies build product-focused networks. A network is only created for the lifecycle of the product. Companies in the network could be exchanged based on the performance, quality and price. Mass customization requires an increased cooperation and connection the networks to satisfy need of the customers [14].

3 HYPOTHESIS AND THESIS GOALS

The thesis is based on the theoretical knowledge gained during PhD studies and working experience with IT project implementation in a global bank. The thesis consists of two hypotheses about the technological barriers and willingness to use mass customization in daily life and the similarities in the implementation of the mass customization. Thesis processing is divided in four goals to examine defined hypothesis.

3.1 Hypothesis

H1 There is no technological barrier for use of mass customization.

Customers do not have technological barriers to use self-service solutions in order to interact with a producer; the producers have entered a new era, an era of digital economy, where mass customization strategies can be deployed

H2 Companies implementing strategy of mass customization have similar implementation of mass customization that is typical for entire industry. There are differences between the industries.

3.2 Goals

G 1 Confirm or disconfirm the hypothesis H1 and H2.

G 2 Provide a literature review of mass customization frameworks in order to define framework based on supply chain.

G 3 Create a framework for evaluating the mass customization based on G2, and define requirements for changes to a company's infrastructure.

G 4 Use newly defined framework to evaluate companies in several industries in order to find common characters for MC implementation.

4 RESEARCH METHODOLOGY AND THESIS PROCESSING

4.1 Research plan und its timeline

Literature review	until February 2007
PhD Thesis Summary	February 2007
Define framework based on	
Customer Point of Intervention	Fall 2007
Selection of companies suitable for analyses	Summer / Fall 2007
Research analyses	September 2007
PhD Presentation	Winter 2008

4.2 Research methodology

Logical methods namely abstraction – concretization, induction – deduction and analysis - synthesis will be used to build the framework of mass customization based on supply chain.

Research data will be collected over the Internet, since customers without the technological barrier are considered as target group. Research validity and reliability will be based on wide sample of statistic data. Statistic methods will be used to validate the research.

5 ACTUAL RESULT OF OWN RESEARCH

5.1 Literature review summary

There are already several models / frameworks of mass customization. They are based on empirical investigation (Pine / Gilmore [12]/ Duray et al. [10]), literature research (Pine / Gilmore [12], Da Silva et al. [9]) and case studies (Piller [19]). Those models should inspire manufactures to move their business to the age of digital economy, where the customers have a direct connection to the producer.

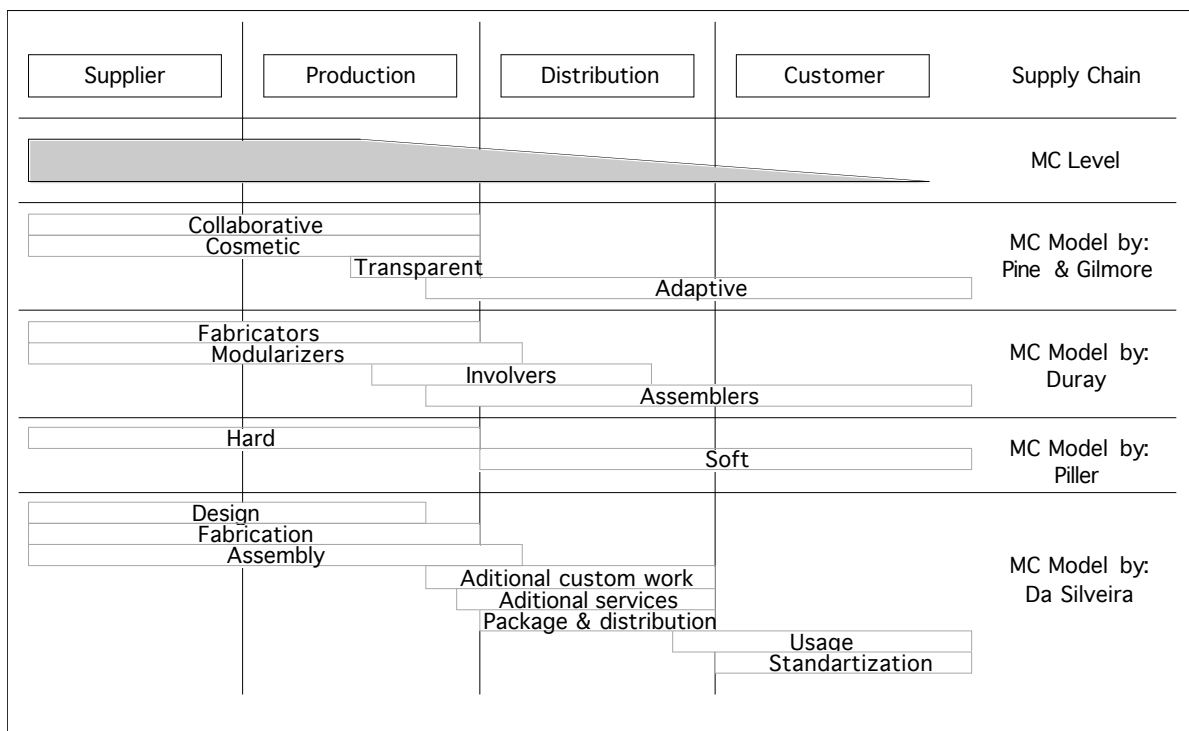


Figure 5-1 Different models of Mass Customization

Duray et al. [10], Piller [19], Da Silva et al. [9] based their classification perspective on a value chain perspective. Blecker (p. 22) [3] shares his concerns for approaches build upon a value chain perspective, since these approaches are based on the assumption of a single point of customization. Figure 5-1 summarizes above-mentioned frameworks from the supply chain perspective. This summary connects this thesis with an independent research in later chapters where the customer intervention point is defined and analyzed.

Mass customization is a flexible manufacturing strategy and the framework of mass customization is a combination of several customization approaches.

5.2 Key Elements of Mass Customization

There are several key elements, necessary for the successful implementation of mass customization. Missing one of the elements would lead to failure. Mass customization interferes with every element of the entire conventional supply chain. All those elements have to be adjusted for mass customization.

In this dissertation following key elements for mass customization are defined as:

- Customer
- Organization
- Product
- Supply chain

Each of these elements has to be capable to fulfill the requirements of mass customization. New technologies / information technologies connect each of these elements and integrate them into temporary virtual teams, which are formed in order to produce customer specified products. After the product is produced, this virtual team fall a part. All those parts are later integrated into new virtual teams.

Mass customization brings new challenges to every element of the company and its environment. Transformation of the company alone is not sufficient; also the environment of the company needs to fulfill the conditions for implementation of mass customization.

Even the best company capable of mass customization cannot survive, if the customer and entire external environment is not capable to deal with mass customization. This capability is mostly connected to a new way of thinking and implementation of modern technologies.

5.2.1 Customer

T.Bat'a's motto was "Our customer is our Master". He realized the power of the entire supply chain, which is satisfying the needs of the customers. In order to be close to its customers Bat'a opens his retail stores operated by a well-trained staff. Customers found at Bat'a's store all what they need. Today the customer is demanding. They do not tolerate weaknesses anymore. Global competition and global markets allow everyone to search for new producers, which are capable to produce according to the customers needs without any tradeoffs.

The customer in the age of mass customization is another type of customer than before. They have a clear idea about their needs and the product, which will satisfy those needs. They demand high quality products manufactured based on their specifications. They will not accept any compromise about quality, price or delivery time. A Customer of mass customization requires everything and in return he is loyal and actively supports the company during the production (post production) process.

Each company has to analyze its own customers. Every customer, every customer segment has other requirements and conditions. According to those conditions mass customization has to be implemented.

Producers have to find out answers to following questions [2]:

- Are the customers ready to communicate with the company over the Internet using self-service applications?
- Are the customers willing to design a final product?
- Are the customers willing to wait for their product?
- Are the customers willing to pay extra for customized products?

Those questions look quite simple, but they are important for the implementation of mass customization. Mass customization does not have a standard form, standard features. Mass customization is a general production strategy and its implementation is important.

This implementation has many faces:

- **Hidden customization:** A company implements the mass customization strategy in the company's processes. Customers do not have a direct connection to those processes but interact with CRM systems. Specialist / Designers gather information from the CRM systems and design the final product for customers. Those design cycles are short and the company produces indirectly based on the customer's requirements.

This art of mass customization provides the company with flexible production processes and compensate the unwillingness of the customers to take an active part in production process.

- **Partial customization:** As the need of the customers for the mass customization is increased some "added / additional" mass customization could be provided. The level of customer insolvent is relatively small. Major part of the production is mass-produced or hidden customization is in place.
- **Full customization** is a goal of mass customization implementation, where every customer could specify the final product. Customers and companies have to be prepared to enter this stage of mass customization. Some temporary stage as hidden or partial customization should allow this move. Full customization is technically difficult stage, which doesn't have to fit every industry or product.

5.2.1.1 Customer readiness for interaction with a company

In the previous chapter discussed the company's readiness for the mass customization. This chapter comes with the question of readiness of the customers. The answer can be found in the publications / databases of Eurostat - The Statistical Office of the European Communities [27], [28]. It is assumed that major self-service communication between customer and company will take place over the Internet.

Eurostat data demonstrate (Table 5-1, Table 5-2, Table 5-3) technical feasibility.

Table 5-1 Percentage of individuals who ordered goods or services, over the Internet, for private use, in the last year [27]

	2004	2005	2006
European Union (25 countries)	22	24	27
European Union (15 countries)	28	28	30
Czech Republic	5	5	n/a

Table 5-2 Percentage of individuals who, in the last 12 months, haven't ordered goods or services over the Internet, because they prefer to shop in person, they like to see product, loyalty to shops or force of habit [28]

	2005	2006
European Union (25 countries)	18	19
European Union (15 countries)	18	18
Czech Republic	9	n/a

Table 5-3 Percentage of individuals who, in the last 12 months, haven't ordered goods or services over the Internet, because they lack the necessary skills [28]

	2005	2006
European Union (25 countries)	4	4
European Union (15 countries)	4	5
Czech Republic	3	n/a

Eurostat provides rather not pleasant information about the Internet usage in EU, though the customer interaction is possible. Only nearly one-third individuals ordered goods or services, over the Internet in the last year. Customers have necessary skills and possibilities to do transactions over the Internet. Only 4% (5%) individuals haven't ordered goods or services over the Internet, because they lack the necessary skills.

One of the factors why the Internet is not used more often besides security issues and payment possibilities is the shopping habit. Approximately one fifth of individuals prefer to see the product before their purchase.

5.2.1.2 Customer willingness to design a final product

Mass customization places the customer in a designer role. Meaning that every customer has to invest time to design the product and has to gain knowledge necessary for the design phase. This is a key moment to lose or gain customers. For example a too complicated design process could lead to the loss of the customer.

Specific research has to be done in order to determine the willingness of customers to take an active role. There are different support tools in place to support customers in this phase. Implementation could lead to two extremes. Extreme one is a highly technical configuration tool, where the customer has a direct connection to every customizable part and she/he could decide based on technical specification. This approach will be welcome by professionals in the technical field, where the technical specifications are necessary for the final product. On the other hand, there are many customers, who don't have a need to understand all hi-tech specifications. A configuration tool based on desired functionality will suit these customers who will then specify their needs and the configuration tool translates those requirements in technical design. That is why every producer has to know its customers and adjust those tools to fit the customers' needs, or deploy more configuration tools in order to satisfy more types of customers.

Very simple example could be found by computer configuration. Computer expert would require video card XYZ (because of its better video editing performance), hard drive ABC (because of its optimized cache mechanism) and of course motherboard KLM (because of its internal bus speed) because she/he needs all those hardware peaces to edit home movies. Another not experienced / or not technology aware customer will customize her/his computer as a computer for Internet use, photo and video editing. Both configurations could lead to the same final customized product; therefore two different configuration tools by two different user groups are used.

5.2.1.3 Customer willingness to wait for her/his product

Mass customization is a special production type, where the production begins after the interaction with the customer. More precisely, the customized production begins at the point of intervention between the customer and the company / network / supply chain.

The production and delivery speed is important for the final product. Every producer has to know the answer to the question: “How long will the customer be willing to wait for her/his product”.

This question is going against global trends, where the production is being outsourced to cheap regions. Then the total production time and delivery time have to be smaller then the time which is the customer willing to wait. In another words highly automatic production cells located close to the end customers could reduce the production time and delivery cost and gain new customers.

Delivery time depends on the industry and the products. Luxurious products like new BMW could have a waiting line of several weeks, modern iPods only few days. Each market segment its special conditions.

5.2.2 Organization

Mass customization is a production strategy. This strategy has to be supported be each and every part of the company. Mass customization is changing the nature of the company and transforms it to the flexible manufacturing company producing according to the customers' specification.

There are several changes to the nature of the traditional company:

- **Marketing:** Traditional marketing, promoting the specific product, specific production line is changed into promotion of production capabilities of the company, its high competence and ability to fulfill the orders. Since there are no specific products, promotion is based on promotion of the brand or brand line, which is capable of additional customization.
- **Planning:** Tradition planning of the produced items is changed to the planning of the production capabilities and bringing a possible production customizable product lines to the customers. Since the customers trigger each production based on their personal preferences new production buffers and production systems have to be put in place. Strategic planning consists of capacity planning and the operational planning consists of the optimization of the production.
- **Pricing:** Pricing of the product is based on the customization processes and is an integral part of each production process. Since the total production price is calculated during the interaction between the customer and company the calculation principles and margins are set up during the planning phase.
- **Cash-flow:** Mass customization brings a revolution into a cash flow of the company. Customers pay before the production is started. Company is able to maintain always a positive operational cash flow by using this model. Since the customer triggers the production, every produced final product has already his buyer. Costs of the warehousing or overproduction costs are minimized.
- **Logistic:** Mass customization brings a 1 to 1 relation with the customer. Since goods for each customer has to be delivered individually, consolidated logistic systems have to change to the customer logistic systems where is still a place for an additional customized work or service.

- **Team work – cooperation:** Mass customization brings a dynamics into the team work. Cooperation between teams is based on the overall processes of the company. The company has to set up the teamwork based on the processes, which are started by the customer. The organization is then responsible for right demand planning which is represented by the capacity of those teams. Organization has to be aware that those teams could generate additional costs if not used and on the other hand they are bottlenecks of the process if they do not have necessary capacity.

Organization capable of the mass customization:

- is a **process-oriented company**, where each customer order triggers a specific process, which is responsible for the production of customized products.
- is **optimized**, since every new order brings instability into the sum of processes and new optimization has to be searched. This ongoing optimization process has to be supported by strong information systems.
- requires **flexible and well-trained staff**, which is capable coordinating their activities according to the planes managed by the information system.
- **is customer managed**, since the customers trigger all production.

The traditional view in regards to a company's competencies has to change. There is not anymore a specific product, there is not anymore a product line, and there is only the production segment. A company has to be organized in order to fulfill the wishes of the customers.

Basic management functions like planning, organizing, leading, coordinating, controlling is changed fundamentally:

- **Planning:** Production is planned according to demand. A company has to forecast customers' demand for production, without knowing the produced goods. The customers at the point of order specify those goods. Traditional production planning is changed to a demand planning, where the organization is offering its production capacities. Planning does not include only the company but entire supply chain, since the company has to react flexible to the demand.

- **Organizing:** There is no specific production plan. Organizing is moved to a different level where the organization is organized according to demand and the production process organizes the organization in order to fulfill the ordered goods. Customers have control over the functions of the production. The organization organizes itself into multiple networks, which cooperate in order to satisfy customer's needs. Organization is reacting like a living organism to the market changes and customer inputs. A company is organized by the entire processes, which are started by the customers. Every change to this organization is done through a change of processes. The changes to the organization over the processes will take place in time when those new adjusted processes are started.
- **Leading:** Mass customization is managed by an information system, which is optimizing the production processes. Those processes are highly automated with minimal human work. Even when human work is required the information system will assign human resources for this task as they are described in the process description. Managers / Employees have to accept a new position, where the information system assigns resources and the people coordinate themselves only within their assigned tasks
- **Coordinating:** Coordination has a different scope based on the customers order. The information system optimizes and places all necessary actions (according to the production processes) into a coordinated production plan. This plan might change with every order in order to minimize production costs. Each team is allowed to coordinate itself only in predefined borders.
- **Controlling:** Mass customization provides all details about every produced item, since from the point of order to the delivery each and every item is tracked. This tracking provides the company with a huge amount of information for future optimization or quality improvements.

Nowadays the management is divided into following categories: Human resource management, production management, strategic management, marketing management, financial management and information technology management.

Mass customization strategy divides those segments into two groups. First is a corporate shared services and production management. Production management is supported by all other functions to produce products efficiently based on the customers' specifications. Shared services provide an organization with a framework in which the organization is managed. Every organization has to investigate closely the level of the mass customization suitable for the industry and customer segment.

5.2.2.1 Company readiness for mass customization

E-commerce is a first step to mass customization. In this stage “man in the middle” – reseller is skipped. The company has a direct connection to the customer, thus the relationship to a customer is maintained and reacting immediately to his needs is possible.

eEurope: Connecting the dots [26], a research provided by consulting firm Accenture provides us with a view of the corporations to e-commerce.

34% of respondents from EU agree that eCommerce is a significant part of how they operate currently. Almost half of the companies believe that eCommerce is leading to develop stronger relationships with suppliers and buyers. 68% of the companies believe that eCommerce brings more understanding of customers' needs. Finally 65% of EU companies believe that eCommerce will enable them to bring new products and services to the market more quickly in the future.

Table 5-4 Do you agree that eCommerce forms a significant part of the way you currently operate? [26]

	EUR00	All EUR	CZE	FRA	GER	SWE	USA
Agree Strongly	15	15	3	20	9	17	8
Total Agree	34	34	32	37	38	37	19
Total disagree	42	41	39	53	31	47	48

Table 5-5 Do you agree that eCommerce is leading you to develop stronger relationship with suppliers and buyers? [26]

	EUR00	All EUR	CZE	FRA	GER	SWE	USA
Agree Strongly	20	21	26	13	19	23	27
Total Agree	49	49	52	47	50	53	59
Total disagree	24	24	16	27	22	20	19

Table 5-6 Do you agree that eCommerce will enable you to gain better understanding of customers' desires and habits so helping you to anticipate customers' needs in future? [26]

	EUR00	All EUR	CZE	FRA	GER	SWE	USA
Agree Strongly	36	37	35	37	34	30	44
Total Agree	67	68	71	63	63	73	75
Total disagree	13	12	16	17	13	10	8

Table 5-7 Do you agree that eCommerce will enable your company to bring new products and services to market more quickly in the future? [26]

	EUR00	All EUR	CZE	FRA	GER	SWE	USA
Agree Strongly	36	38	55	50	38	30	33
Total Agree	64	65	77	60	69	50	63
Total disagree	18	19	13	27	13	27	20

The above-summarized research [26] provides us with a view of the companies to eCommerce, which can be seen as very early pre-stage of mass customization. The research points out similarities of the companies based in the USA and Europe. They both share the expectations of adding value to the eCommerce implementations, even though a minor number of the companies currently operate in eCommerce. For implementation of mass customization are those eCommerce solutions necessary to allow customers interacting with the self-service solutions of the producer.

5.2.2.2 Employees

Mass customization creates new challenges for managers and employees. Brown, Bessant [6] defines key issues for mass customization includes teamwork, worker empowerment, ongoing training and learning. The organization should by continually learning and evolving. First and most important is the transformation of the thinking. There are not anymore accurate production plans optimized for efficient utilization of the production. There are now new flexible processes-based production processes, where the customer triggers the process-based cooperation of the teams and employees. According to the Kotha's case study [16] there is a need for additional qualification of employees involved in mass customization. This has to be considered during the transformation from a traditional company into modern customer oriented company.

5.2.3 Product

A mass customized product is designed to support the strategy of mass customization. This product could be easily changed according to the customer's requirements. The customization is based on:

- **Modularity:** Each product consists of separated modules, which are assembled together according to the requirements. The function of each module determines the functionality of the entire product. The modularity approach is well established in computer and automotive industry.
- **New modern production technologies:** Modern production technologies controlled by a computer system allow producing highly customized products without high additional costs. For example: Modern CNC machines produce final products based on the programming created by the customer (industry production), modern print machines could print even a single copy of customized book in decent price.

Modern technologies might be the trigger to implement mass customization as they allow the production of the customized products. Mass customized products are modular, produced by modern hi-tech production machines (controlled by computer).

5.2.3.1 Modularity of product

Modularity [Figure 5-2] is the way that the modern products are customized. Modules are subsystems with a lower complexity, with well-defined interfaces and functionality [30]. Modules can be exchanged according to customer's wishes. Then the customizing is considered as a choice of the right modules.

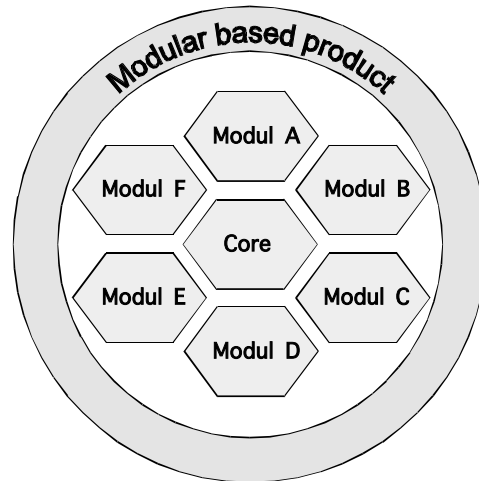


Figure 5-2 Modular based products for mass customization

It should be not forgotten, that this approach has a positive influence on the final price, since only requested modules are build in.

5.2.4 Supply chain

Dynamical demand driven networks are typical for mass customization. These networks are built in order to produce one specific product. Producers could be part as many networks as many products they produce. Involvement in several networks increases the experience of the producer. All parts of these networks share all necessary information (they information systems are connected) in order to master the production and deliver customized products in decent time.

5.3 Customer Intervention Point (CIP)

Eloranta et. al [11] defines “Value offering point” (VOP) in order to identify how is the supply chain linked to the customer’s demand. The VOP defines how and when a customer makes the purchase. Rudberg and Winker [21] define the “Customer order decoupling point” (CODP). The CODP, which is defined as the point in the supply chain, which separates the decision made under uncertainty from decisions made under certainty concerning the customer demand.

In this thesis a Customer Intervention Point is defined as a point in the supply chain, where the customer interferes with a supply chain and takes an active role in forming the final product. From this point the customer is a decision maker and co-designer of the product, in order to satisfy its needs.

The Customer Intervention Point (CIP) goes further as a VOP or CODP. CIP defines the point in a supply chain, where the supply chain changes its nature and becomes demand chain. This supply / demand chain is built by the network of cooperating companies under the control of the customer. The customer changes the nature of this supply / demand chain and creates a suitable mix for him.

The Customer Intervention Point (CIP) over the entire supply chain presents as well the level of mass customization. The point of customer’s interaction provides us with requirements on the company and customer.

CIP moving to left side places more pressure on the supply / demand chain. Customer’s intervention of production process brings certainty. Certainty that produced goods will be sold without need for additional storage requirements. Even better certainty allows optimization of production. Only ordered products are produced.

5.3.1 Framework by Customer Intervention Point

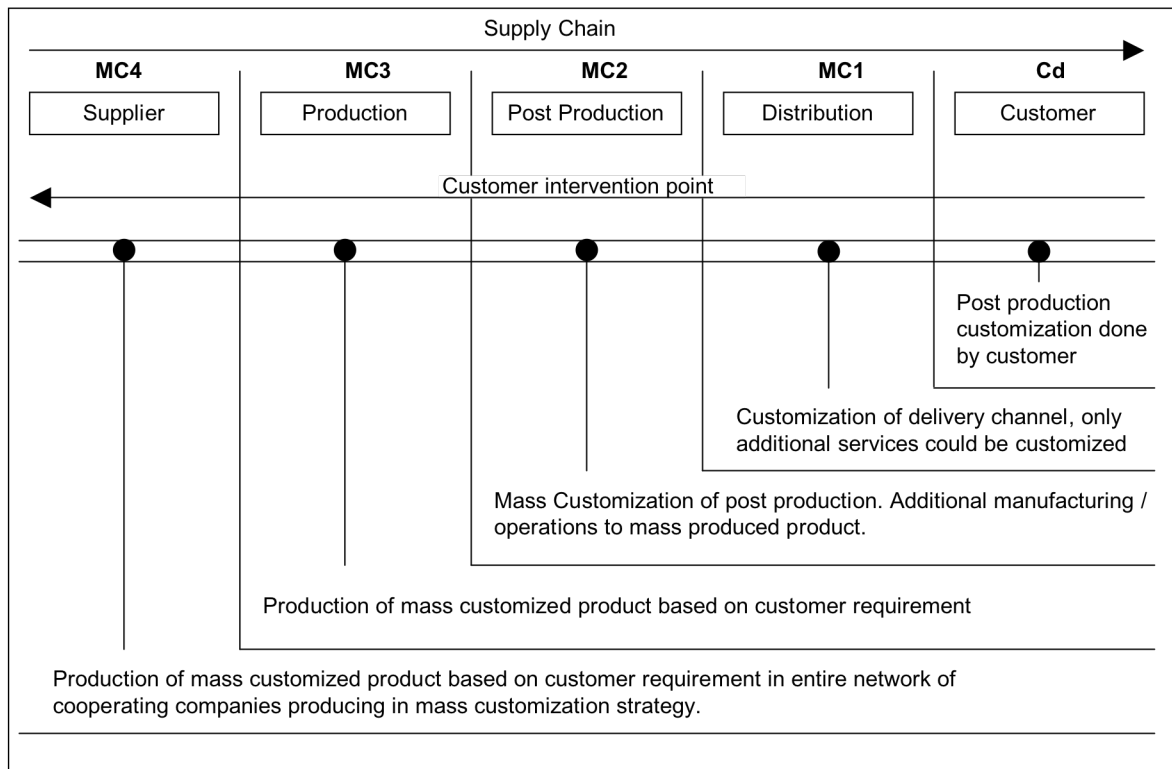


Figure 5-3 Mass customization framework by Customer Intervention Point (CIP)

Customization (Cd) done only by the customer after purchase is not considered as a type of mass customization in this thesis, only when it's combined with another type of mass customization.

Customization of delivery channel (MC1) is the lowest level of mass customization, where no customization of product is done, but additional service or modification of distribution channel could be ordered. The company has a unique relationship with each customer and is prepared for entering a higher level of mass customization [e.g. Figure 9-1, Figure 9-2]. This stage is known as B2C or eCommerce.

Mass customization of post production (MC2) is used when parts of the product are mass-produced and customized postproduction adjusts the product to customers needs. In this stage configuration systems are in place to configure and adjust the product [e.g. Figure 9-3].

Mass customization of a product (MC3) or mass customization over of the entire network (MC4) is transparent to the customer. It allows the customer to go to the edge of the design. Unique products are produced to satisfy unique needs. Customized CAD, CAE, CAM are used by customers to design their products.

Mass customization over the entire supply chain (MC4) requires binding companies into network in order to satisfy the needs of the customers.

The Customer Intervention Point [Figure 5-3] divides the supply chain into its supply and demand sections. When the point moves all the way to the left, the supply chain becomes a full demand chain. Movement from supply to demand chain is an important trend, which a thesis like this should not miss.

5.3.2 Customer customization (Cd)

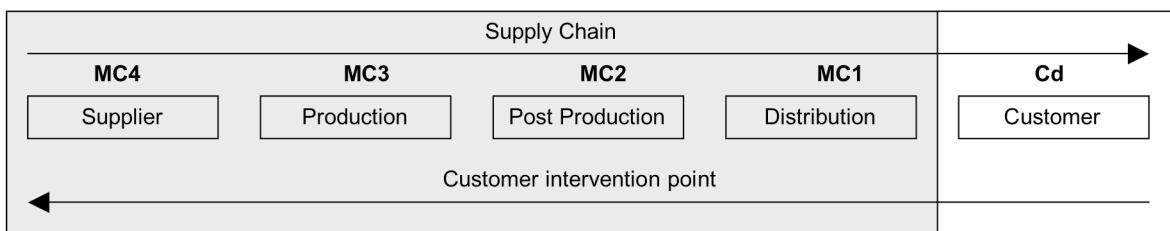


Figure 5-4 Mass customization framework by Customer Intervention Point - Cd

Definition: Customer customization or a self-customization is a change of product parameters done by a specific customer. This customization is supported by the product design and allows customers to do a final tuning of the product.

Customers have different requirements to products to satisfy their needs. One group of these requirements is solved by self-customization – customization done by customers after final production. Stereo equalization filter, adjustable mobile phone themes, adjustable car parameters (seats, breaks, engine) are examples of the customization done by the customers, without any change to the production or the supply / demand chain. These products can be produced either by mass customization or mass production. Customer customization is an integral part of the mass customized production.

New modern products are equipped with modern technology, which allow the customers changing default parameters with parameters that fit their needs. For example a modern car allows changing of different parameters like different steering wheel position, its maneuverability, seat position, breaking system properties (soft or hard breaking with APS) and engine properties (power, petrol consumption, and so on). Then every user of the car can use her / his settings which are stored in the key, which is used to open / start the car. During this operation the cars adjust the customizable parameters in order to fit the customer's needs. Cars, mobile phone, mp3 players, stereos, TVs, home accessories and all new hi-tech devices are capable of customer customization.

This customer customization is typical for modern products whose parameters or behavior are controlled by firmware software that controls a product). This firmware can adjusted / updated to follow latest trends. This update is possible over the Internet or by other special operations.

5.3.2.1 Customer

There are no special requirements based on the customers. They buy products over the normal supply chain. They have just one possible decision to buy or not to buy the product. There is a detailed description of every product feature and customers choose the products with the minimal trade-offs between what the customer wants and what he gets.

New products are developed with build in customization capability in order to be adjusted by the final customer.

5.3.2.2 Organization

Mass production is a key element of the price optimization and there are no visible changes compared with traditional companies.

5.3.2.3 Product

Cd changes only the product. The product is mostly hi-tech product, where setting variable properties does additional customization. To this category belong for example mobile telephones, where the customer could change some visual and sound effects.

5.3.2.4 Supply chain

Customizable products do not require any changes to the current supply chain, since the nature of the change is build in the product itself. Products are delivered over the existing supply chain.

5.3.2.5 Entry requirements from traditional company

Since the changes are only in products design, the company is not required to change anything. Cd is supported by the customizable design and use of the product.

5.3.3 Mass customization over the distribution channel (MC 1)

Definition: MC 1 is a mass customization generated out of production facility performed by the logistic provider. This MC consists of additional service or additional work supported by the product’s design.

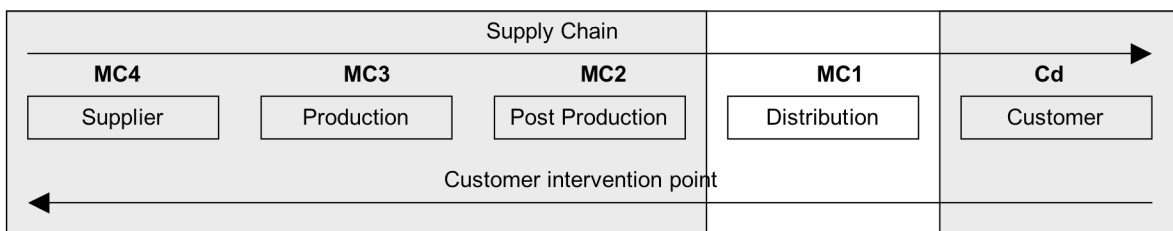


Figure 5-5 Mass customization framework by Customer Intervention Point – MC1

MC1 requires implementation of e-commerce and CRM systems. Starting from the MC1 the company has to communicate directly with the customers. Each order of a specific customer has to be tracked and requires additional service or additional work. The entire production process is not touched and only additional service or work is offered.

5.3.3.1 Customer

Customers do not play this time a passive role. They have to find the product, which fits best, and customize this product with an additional work or service. Since the customer performs only changes during distribution phase, it is not required to have knowledge of the product design. The customer spends minimal time with an additional customization and receives a benefit of the direct communication with a company.

Communication with the customers is changed. Traditional stone shopping malls are replaced with virtual shopping malls. All products are available over the Internet, easy accessible, traceable and the communication between the producer and customer (1:1) is possible. Customers have to communicate over the Internet in order to specify the necessary requirements for the additional customization. Products without additional customization can be still bought over the traditional distributor.

5.3.3.2 Organization

The adoption for the MC1 is done only on the distribution part of the company. The rest of the company is free of any changes. The organization gains the knowledge of its customers. The company has to be transformed into an e-commerce company in order to be able to work with individual customers. All orders are tracked and additional specifications for each product are stored in the information system.

Is the distribution outsourced, the company will not even experience any change. The logistic partner carries on the requirements for the MC1, being supported by the company with the necessary product information and deliveries.

New information systems are built in order to satisfy the requirements of Customer Relationship Management tools. Those new systems make communication possible (between customer and producer) and customer relationship management. Since those systems contain only the customer information, there is no need to connect this system with a production system and it operates independently.

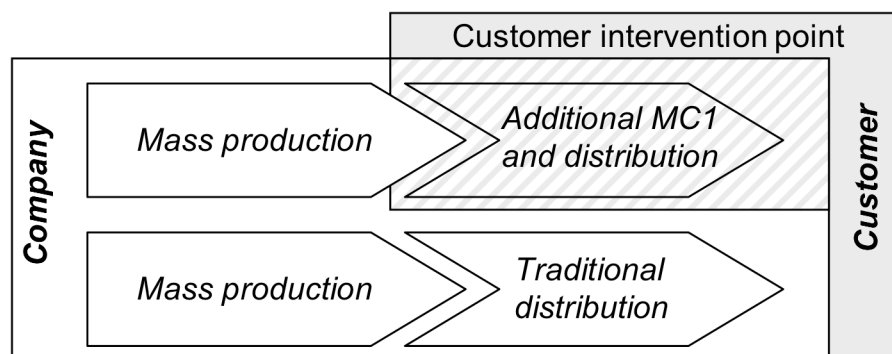


Figure 5-6 Combination of traditional distribution channels and MC1

Company can combine a mass production approach with a mass customization [Figure 5-6]. Since there is possibility to get access to products over the traditional supply chain / traditional MC1 is an added service to customers.

New information systems provide a company with detailed information about customer's preferences and could be used for future planning. Therefore the company has a direct connection to its customers; the customers do not have any influence to the production processes and are still "passive users" of the product with a choice to buy or not to buy.

5.3.3.3 Product

MC 1 – "additional work or additional service" is provided during the distribution phase, when the production process is finished. These changes are mostly small changes to appearance (like laser engraving or packaging) or additional services connected to the delivery of the goods. Customers influence a very small part of the final product and mass customization is an added value to a mass produced product.

5.3.3.4 Supply chain

MC1 brings customer knowledge into the supply chain. The supply chain knows all transactions of end-customers and thus information is used to maximize the profit of the supply chain.

New technologies are deployed inside the supply chain and the chain should be prepared for the next step → MC2.

5.3.3.5 Entry requirements from Cd

There are basically only two main entry requirements. The first one is an information system (supporting CRM), second is the product design (supporting mass customization during distribution process).

Internet accessible information systems play a major role during transformation to the e-commerce company. This company slowly gains the knowledge of their customers.

5.3.4 Mass customization of post production (MC2)

Definition: MC2 is mass customization created by the producer in the end of the production process. The proportion of mass customized product compared to the mass produced is minor.

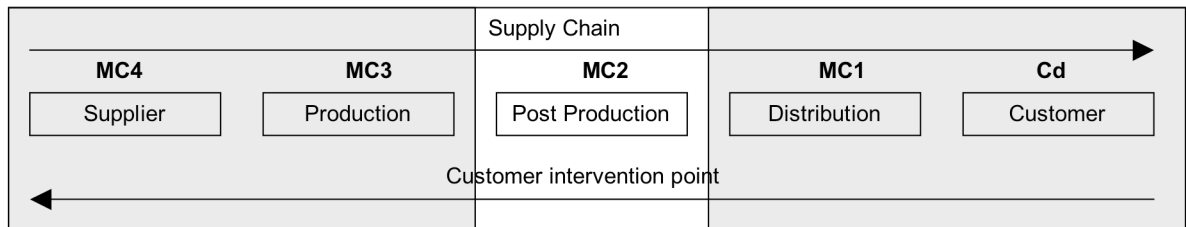


Figure 5-7 customization framework by Customer Intervention Point – MC2

MC2 provides customers with an access to the production systems. This access is realized with the modern communication technology like Internet. The customer specifies minor changes, mostly in the end of the production cycle. This art of mass customization co-exists with mass production principles and does not require total transformation of the mass customization company.

5.3.4.1 Customer

Customer plays for the first time an active role in the production process. Customers have to be aware of the product design and have to take qualified decisions. Since the product setup fulfills some basic functionality, the customer has to be able to define only her/his specific requirements. Customer involvement requires some technical understanding of the product and necessary time to customize the product.

The communication necessary for the customization requires knowledge of the modern communication technologies. The customer has to feel comfortable to make orders over the Internet.

5.3.4.2 Organization

Organization is first time directly confronted with a customer. The customer enters the production process and specifies her / his requirements. The organization has to be partially transformed into the process-based organization to fulfill customer's needs. The size of the transformed organization is defined by the size of provides MC2.

The organization is logically split into two parts. First, the main production parts follow still the mass production principles and produce products of low costs in huge quantities. The products are planned according to the market research and are promoted via the marketing department. The second part of the company focuses on the customer's requirements and takes production output of the first part of the company as its inputs. Those products are then customized for the end-customers.

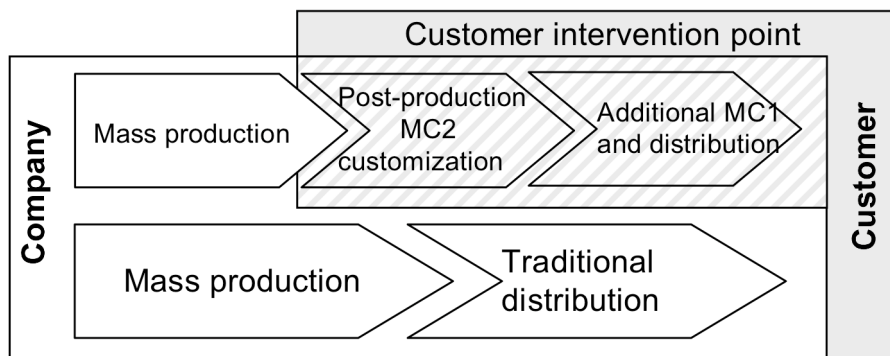


Figure 5-8 Combination of traditional distribution channels and MC2

This stage of mass customization is suitable for companies that would like to pilot a mass customization production and test their, customer's and market readiness for mass customization [Figure 5-8]. Mass customization co-exists with mass production and provides an added value and minimizes trade-offs for picky customers. This art of coexistence of mass customization and mass production produces synergies for both parts of the production. The mass customization part benefits from the cheaper production costs of the basic product part. The mass production part of the company benefits from the "online" market research where online customers specify their individual customization needs which could be implemented later into the basic product.

The company has to provide the customers with sufficient tools for this part of mass customization. These tools are simple Internet based modular configuration tools, which allow the customization and make sure that the company is able to execute those changes in its assemble line. The company has to invest time to setup those tools since they substitute the shop assistants and guide the customer through the virtual shopping mall and provide her / him with basic advices.

It is useful to provide contact to a shop assistant over the phone that supports the customer. This call center shop assistant should have an access to the current customer order and provides customer with a professional support.

5.3.4.3 Product

MC 2 is a mix of the mass production and mass customization, where the major part of product is still mass-produced. Some products are then after the mass production mass customized with an additional post-production work and service. This implementation of mass customization would mean additional steps into the production process, which lead to higher production costs. Since the customer defines those additional steps he should accept higher prices.

Products should be modular designed, where basic mass produced parts fulfill basic functions and additional mass customization adapts those functions for specific customer's needs. Mass customization does not change the nature of the product, but adjusts the product "performance" to satisfy the customer's needs. These changes are connected to the higher price. The customer positively accepts this higher price since the product is created for her / his specific needs.

5.3.4.4 Supply chain

MC2 does not require any special agreement with supply chain members, since the only one relevant supplier is the company by itself. Part of the company producing the basic products in mass quantities delivers almost finished products to last few mass customization changes into another part of the company implementing ideas of mass customization.

This is a suitable stage of mass customization for testing implementation of mass customization. This implementation should provide the company with a view of the complexity of mass customization and prepare the company for extension of mass customization over the supply chain.

5.3.4.5 Entry requirements from MC2

Company knows already its customers, CRM systems are in place. The switch to the MC2 requires additional or parallel to mass production work or service. This work or service is tracked by new production systems, which allow tracking each customer’s order.

5.3.5 Mass customization of production (MC3)

Definition: MC3 is a core of mass customization, where the customer plays a main role during the design phase and her / his customized product is produced according to her/his specification. The entire production process, involved machines and teams are specified during the customization of the product. In the extreme cases every product is unique and all the production processes have to be enough flexible to accommodate the production differences.

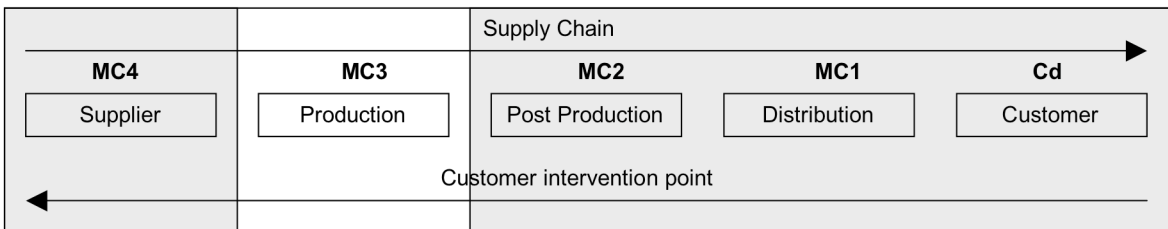


Figure 5-9 Mass customization framework by Customer Intervention Point – MC3

5.3.5.1 Customer

The customer has total control of the product design. The producer provides the customer with a tool to customize the product. Producers have to expand awareness of the product and its design. There are several self-service systems that allow customers to interact with a company and specify the product.

Customers are involved in production and they are aware of its flows. They are patient, since the company produces goods according to their design, but they do not tolerate higher costs or production delays.

Mass customization customers can be described as customers looking for products with no trade-offs, fast production /delivery time, high quality and reasonable price.

5.3.5.2 Organization

Implementation of this art of mass customization brings key changes to the company. An organization that has implemented mass customization is changed and totally different to the traditional company. Company's functions described in chapter 5.2.2 are key areas that have to be changed in order to build an environment, which has proper conditions for mass customization. The organization has to be aware of all benefits and disadvantages of mass customization.

Mass customization transforms a traditional company into a company, which is integrated into the business environment. The company has a direct connection to its customers and is capable to produce according to their requirements. This company is a process based company and allows the customers to co-operate or better to co-design product by themselves. Customers could influence all production processes.

Companies are partners for their customers and deliver not only goods but also service – the ability to produce goods according to customers needs and support those products. When the company produces based on the real customer demand there is a potential to gain a higher market share and reach a cost saving.

Mass customization brings a transparency to the production processes and allow to segment a production processes into a blocks, which could be easily outsourced. Present phenomenal is an outsourcing of the production to China, where even hi-quality products could be produced. Customers then could see on the products following statements: “Designed by Apple in California, assembled in Chine” or “Tamron Japan, assembled in China” which point out a split between the product design and pure production (smiling curve by Stan Shih).

Since small companies could rent production facilities and do in the way an outsourcing of the production, they focus on the main part of the work, which is providing a good individual service to the customers. This environment will make place for small “producers” who will be able to gain their share of the market without huge inventory investments since the production costs are created after placed order and commitment to pay for this service.

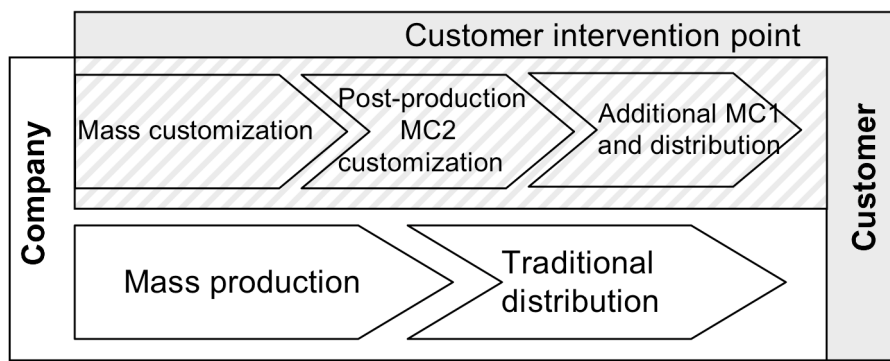


Figure 5-10 Mass Customization MC3 as a strategic production model

On the other hand the company is integrated into the supply chain and helps to transform the chain into a demand chain. The capability to produce according to the customer's specification requires the company to integrate their suppliers or better the entire supply chain into this production process [Figure 5-10]. A company in cooperation with its supplier has to be able to react fast and has to be able to produce in real time requested products.

Since the JIT production needs build-in production buffers and production supply flow, the MC3 is not anymore specific to one company but for one company and its supply chain. The company is successful, when the supply chain is capable of fast reaction and low costs.

5.3.5.3 Product

Products for MC3 can be divided into two main groups: modular based and free design products. MC3 provides a customer with a construction freedom where only the physical constrains of product or production facility could break the production process. In this case the customer is provided with tools to design its product and take full control of the production process.

Configuration solution provides a customer with easy to use self-service solution to design the product. Modular products are customized in level of modules and the customer can choose necessary modules to satisfy its needs.

Typical products are modern electronic devices with standard interfaces between the modules and standard build of the modules. In this case the producer has to manage successful combination of those modules. Mass customization does not mean implicitly higher costs, while MC3 provides a possibility to design the products from the modules that are needed and skip the modules that are not necessary.

Free design products are a new type of products created for customers. In this case self-service solution provides the same interface to production, as have company engineers or designers. Highly qualified and experienced customers are able to design their products, test them and when they are happy with their design, they can send their specifications to the production.

Here are several examples of such products:

- Swiss post allows their customers create their own stamps
- Swiss shopping chain Migros allows customers to design their own Credit Cards define based on their favorite photos
- Printing shops all around the world allows the customers do design their photo albums and print them according to customer's specification.
- German shoe stores have a laser measuring machines to determine right shoe size and shape for small children who are not able to tell if the shoe fits. This machine provides answer, which shoes fits or provides a production specification for "perfect-fit" shoes.

Modular based products are typical for hi-tech products, which consist of many modules with well-defined interfaces between them. Producers provide then a configurator, which allows tested combinations.

There are several examples of these products:

- Almost every computer store allows configuration of millions of different combinations.
- Automotive industry provides possibility to build a car which matches customers requirements (car basic parts and additional accessories)

Typical problem of these solutions is a huge amount of possible configurations; therefore many customers would be satisfied with a smaller range of possibilities.

5.3.5.4 *Supply chain*

MC 3 is mass customization, where entire supply chain cooperates to deliver specified products. Suppliers are closely connected into the production processes delivering JIT specified supplies. Necessary production buffers have to be built in order to satisfy dynamical needs of the production.

The company has to search for reliable suppliers who are capable to fulfill supplies according to the provided orders.

Supplier management is critical for this phase. It is important to understand that these organizational connections are done according to the production line. In other words supplies are organized according to products. When the product's life cycle is over the cooperation becomes obsolete and new cooperation possibilities have to be established. During the product life cycle some changes might be done when the producer is not pleased with the deliveries.

The customer drives the supply chain coordination since the customer specifies all the modules used for production. The customer triggers the usage of this supply chain and is changing the nature of the supply chain to demand chain driven to by customer demand.

Transformation from the supply chain to demand chain is changing the entire business environment. Traditional management methods and best practices have to be changed to new dynamical transformation of the chain with only one goal and this is to satisfy customers needs by reducing trade offs, delivering best fit product with reasonable prices in reasonable time.

5.3.5.5 *Entry requirements from MC2*

MC3 requires direct customer's involvement into the entire production process. MC2 connects customer and the postproduction processes, without direct connection to production. This missing link is realized within MC3.

A self-service solution should connect the customer to production processes and allow bi-directional communication. Customers should be able to communicate production requirements and the company has to be able to react.

The company provides customers with detailed information about the production capacity and possibility to produce specified products as well as the availability of the necessary parts and specify the delivery date.

5.3.6 Mass customization over the entire supply chain (MC 4)

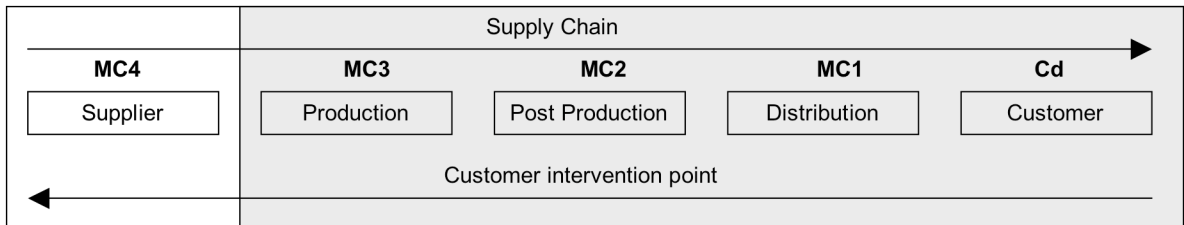


Figure 5-11 Mass customization framework by Customer Intervention Point – MC4

Definition: MC4 is a special case of a mass customization where the entire supply chain is fully flexible and gives a customer the ability to customize the product. This product customization is not only done by a “main” producer, who produces a mass customized product, but also the customization is done in every part of the supply chain starting at the supplier.

There are basically two possible models:

- Supplier as a co-producer, responsible for his part of mass customization, delivering to the “main” producer.
- Supplier as a provider of customized product according to the specifications of the “main” producer.

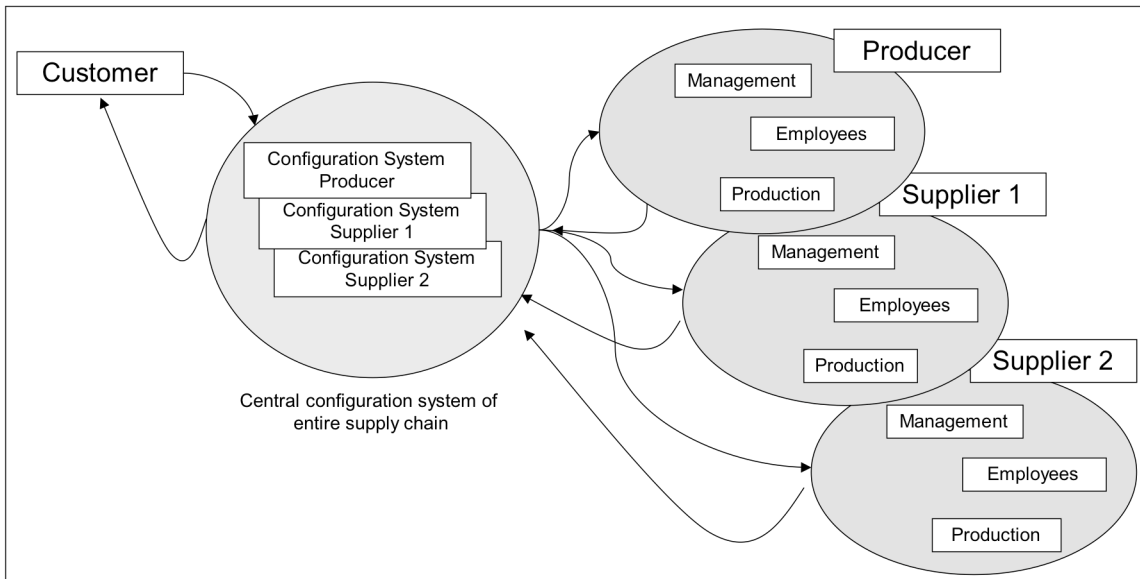


Figure 5-12 Supplier as a co-producer

Supplier as a co-producer [Figure 5-12] is most common model for mass customization. The level of cooperation is high and the success of this network is based on the trust. Trust to fulfill the customer's requirements and share all the necessary information. This network is dynamical and could be different for every product [14]. In other words one company could be part of as many networks as many products are produced. This network approach allows the company to gain much more knowledge and master its own internal and external processes.

Further more knowledge of one network is extended to the other networks, since the company / network will be as strong as the weakest part in this network. This art of cooperation puts emphasis on processes over the entire supply chain and exchange of the knowledge is necessary for success of the entire network. Today there are many examples of this cooperation in this customer – supplier relationship, since many large companies figured out the necessity for improvements of their current supply chains.

For example the Apple company designs all products in California and later creates a different networks to produce those products in China. Each new product could be produced by totally different network of the companies based on the Apple satisfaction or technical abilities of the chinese companies. Apple has a different networks to produces its different products like AirPort products, iPods, iPhones, iMacs or Mac Books.

Network of cooperating companies is setup in order to satisfy the needs of the customer. For the customer the organization of the supply chain is not transparent and he has a direct contact only with the “central configuration system”, which guides her/ him through the product configuration. There is direct communication between the customer and each supplier. Every supplier is responsible for product delivery and quality.

This model is appropriate for difficult production processes where the entire communication / product specification could not be done with a “main” producer and this specification / availability / requirements have to be discussed directly with the responsible supplier.

On other hand this model allows each supplier to keep his production specification secret and provide the network with a final product, without detailed specification.

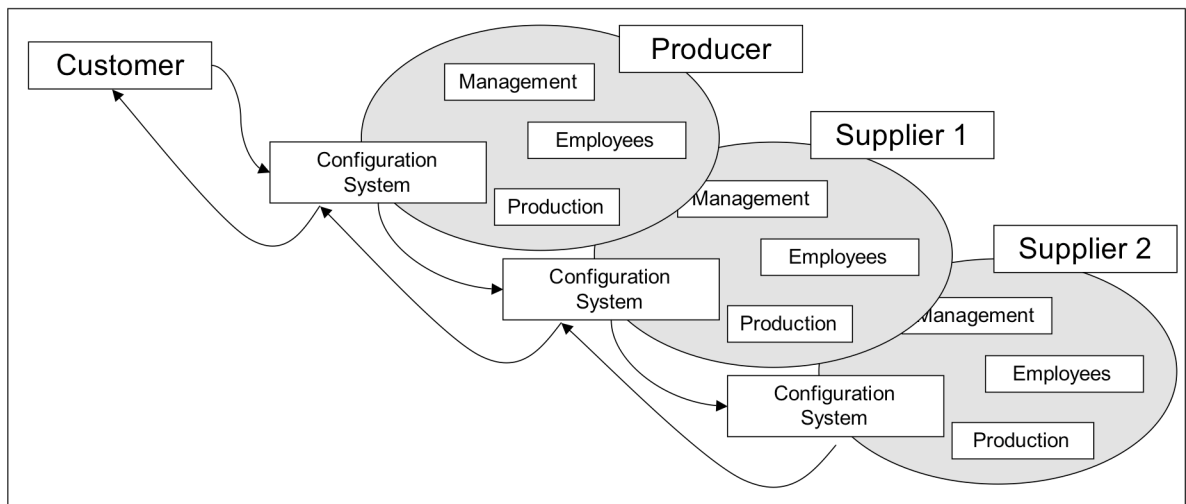


Figure 5-13 Supplier as a provider of customized product

The supplier as a provider of customized product [Figure 5-13] is the second possible model for mass customization over the supply chain. There is no direct communication between the customer and supplier. The producer has direct access to all necessary information from the supplier and provides customer with all information necessary for product specification.

This model is suitable for simple product customization, where only a limited amount of the customization on the supplier place is done. The cooperation between the producers could be predicted and suitable amount of deliveries could be scheduled and managed. The main responsibility to produce a customized product has the producer which will be rewarded with the higher margin and the supplier do not benefit from the customized product, which is slightly more expensive than the mass produced.

There are many current production / supply / demand chain optimizations in place in order to fulfill customers' needs without bringing the complexity of mass customization over the entire supply chain to the supplier. Although optimization of the supply chain and its efficiency has to be in place as well.

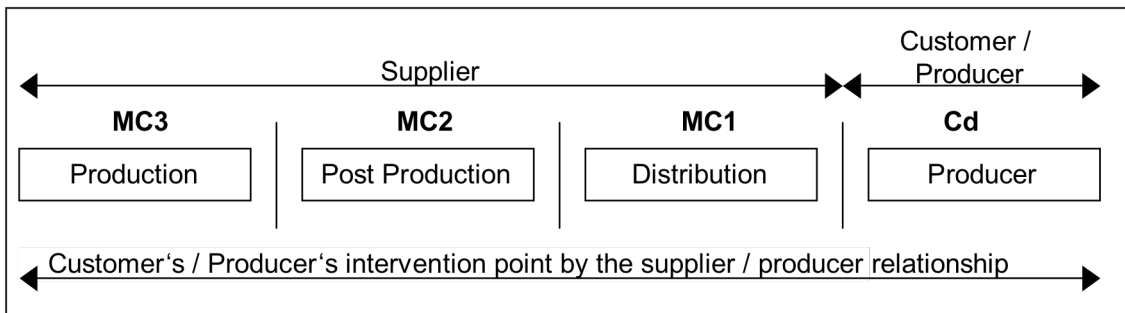


Figure 5-14 Producer as a customer of mass customization

Since there is not only one single order of the product from the producer, all those orders can be optimized and can provide more place for efficiency of the supply chain. The producer plays here the role of the customer [Figure 5-14]; his customized orders are aggregated and provide a volume of mass production for optimization.

MC4 is transparent to the customer, which interacts with a “virtual company”. Requirements are then fulfilled by the network of cooperating companies rather than by one single company. This strategy could be fulfilled with new trends of outsourcing and its implementation into supply chain.

6 ANALYSIS OF THE COMPANIES BASED ON CIP

The following chapter is devoted to the Internet research. Since the prerequisite of the mass customization is direct connection to the customers it is assumed that every company implementing the strategy of mass customization is on the Internet and the level of mass customization can be observed.

Mass customization framework based on CIP described in Chapter 5.3 is used to identify the CIP for each examined company and the presence or level of mass customization over the entire supply chain. Each level of mass customization was subjectively rated.

The level MC3 and MC4 described in Chapter 5.3.6 are same from the customer's point of view. That is why this thesis analyzes only the customer intervention point in Cd, MC1, MC2 and MC3, where MC4 is a part of MC3.

6.1 Selection of the companies for analysis

To identify the companies using the strategy of mass customization many sources were analyzed. Lists like "Top 100", "Top 500", "Best companies" provided by companies like Gartner or Fortune were analyzed without any significant success identifying companies using strategy of mass customization. No reputable source was identified.

Therefore following assumptions were made: Every company applying strategy of mass customization has to be present on the Internet and has to provide customers with a self-service solution implemented via configurator. Blog Mass Customization & Innovation News (<http://mass-customization.blogs.com/>) presented new initiative of the company cyLEDGE Media GmbH. CyLEDGE makes complex digital solutions easier to use and emotionally more appealing. They are particularly dedicated to software systems known as configurators, which enable fabrication of tailor-made products with a high degree of efficiency.

CyLEDGE provides a list of analyzed configurators on the Internet and cooperates with academic organizations and research teams. A list of companies provided by cyLEDGE was used for this thesis. Analysis of this list showed that cyLEDGE collects its data for the evaluation of configurators without a connection to the art of mass customization. Their database includes the features of the configurators without the connection to the level of the mass customization represented by the CIP.

Therefore only the list of the companies using the configurators was used for this research.

6.1.1 Companies included into a research

cyLEDGE provided a list of the companies using configurators. This list could be found online on the <http://www.configurator-database.com/> and the snapshot dated to January 2008 was used for this evaluation. Each company was analyzed based on their presentation on the Internet and only these companies using strategies of mass customization were included in this research (another use of configurators is to map customers need to already produced product and provide the customer with information about best match). List of all companies is included in List of Attachments and rated with value 0, in order to make clear that the company was evaluated but not included for the CIP / or the Level of Mass customization analysis.

6.1.2 Research data and methodology

Each company was evaluated based on their Internet configurator. Common sense was used to rate level of mass customization and determine the CIP of the company. For each product was entire customization process performed in order to identify the level of MC and determine CIP of selected product. Please be aware that the CIP or the MC is specific to produced product. One company could provide customers with more products each produced with different CIP. Following table [Table 5-1] defines CIP and the intensity over the supply chain.

Table 6-1 Definition of CIP and the Intensity of mass customization

MC Group	Index	Definition / Grouping
cd	small	Limited selection of design adjustments (no special design for customer customization).
	middle	Middle level of customization, therefore there are several possibilities of customization, there are still some tradeoffs.
	high	High level of self-customization. Therefore customer could not influence the production process, the product is so well designed that there are rich possibilities for a customization.
MC1	small	Very limited customization of distribution (only limited additional work or service is offered).
	middle	Middle level of distribution customization. There are some customization possibilities, but there is still a potential for the expansion.
	high	High level of distribution customization is done. Offer reflects the broad range of distribution services custom for specific country.
MC2	small	Mass customization of post production allows only limited customization.
	middle	Several post production customization possibilities are offered.
	high	High level of postproduction customization is possible. There are semi-finished products capable of post-production customization.
MC3	small	Limited mass customization is provided. The productions of the parts do not begin before specific order is placed. But limited possibilities of MC are provided.
	middle	Middle level of mass customization is provided. Therefore customer cannot change all production parameters the product is designed to her / his needs.
	high	Huge selection is provided for mass production. Customer needs a high technical knowledge in order to design those solutions. Time spend is highly depending on the technical difficulties of the production.

6.1.3 Industries

Companies presented by cyLEDGE in their <http://www.configurator-database.com> are structured by Industry and Product. This thesis adopted this selection and classification without additional adjustments. The selection according to the Industry is important in order to identify specific needs of each industry and prove that there is no common level of CIP over all industries, but there is specific CIP for specific products.

6.1.4 How should data be interpreted

This chapter presents explanation of research results, and provides insides on how charts should be interpreted. The following values are identified:

- **MC Level in Industry** – Chart presents two values. First the “Overall MC” presents where of the mass customization is present. Second value “CIP in Supply Chain” presents the amount of the products where the highest level of mass customizations is reached in another words where is the Customer Intervention Point is located.
- **MC Intensity allocation in Industry** – provides information about the level of mass customization for each level of mass customization (rating according 6.1.2)

Collected data are presented for every industry and then consolidated together in a summary section.

6.2 Apparel Industry

Apparel industry contains most companies from the configurator database. This industry is typical by a wide range of the CIP, which is placed between MC2 and MC3. Implementation of mass customization in Apparel industry does not require any special technical skills. Mass customization is a tool to be different from the competitors and gain competitive advantage in industry where a unique design brings a high added value.

Self-service configurators are the key to competitive advantage since the level of mass customization is for the most of the companies the same. Configurator is a new company representative who has to take care about the customer and satisfy its needs. How the customer feels, how customers interact with the company makes the difference. The more user-friendly and intuitive solutions are key factors for the success.

There is no right level of mass customization, after reviewing more than hundred solutions there are following findings to be mentioned:

- MC as necessity to follow the market – there are dozens of companies using the same configurator to interact with their customers. These configurators are common solutions enabling MC. In this case configurator or implementation of MC does not generate competitive advantage anymore. The price and the service is a key factor for success.
- MC as innovation and better service for customer – some implementation of MC are very unique and those implementations bring competitive advantage for producers since they are rare on the market.
- MC as a 3rd party service – producers are offering a gateway to their production and challenge independent designer to design products, which will be sold to customers. Mass customization is given to independent designers that support end-customers with design, saving their time and providing them with additional service.

6.2.1 Customer

Mass customization is well implemented in the apparel industry. There is good balance between the time spent and achieved results. In less than 10 minutes customers can specify what they want to produce. Configurators are connected with CRM systems storing customers profiles in order to save designs, provide possibilities to send designs to another customer and store customers data in order to make repeating orders efficient.

Customization in the apparel industry does not require any special skills but moderate sense for fashion is necessary (since configurators do not provide customer with those information or suggestions). Production time is reasonable and mass customized products are not expensive.

6.2.2 Product

There are basically two groups of products. First smaller group includes already finished goods, which are customized after the production (MC2), not reducing the production costs or optimizing the supply chain. Typical representatives are stores allowing choosing a suitable t-shirt and making suitable postproduction customization realized by additional printing. Second group consist of a little expensive goods (not specially because of mass customization) that are produced according to the detail specification like shirt (MC3), where material, all measurements and production details are provided.

6.2.3 MC Level

Apparel industry is suitable industry for MC. There is a high level of MC, which is located in MC2 and MC3. It is important to mention that only MC2 or MC3 is provided and the combination of MC level is very rare. MC1 is present for almost every product and products do not allow any customization done by customer (Cd).

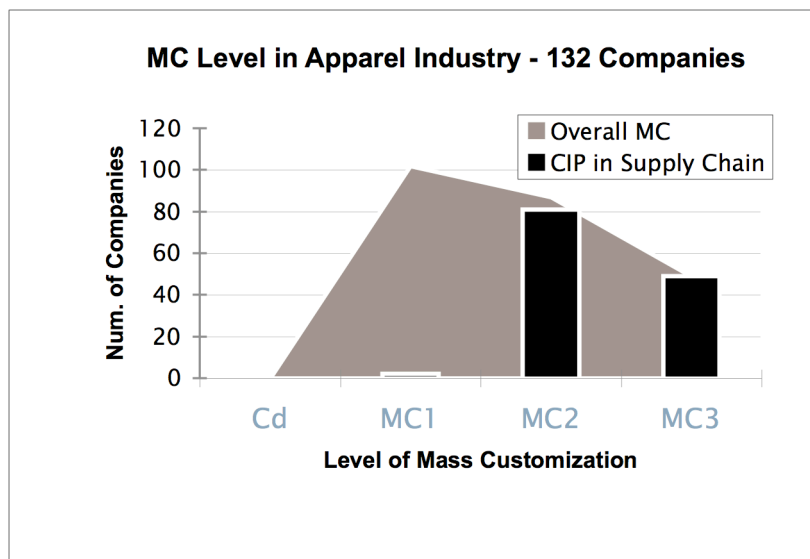


Figure 6-1 Apparel Industry – MC Level in Industry

6.2.4 Mass Customization Intensity allocation over the supply chain

Intensity of mass customization is harmonious with the level of mass customization. Lower levels of mass customization as MC1 (or even MC2) is offered with a small intensity of customization. Higher level of mass customization as MC3 provides customer with a higher-level MC intensity. Apparel industry is specific with a wide range of customization, where most common is customization with a small intensity.

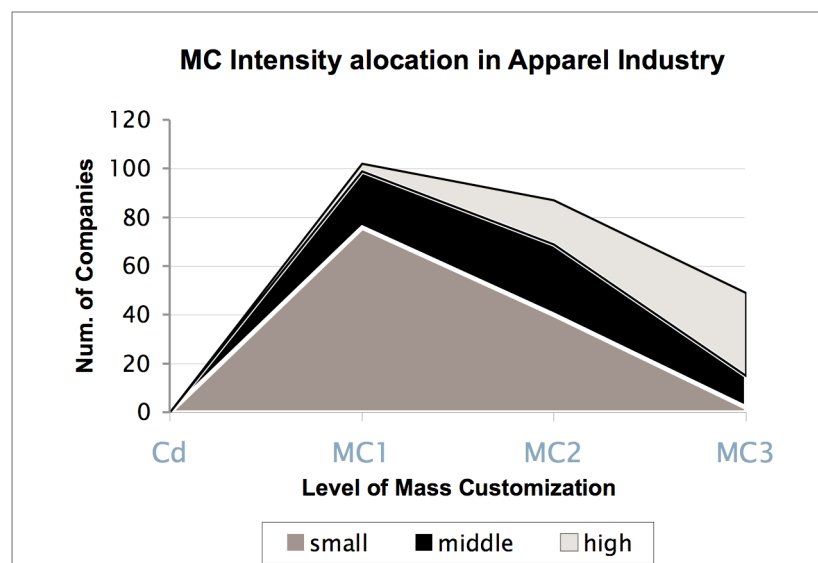


Figure 6-2 Apparel Industry – MC Intensity in Industry

6.2.5 Summary

Most companies analyzed in this thesis are companies from apparel industry. Last century in USA known as “follow a Joe”. In another words society required a same products in low price. In last decade, society has changed and the customized products in decent price (compared with craftwork) are demanded. Customized t-shirts, shirts, caps, jeans and bags are hot on the market. Even small intensity of customization allows customers to fulfill their need for unique products.

New trends in apparel industry were observed. Independent designers use a configuration systems of manufacturer and present online their products, which could be purchased. Customers then do not customize their products, but well-trained designer prepares them and only body-measurements are necessary for the production.

Mass customization is well established in this industry and new producers should consider its implementation. MC created place for creativity that can be performed by the customers or done by 3rd party companies.

6.3 Automobile Industry

Automotive industry is the cradle of mass customization. When Joseph Pine was defining his theory of mass customization automotive industry was prepared to adopt this strategy. Nowadays, almost every car is produced based on direct order. Almost every car producer adopted mass customization strategy, where individual cars are produced after the final order. Then mastering the supply chain in order to handle huge amount of customized product in one assembly line is necessary. Modern production assembly lines are capable of completing totally different products without any production loss or down times.

Car producer are selling their products on global basis, company Peugeot adopted unique usage of mass customization. The corporate configurator on Austrian and German web page provides a different customization options. Legal regulations and good knowledge of the buying habits of the local customers are prerequisites of such approach.

Mass customization is supported in every level of design process:

- Cd – ergonomically designed interior
- MC1 – consulting of the design, test drive, credit handling
- MC2 – automobile industry is one to the strongest with support of accessories, which can be chosen after the production
- MC3 – total freedom narrowed only by selection of the base model, which will be customized for customer.

6.3.1 Customer

Customers have to be very patient to receive their customized product. Time spent configuring the final product and delivery time belongs to the longest in analyzed industry range.

Customers are required to know all the technical details and have good overall understanding of the configured car. It was observed that more expensive brands and luxury car do not offer freedom to select each and every technical part, but those customization are bundled in packages like standard, luxury or premium in order to support customers to configure their products

6.3.2 Product

Cars are common in our lives. Almost every western family owns one. Cars do not serve only for the transportation, but show also social status. There are almost no differences between the levels of mass customization offered by producers. They all enable customers to design the product from scratch selecting each end every part. Automobile industry is known for high level of production automation and implementation of modern technologies to production.

Although it is possible to configure the entire product online, the final signature of contract is done traditionally offline, where additional services like driving test and personal consulting still play an important main role.

6.3.3 MC Level

Level of mass customization is extremely high in the Automobile industry. Almost every producer allows customers to customize the product over the entire supply chain. Typical CIP for this industry is MC3. Few products have their CIP on the MC2 level, where mostly pre-finished cars with additional work are provided for customers. These cars belong to luxury or very cheap brands. Mainstream manufactures position their CIP to MC3 and more than a level of configurator or on-line presentation glory of the brand is the main reason for a buy decision.

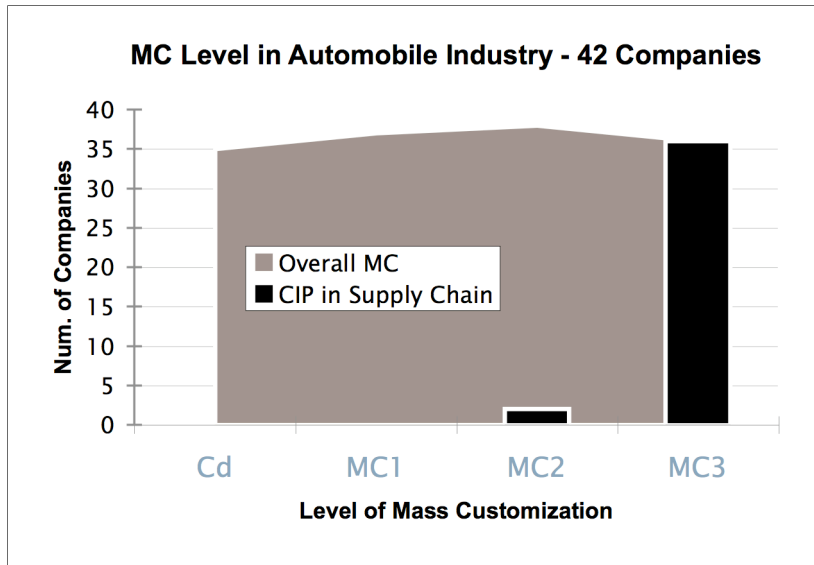


Figure 6-3 Automobile Industry – MC Level in Industry

6.3.4 Mass Customization Intensity allocation over the supply chain

Mass customization is present all around a car production processes. Modern cars are designed for customers. Ergonomically designed cars allow every customer to feel comfortable and being able to use this product.

The most intensively used mass customization is located in MC2, which presenting the nature of automobile industry – modular design. Customers have freedom to customize their product; they are limited by the selection of modules. However, this “limited” choice stands for millions of different configurations.

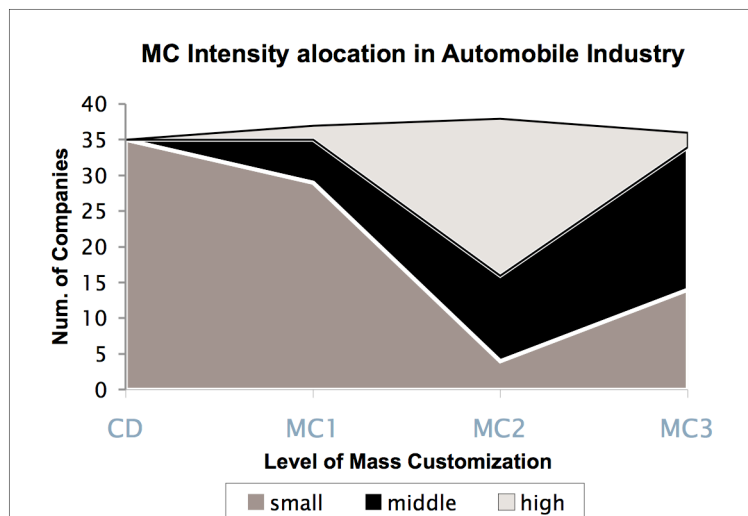


Figure 6-4 Automobile Industry – MC Intensity in Industry

6.3.5 Summary

Automobile industry is a good example of how mass customization should be deployed to the organization, and how the entire supply chain should be organized. Automobile industry combines well mass customization with mass production -> real production of mass customized product in mass production dimensions.

Maybe there is a beginning of production revolution like a hundred years ago, when Henry Ford implemented assembly line and began with mass production principles.

6.4 Construction Industry

The construction industry is represented with products like prefabricated houses, winter gardens, doors, kitchens and others. This industry makes good usage of modern technology, which allows visualizing the product. Buying new doors, windows or other construction products are easier when the final product is visualized. The customers make their decisions based on graphical presentation of the final product. Some configurators allow downloading original pictures of the house and checking if the final product fits to the already existing house.

6.4.1 Customer

There is a limited group of the customer, who are building or renovating their houses. There is no specific knowledge necessary for the product design; only a precise idea of the customers' needs which is then transformed into a final model.

6.4.2 Product

Products are divided into two groups:

- Build-to-order according to specified proportions (for example doors or windows)
- Module based systems where modules are combined in order to build the entire product

A more complicated or expensive constructions are not possible to order online, but the configurator allows the customer to visualize his design as a draft for direct discussion with a company representative who then provides an additional consulting services.

6.4.3 MC Level

The nature of construction industry integrates the customer deeply into the supply chain moving CIP to MC3 level. Products where CIP reaches MC2 are dominant. This group consists of modular based products, where customer combines modules to satisfy its need. For example storage systems, which are easy connected together to provide desired place for storage.

The next group is represented by products following general construction rules allowing customers to provide specific sizes of their customized products.

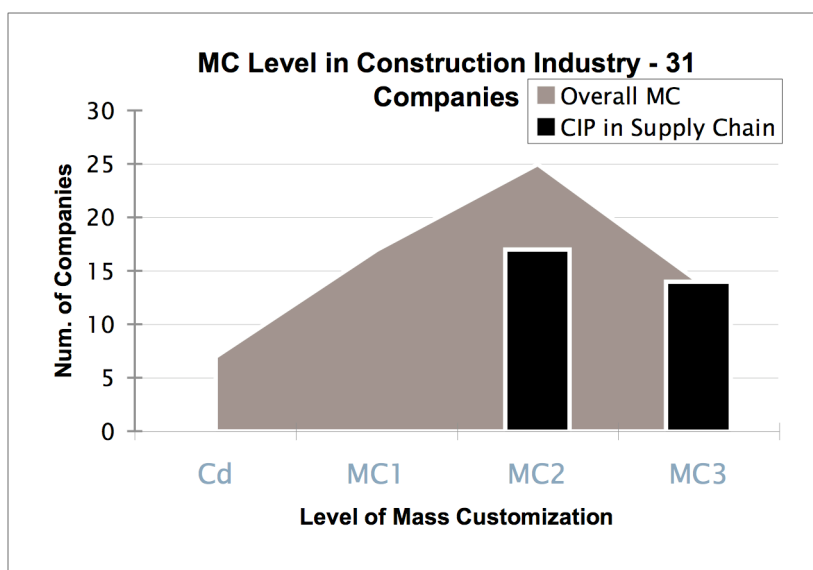


Figure 6-5 Construction Industry – MC Level in Industry

6.4.4 Mass Customization Intensity allocation over the supply chain

Customer customization is realized by module design of the product. MC1 is limited due to nature of those products, where no additional work during distribution is possible. Small intensity of the MC1 is mostly realized by offering financing services only of a unified distribution channel.

The intensity of the mass customization is almost equally distributed between MC2 and MC3

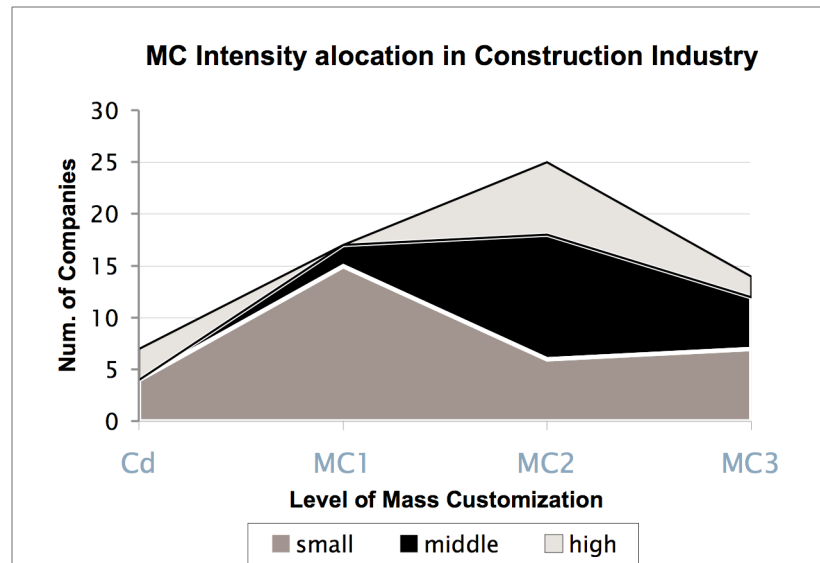


Figure 6-6 Construction Industry – MC Intensity in Industry

6.4.5 Summary

Unique houses were built for centuries. Last century is known for pre-fabricated houses, which lost their unique design. All the building parts are standard and the customers design their houses based on these standards.

Mass customization and module design of houses allow producers to offer unique houses. The unique design is reached mostly by the combination of the modules (MC2). Smaller group of the products is built based on detailed customer specification following the nature of customization based in MC3.

6.5 Giftware Industry

Giftware industry is a typical industry using mass production. Mass produced gifts, packaging, decoration items and many others exists but they are missing a personal touch. Personalization makes a difference and improves these products.

It could be discussed what customization means exactly in this industry. From one point of view we can agree that this industry is based on MC1 because mass customization is done during the distribution outside of the company when the base product was already produced (ribbons, cups, decoration, ...).

On the other hand we could see this production as MC3 because the producer of the customized product does not place its order for the mass customized product before he receives the final customer order. Therefore a pragmatic approach was selected where mass producer and point of mass customization were bundled together into one network, which was evaluated according common criteria defined in chapter 6.1.2.

6.5.1 Product

Personalized gifts like tee cups, ribbons, packaging, t-shirts are a mixture of the typical products of this industry. This industry has a potential, since nowadays a society makes a pressure to produce and present personalized products.

Personalized products are used for marketing purposes. Even small companies can prepare personalized presents, which support the reputation and image of the company. Configurators mostly present an original mass produced product and customization is only described without a final visual representation. This approach is acceptable, since only minor post-production changes are done.

Delivery times are reasonable. Price is moderate and is adequate to delivered service - customized products.

6.5.2 Customer

There is a large range of the customers that can use configurators in giftware industry. Customization does not require any special skills because the configurators are not complicated the entire customization can be done in a few minutes.

6.5.3 MC Level

CIP is mostly located in MC2, which is typical for customization of post-production. Mass produced products are customized and the customization creates unique goods. It allows company to increase their share on the market. Implementation of the mass customization is not anymore a competitive advantage in this industry, since companies uses same implementations of mass customization.

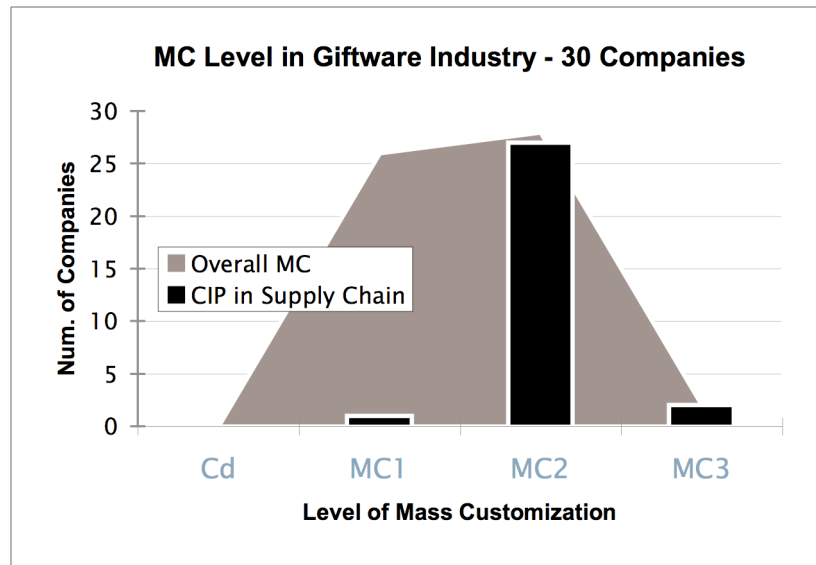


Figure 6-7 Giftware Industry – MC Level in Industry

6.5.4 Mass Customization Intensity allocation over the supply chain

MC intensity compared to other industries is low. Only limited customization possibilities are offered. The high level of mass customization creates a competitive advantage, since there are only few companies in this level.

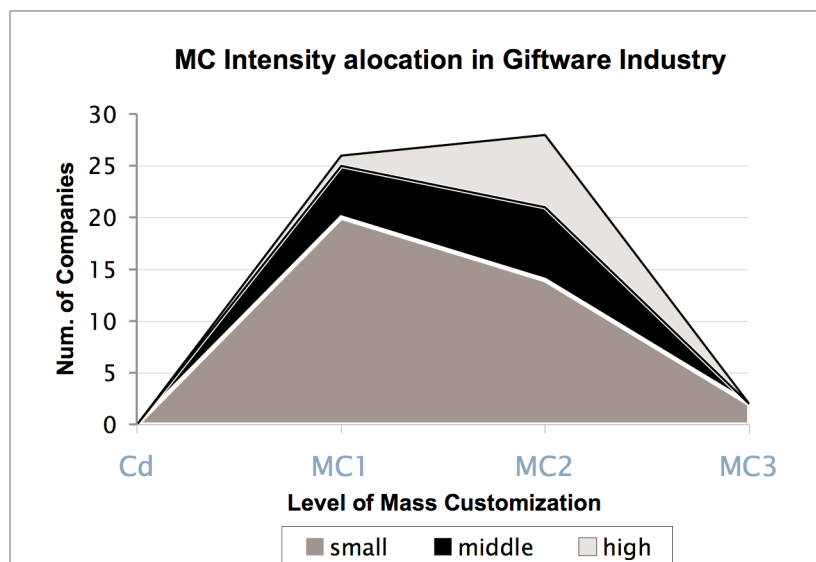


Figure 6-8 Giftware Industry – MC Intensity in Industry

6.5.5 Summary

Giftware industry implements mass customization to support sale of mass produced giftware products by individualizing the product within certain ranges. This approach could be an inspiration for other industries thinking about strategy of mass customization.

6.6 Accessories Industry

This industry has much in common with an Apparel industry, where products for daily use are produced according to customers' specification. This industry is mostly influenced by a fashion. Fast reaction to the demand and new trends is necessary for success.

6.6.1 Customer

Customers are cognizant of the fashion. They require unique products and they are willing to pay a price for mass customization (money, time). No special knowledge for the configuration is needed. Configurators support customers to specify their design in a few minutes and the final product are delivered in a few days.

6.6.2 Products

Evaluated products in this industry are organized into two groups - dress accessories and jewelry. Products have a simple construction without a modular design. The customization is done mostly by choice of the production material without adjustments of the production processes. Selection of the production material creates unique products.

6.6.3 MC Level

CIP is mostly based in sector MC3. Selection of the production material creates unique products. Customization placed in MC2 is the art of customization done in giftware industry, where mass produced products are customized. For example a mass-produced ring with an additional monogram.

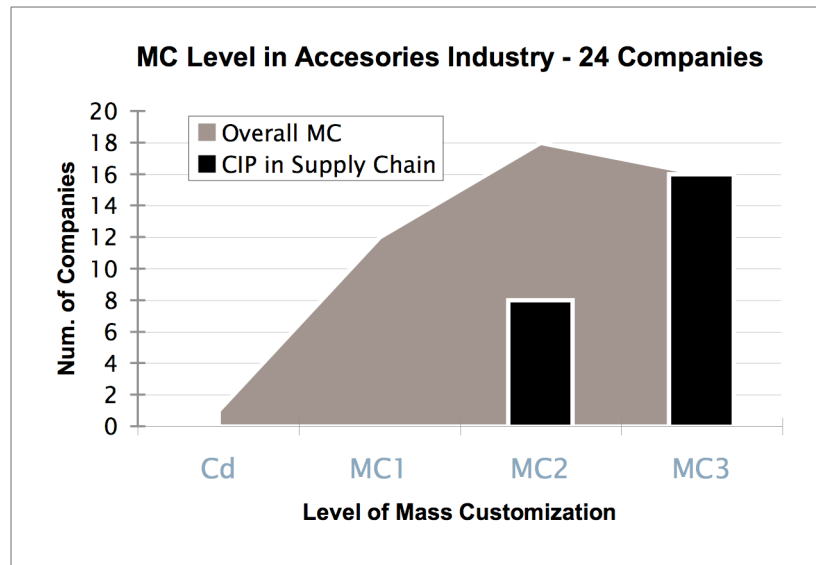


Figure 6-9 Giftware Industry – MC Level in Industry

6.6.4 Mass Customization Intensity allocation over the supply chain

Mass customization MC1 is realized via different payment systems, packaging service and delivery channels. Distribution of mass customization intensity is distributed in MC2 and MC3. Customization is generated by material selection. Typical representative belong into MC3 with a middle intensity of the mass customization.

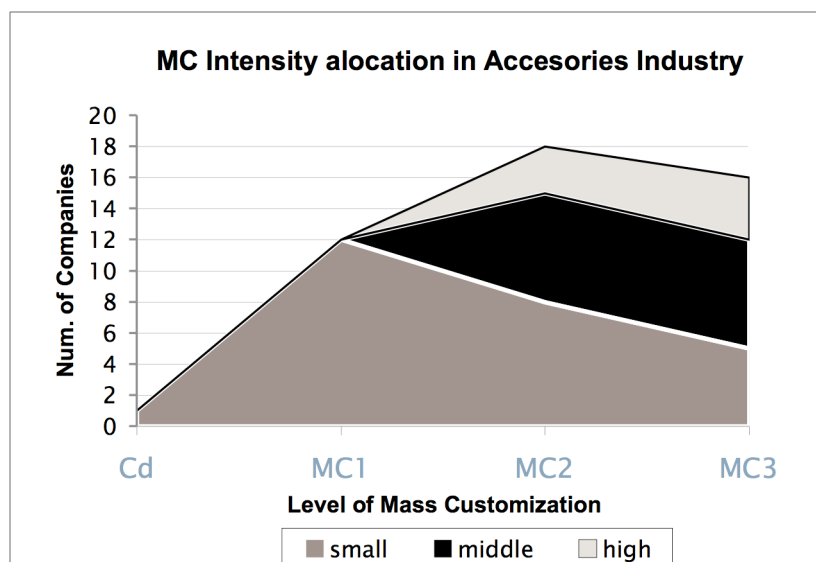


Figure 6-10 Accessories Industry – MC Intensity in Industry

6.6.5 Summary

The evaluation of this industry shows that even a small local company can use this production strategy and act on the global markets. Standard, easy to use configurator connected to standardized payment system like PayPal or Google Check Out and standard delivery channels (post) are used. Customization is reached by the material selection, which creates unique products, though a standardized production processes are executed.

6.7 Sport & Leisure Industry

Mostly golf products, but also other products like goggles, ski or snowboards are represented in the sport and leisure industry in this evaluation. Golf products were typically represented by the post-production of the mass produced products. The rest of analyzed products moved CIP into section MC3, due to special design of the sky, snowboards, which are done according to a detailed description of the customer.

6.7.1 Product

Since sport equipment is standardized, there is a small room for the customization. Customized are mostly only the initials of the players. Golf players require unique labeling of the product in order to identify their equipment during or after the game. Second group of the products are a module based. Selection of the different modules creates unique products.

6.7.2 Customer

Customers have sport as their hobby. Therefore this target group has necessary knowledge of detailed specification of their customized product.

The level of customization is adequate to the product and customization process is easy and not very time consuming. Customers use more MC in order to label the product than to design only that would fit better to their needs since sport standard exists.

6.7.3 MC Level

CIP is identically divided into sections of MC2 and MC3 due to mixture of the product provided by configurator-database.com. Post-production of the golf clubs, balls and tees bring diversity in otherwise uniform products and locate CIP in MC2. Individually designed sport equipment belongs to MC3 (these products are always customized in MC2 as well).

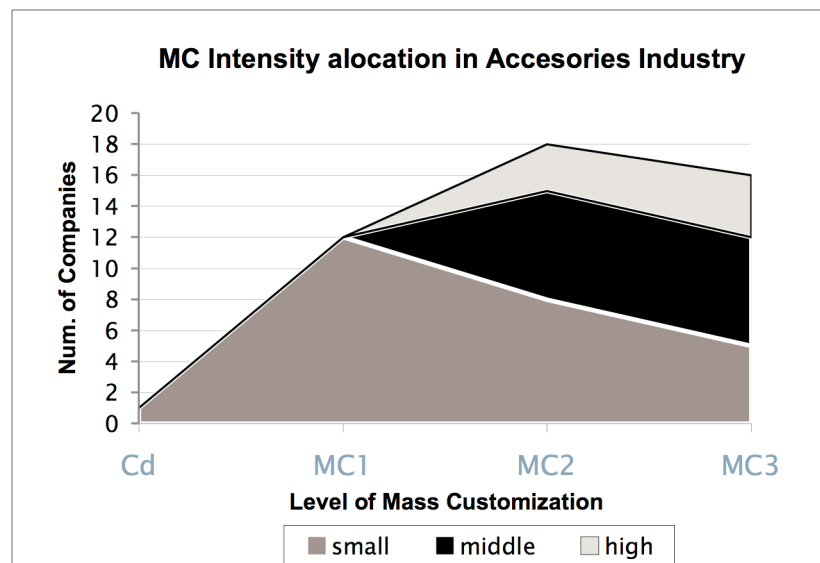


Figure 6-11 Sport & Leisure Industry – MC Level in Industry

6.7.4 Mass Customization Intensity allocation over the supply chain

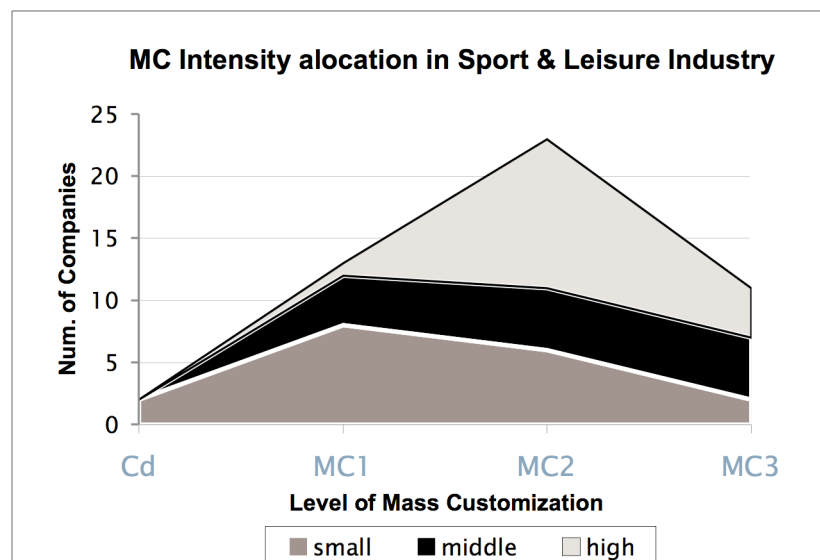


Figure 6-12 Sport & Leisure Industry – MC Intensity in Industry

Generally the high level of mass customization intensity is common for sport industry, which is located in MC2. The MC intensity of the MC3 is equally divided. MC1 as is common for industries with a relatively simple production is observed with a mostly small intensity of MC.

6.7.5 Summary

Sport & Leisure industry was mostly divided into two groups of the products. The nature these products located CIP into two sections. First group follows strictly product standard measures, locates CIP to MC2, where only an apparel post-production customization is possible. Second group changes the product measurements, locates the CIP to MC3, where the customer creates the final products before the producer starts with the production.

6.8 Print Industry

The development of the last years provided printing industry with digital printing machines capable of profitable printing even for small-scale production. Those new and modern printing machines bring flexibility to this industry and allow printing shops to provide a new service -> mass customization.

Several implementations are observed. On the one hand is the customer provided with total freedom to design its printouts, on the other hand various templates (where only some details can be adjusted) increase customer productivity and guarantee a professional look of printouts. Most of the shops provide combinations of both approaches.

Special category presents books. Books printed for children, telling stories from daily life with small customization based on the names and places. Interesting is the option to change character names in the classic books and read for example a book “The hound of the Baskerville” with a friend’s names as a main participants like “little Tommy and uncle Bob” instead Sherlock Holmes and Dr. Watson.

6.8.1 Customers

This industry provides its services to many customers. With existing Internet connection, everyone can design their printing products and use those services.

Basic IT knowledge is necessary to use the configurators and thanks to the prepared templates the design is fast.

6.8.2 Products

Typical products are printed invitations cards, calendars, wine labels. This industry is benefiting from IT usage in households. Via the Internet every one can outsource their need for printing from a locally connected printer to a professional shop in order to receive professional looking products. For example the company Primis provides service to university professors to design their textbooks by selecting special chapters from their archive (or delivering their notes) and collecting a customized textbook for specific university courses, which students could order by themselves.

6.8.3 MC Level

CIP is clearly located in MC3, which is due to modern technology used in industry to produce those products.

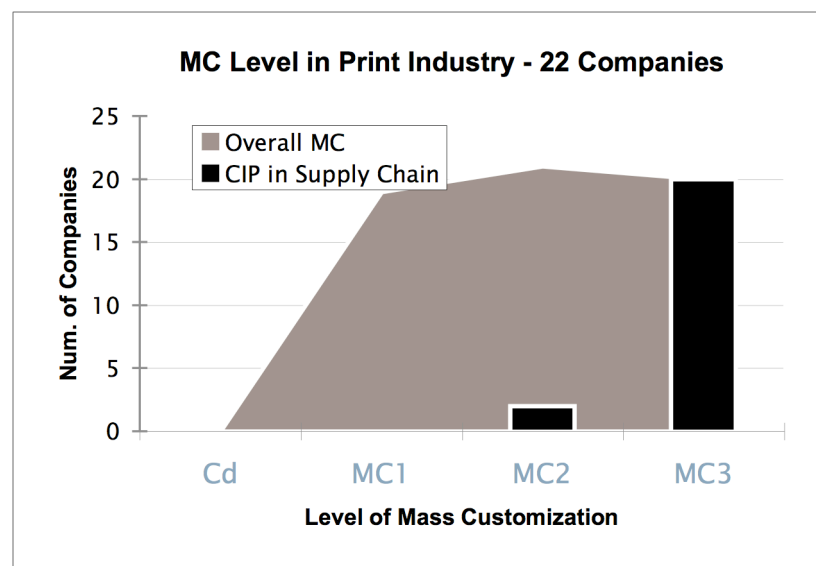


Figure 6-13 Print Industry – MC Level in Industry

6.8.4 Mass Customization Intensity allocation over the supply chain

Modern technology creates the preconditions for high intensity used in MC2 and MC3. Only standard distribution channels, limited added service and small level of customization is offered in MC1. MC2 & MC3 offer a flexibility, which is represented by a high level of MC intensity.

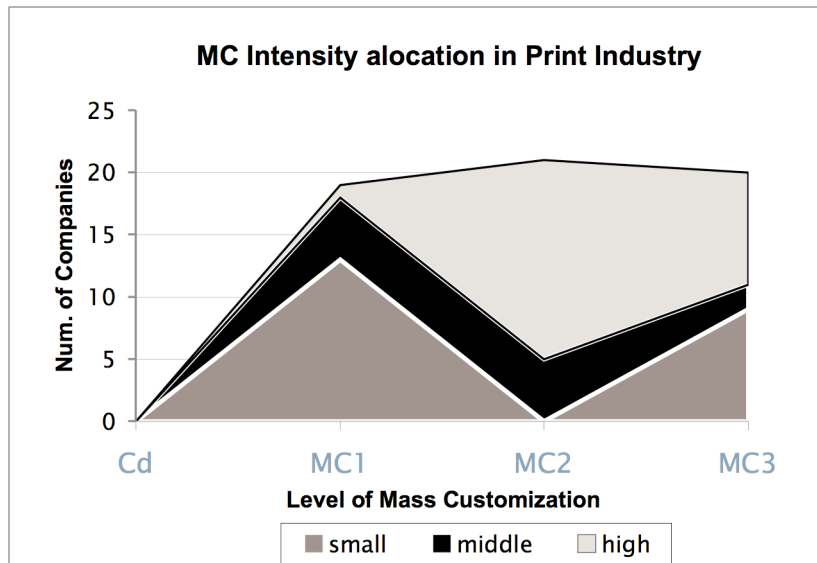


Figure 6-14 Print Industry – MC Intensity in Industry

6.8.5 Summary

Print industry profits from the development and implementation of modern technologies. These technologies make possible to reduce a print quantity to a one copy of the book with a reasonable costs. This was not thinkable before a decade, when minimum printed amounts were located in thousand of copies.

Digitalization of the books content, Internet with the interactive configurators makes possible to create a books “on-the-fly” and print then in a professional quality.

6.9 Electronic Industry

Electronic industry has right preconditions for the implementation of mass customization. Modern, hi-tech technology is used for the production. Computers are the main products evaluated within this industry. The electronic industry integrates customers deep into their supply chain. Most of the configurators are targeting well-informed customers, who do not require consulting services.

6.9.1 Product

The modular structure of computers makes it a perfect fit for a mass customization, but implementation is usually for a common customer too complicated. Dozens of different computer modules, their incompatibility and dependencies make customization difficult.

Standards used in for computer industry make it possible to build a product from thousands differed suppliers.

6.9.2 Customer

High technical skills are necessary. A broad selection the modules make customization for regular users almost impossible. Customization of the products takes a lot of time and high level of knowledge is necessary, but the customer is rewarded with a “perfect” product, which corresponds to the chosen modules.

Simplified approach was adopted by Apple, which provides a low level of customization. The success of the concern in the recent years proved that this strategy is worth of consideration.

6.9.3 MC Level

Electronic industry shows a high level of customer customization that is enabled by their hi-tech design. This design enables customers to adjust their products after delivery (Cd). Almost each producer provides possibility of MC1. The chart shows that the producers position their CPI in MC2 or MC3 section, where no combination MC2 or MC3 is observed. When we look more closely at the analyzed data, all computer configurators are located in the MC3 section.

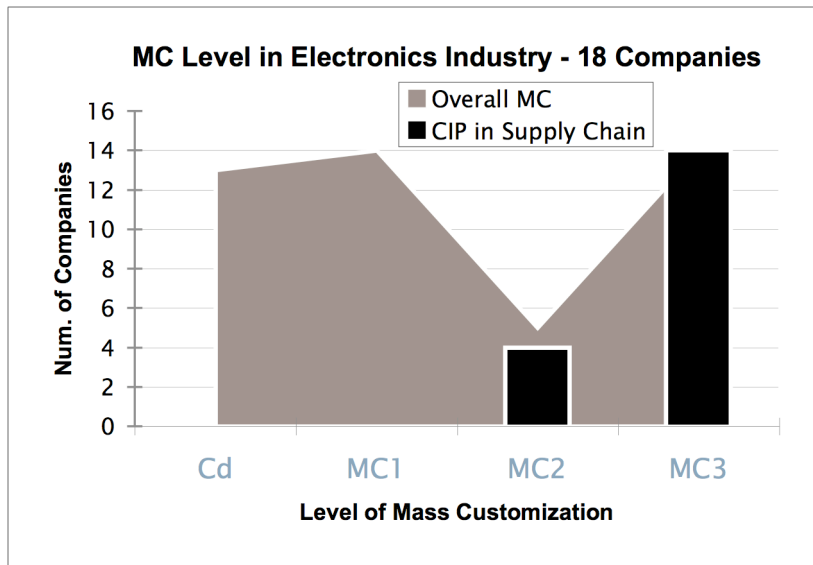


Figure 6-15 Electronic Industry – MC Level in Industry

6.9.4 Mass Customization Intensity allocation over the supply chain

Electronic industry shows a high level of intensity of customer mass customization (Cd) due to the design of products. MC1 is dominated by small and middle intensity of mass customization, which is represented by special payment, packaging and delivery possibilities. MC2 section is presented mostly by the companies with CIP located in MC2. MC3 is dominated by high level of mass customization.

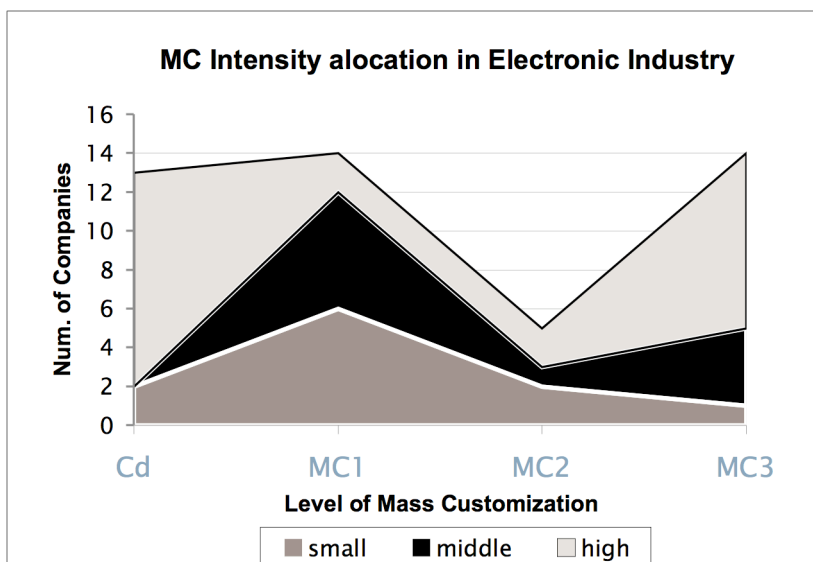


Figure 6-16 Electronic Industry – MC Intensity in Industry

6.9.5 Summary

Mass customization is suitable for the electronic industry due to its modular design. This modular design (is demanding specific knowledge from its customers) requires a good knowledge of the products do not fit to every customer. Companies should focus to simplify the configurators and make the customization standard as it is done in automobile industry.

6.10 House & Garden Industry

This industry is represented by a broad range of products like sauna, floor mat and beach chair (for details see attachment) without any common signs. Its is surprising that even this industry has already customized products, but this trend confirms that strategy of mass customization can be implemented in various industries

6.10.1 Customer

Customers do not need any special knowledge and are able to customize products easily and fast. Customers benefits from visualization of the products, which makes their taking decisions easier.

6.10.2 Product

Products in this category are simple and are customized after the production, or have a simple construction that can be easily changed before the production process. Since mass customization of the final products is realized by the module design no significant increase of the expenses can be expected.

6.10.3 MC Level

Due to art of mass customization – module based is the CIP located between MC2 and MC3. The customer is involved in the production process from the beginning, since the construction of that product requires it -> MC3. The combinations of already produced parts realize this art of mass customization and therefore those products are located in MC2 section.

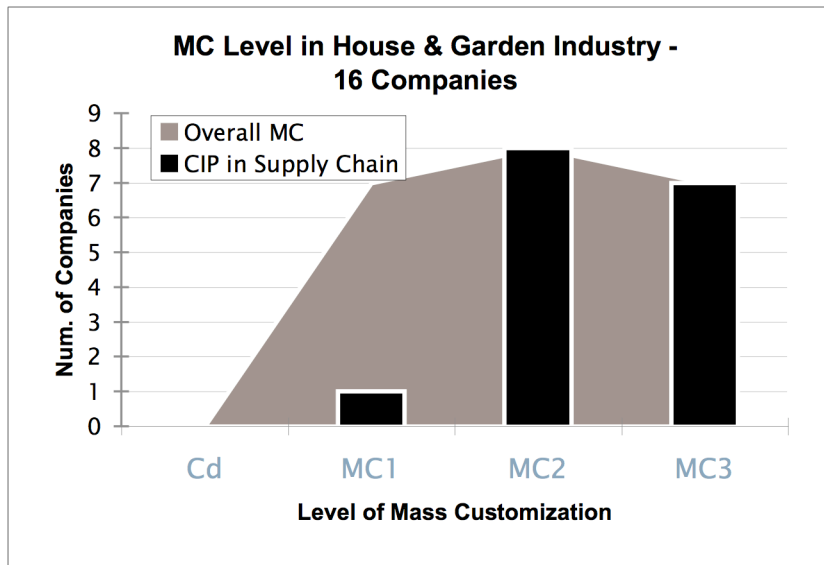


Figure 6-17 House & Garden Industry – MC Level in Industry

6.10.4 Mass Customization Intensity allocation over the supply chain

Combinations of the module design and middle complexity of the products caused a low intensity of MC in House & Garden industry. Customers create their products based on standards where is a small place for creativity.

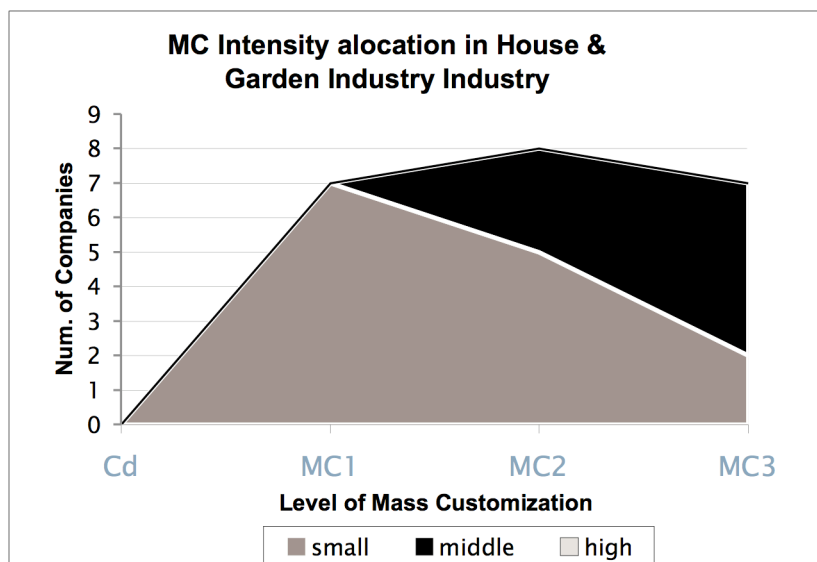


Figure 6-18 House & Garden Industry – MC Intensity in Industry

6.10.5 Summary

The house and garden industry shows an interesting implementation of mass customization connecting low level MC intensity with customization based on standard modules. Customers partially benefit from visualization of final products. This industry shows that not only automobile or electronic industry is suited for customization.

6.11 Furniture Industry

Each family lives in different houses and has different needs. Mostly storage racks, lamps or beds are represented in this industry research. This industry suits well to the concept of mass customization since different design; parts measurements and used material are mostly demanded.

6.11.1 Customer

There is a large group of customers. They benefit from visualization techniques used for customization. Mostly a visual configurator is provided for customization, where the customer defines its requirements of the place to be equipped with furniture. Then each product can be placed in this framework and all mutual connections can be identified and customer can gain a feeling about the provided product.

There is no necessity for special know-how. Basic computer skills are sufficient. Customization done via configurator benefits from timesaving due to easy selection of fitting furniture parts.

6.11.2 Product

Customization is realized by two different approaches. First, modular design of already produced furniture parts -> mostly presented by the storage racks, where whole customization is realized by combination of a few building parts. Second, some products are based on the customer inputs, where key products parameters can be changed -> typical for lamps or beds.

6.11.3 MC Level

CIP is placed mostly in MC2 section represented by the module-based furniture. There are some producers customizing only in MC1 that is mostly on the selection right parts for the final construction of furniture. There are several producers producing in sector MC3, they provide customers with certain flexibility within standards.

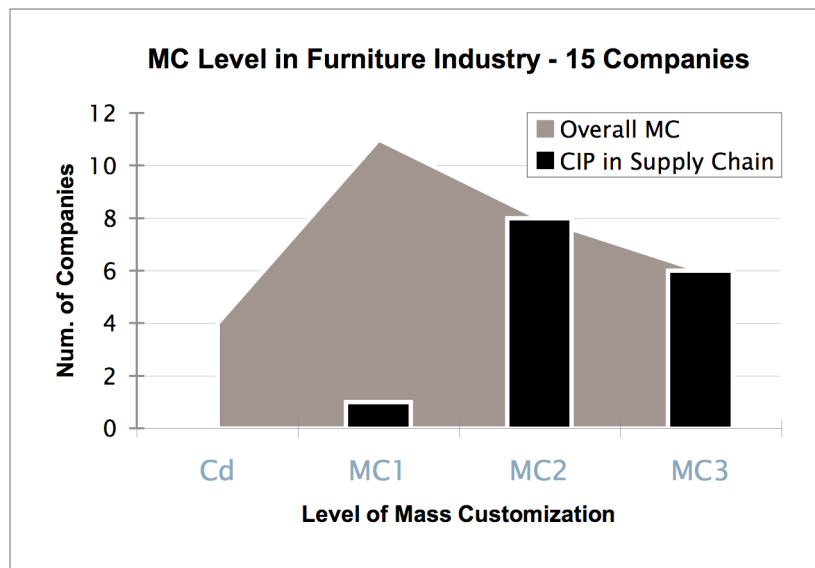


Figure 6-19 Furniture – MC Level in Industry

6.11.4 Mass Customization Intensity allocation over the supply chain

As mentioned in the previous chapter, furniture is represented with a customization within standards. This is reflected in the MC Intensity charts as a small or middle intensity. Middle MC intensity is rare for this industry and is only increased for the deeper integration of the customer to the supply chain (MC3).

These findings are useful for newly coming companies to this industry in order to gain a competitive advantage by providing a high level of MC over sections MC2 and MC3. This is possible by the future furniture design suitable for mass customization.

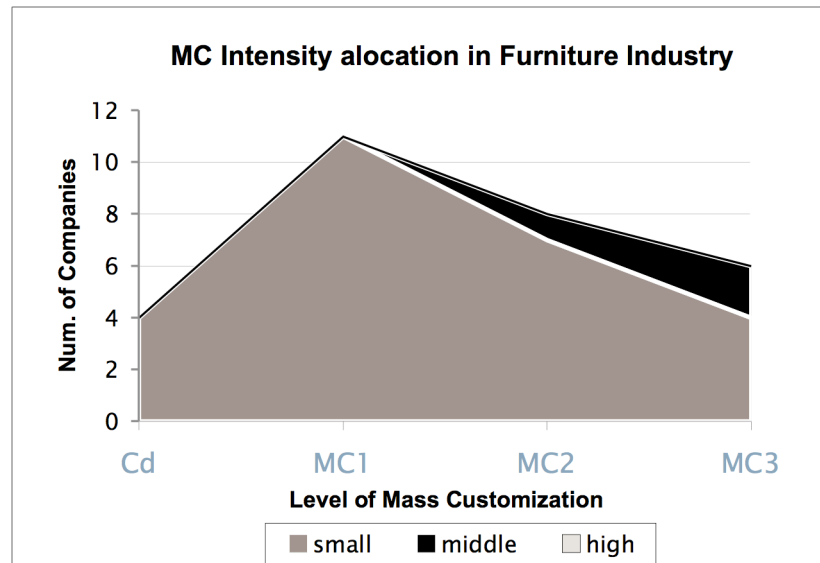


Figure 6-20 Furniture Industry – MC Intensity in Industry

6.11.5 Summary

Furniture industry is also suitable for mass customization. This finding makes sense -> everyone has a specific needs for living. Customers demand unique furniture in order to fit them to their homes and express their taste of fashion. MC in furniture industry is presented by a combination of the standard furniture parts (modules) connected together.

6.12 Stationery Industry

The last evaluated industry is stationary. Stationary is a combination of printing industry and giftware industry. Pens, office equipment and greeting cards represent products of this group. They are used for presentation, where a unique design is a must.

6.12.1 Customer

Customers are located within companies that need promotion items or individuals who require professional looking products. There is no special technical knowledge necessary to do customization and the configurators are user friendly allowing customers to create their profiles in order to save time for next orders.

6.12.2 Products

Products are the same as in giftware or printing industry group, but their use is slightly different. Products created by hi-tech machines make MC easy in this industry and allow a high level of MC and CIP.

6.12.3 MC Level

The nature of stationary products (no module based design) moved all stationary CIP to the MC3 sector. Customers have total freedom to customize their products. There was no post-production customization (MC2) observed.

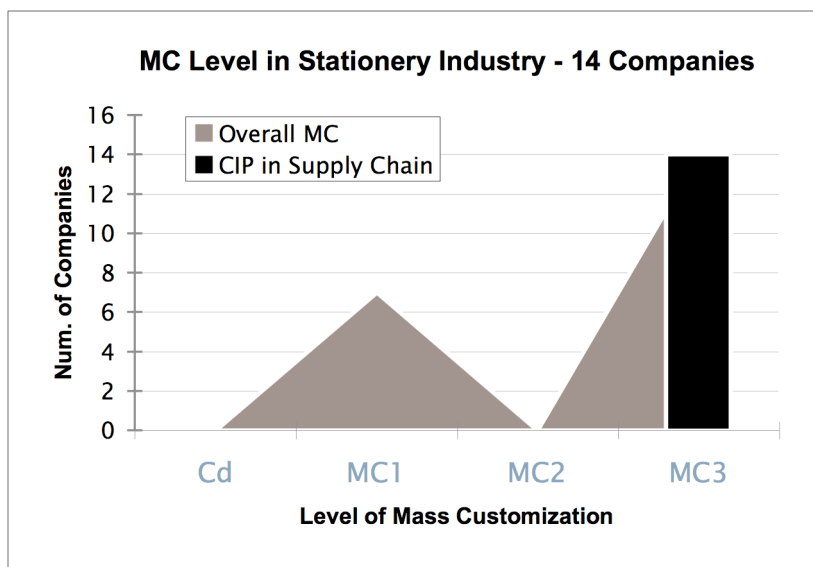


Figure 6-21 Stationary – MC Level in Industry

6.12.4 Mass Customization Intensity allocation over the supply chain

The intensity of MC3 is equally distributed between small and middle intensity. This characteristic is typical for products designed and produced by modern technology. Sector MC1 is only represented with a small intensity of MC realized by delivery and payments possibilities.

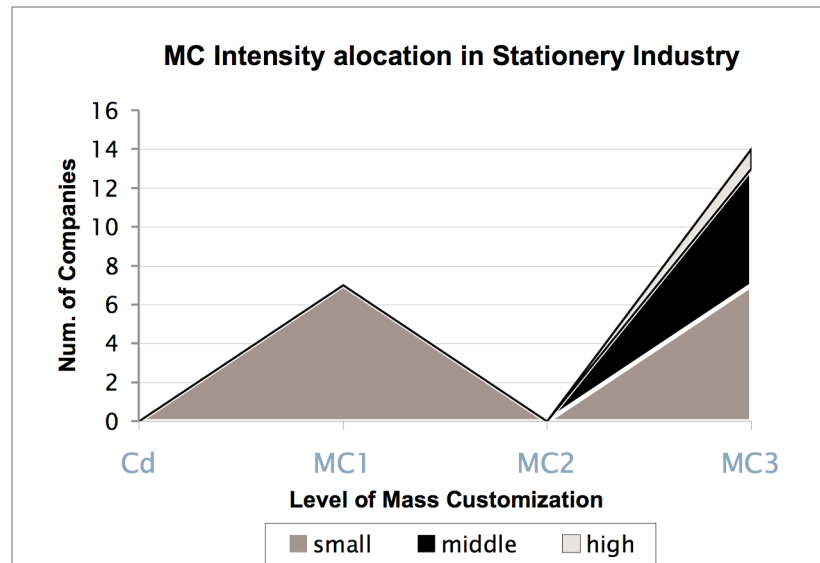


Figure 6-22 Stationery Industry – MC Intensity in Industry

6.12.5 Summary

Stationery shows similar findings like giftware and printing industry. Modern technologies allow customers to design their stationary products on their home / office computers and use this service of special companies to transform their design to final professional products.

6.13 Analysis summary

This chapter is devoted to the CIP analyses of selected companies. Findings prove the prediction that CIP (implementation of mass customization) is different for each and every product, but similarities were identified between products inside one industry (hypothesis H2, goal G4).

6.13.1 Customer involvement point over analyzed industries

The analysis shows that the industries of Stationery, Electronics, Print, Accessories, Sport & Leisure and Automobile industry are typically placed in MC3 – mass customization in production.

CIP in MC2 is typical for Apparel, Furniture, House & Garden, Giftware and Construction industry.

No evaluated industry locates its CIP in MC1 or Cd sector.

The following charts summarize the research and compare CIP of individual industries. The charts display a proportion of products with specific CIP (maximal level of mass customization) without any connection to the number of evaluated companies. This representation was selected in order to present the level of CIP in industries with different amounts of evaluated products. Aggregation of each CIP is equal 100%. For details please see separate industry chapters [6.x] and included tables with evaluation results [Chapter ATACHEMENTS III: ANALYSED COMPANIES].

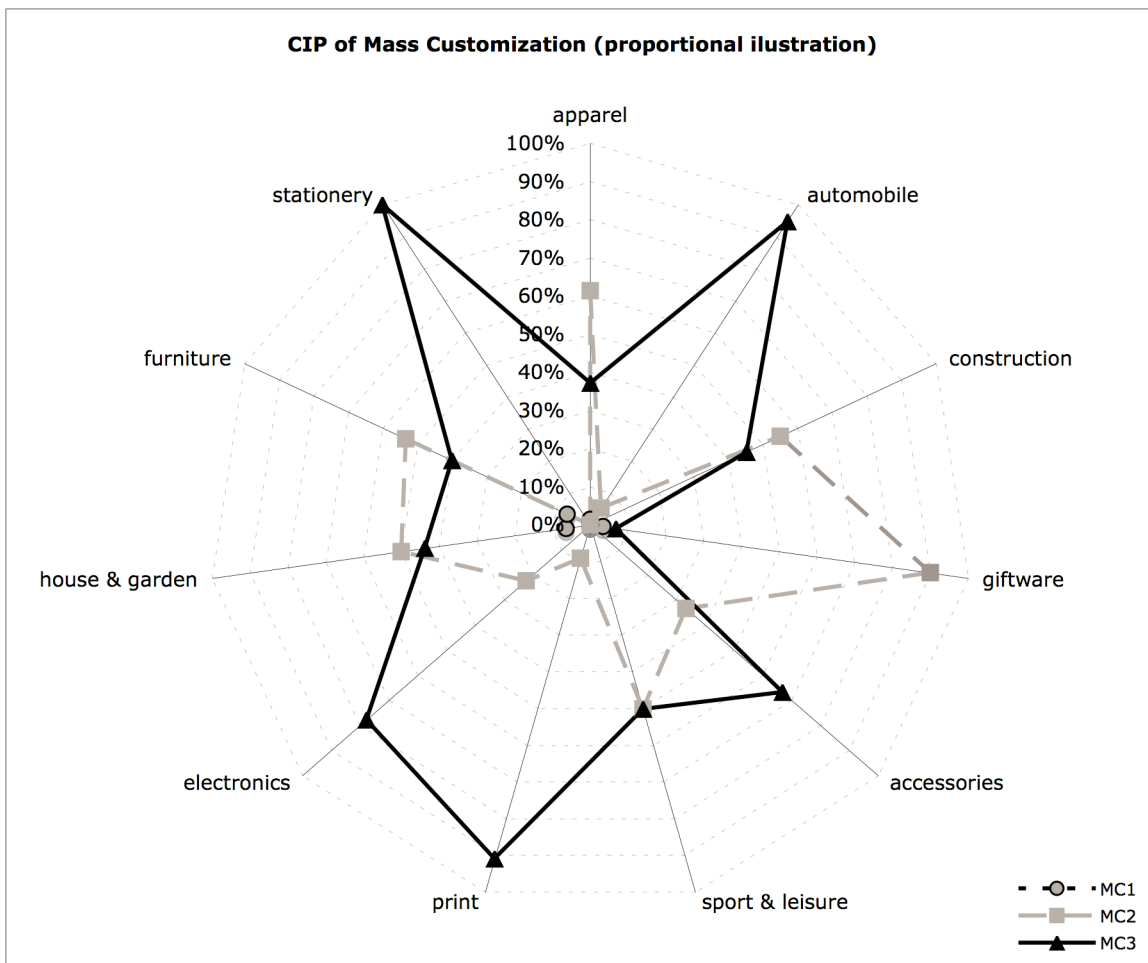


Figure 6-23 CIP of Mass Customization – entire supply chain

MC1 is a seldom use as a CIP. This art of mass customization was only observed in furniture, house & garden, apparel and giftware industry. Direct connection to the customers creates benefits for the producer, where MC brings only limited added value. This level of customization could be seen in almost every Internet shop.

Customization is realized by additional delivery services, packaging, or a selection of financing to purchase those products.

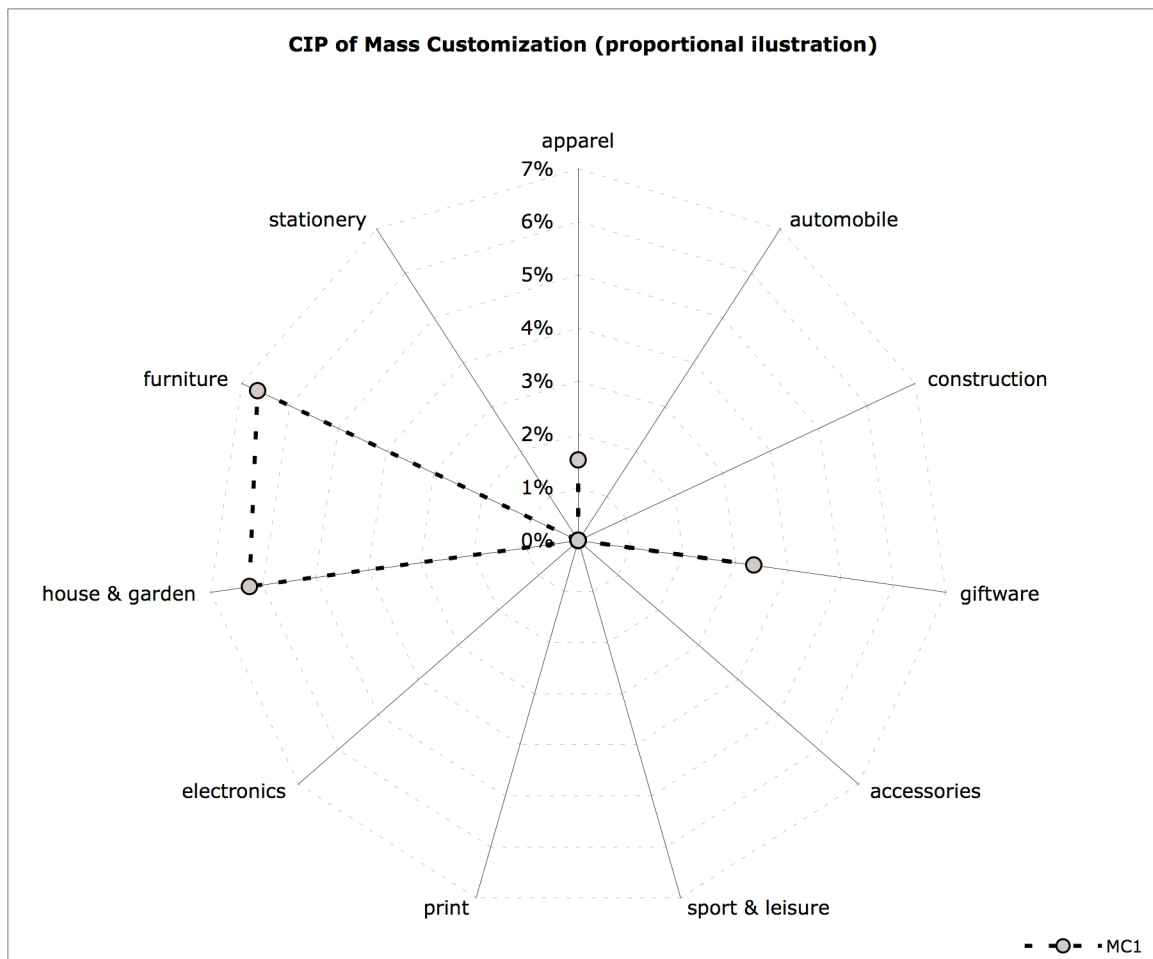


Figure 6-24 CIP of Mass Customization – MC1

Mass customization of post-production brings a benefit of mass production with a personalization. Mass produced goods are finished based on the customers' wishes and limited customization is possible.

The post-production realized mostly by apparel changes to the products (without a functionality changes) are identified in giftware, apparel, sport & leisure industry.

The post-production with a functionality changes is typical to a modular product design, where the selections of modules reach the required functionality of the product. This approach is mostly selected in furniture, house & garden, construction industry.

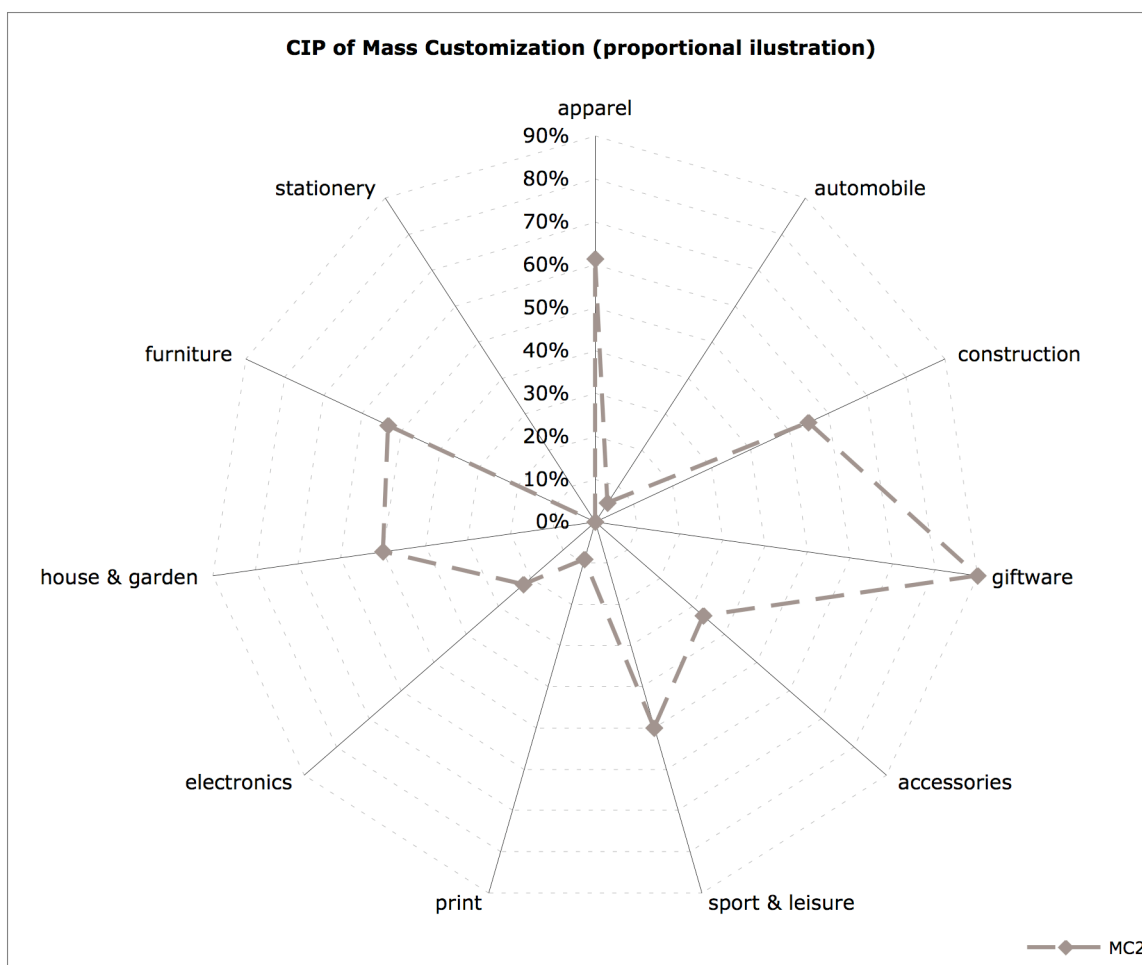


Figure 6-25 CIP of Mass Customization – MC2

Mass customization of production is typical to the industries, where modern technologies are used for production like stationary, automobile, electronic and print industry. Customization is reached via a module design of product (automobile a electronic industry) or modern technologies, which allow a customized production based on the customer design (stationary, print and accessories industry).

Industries, which position the CIP in MC3, allow the customers to produce the goods, with no functionality tradeoffs. This level of CIP creates challenges on both sides. Customers have to be ready to enter the production processes and on the other side company has to be ready fulfill the requirements of the customers.

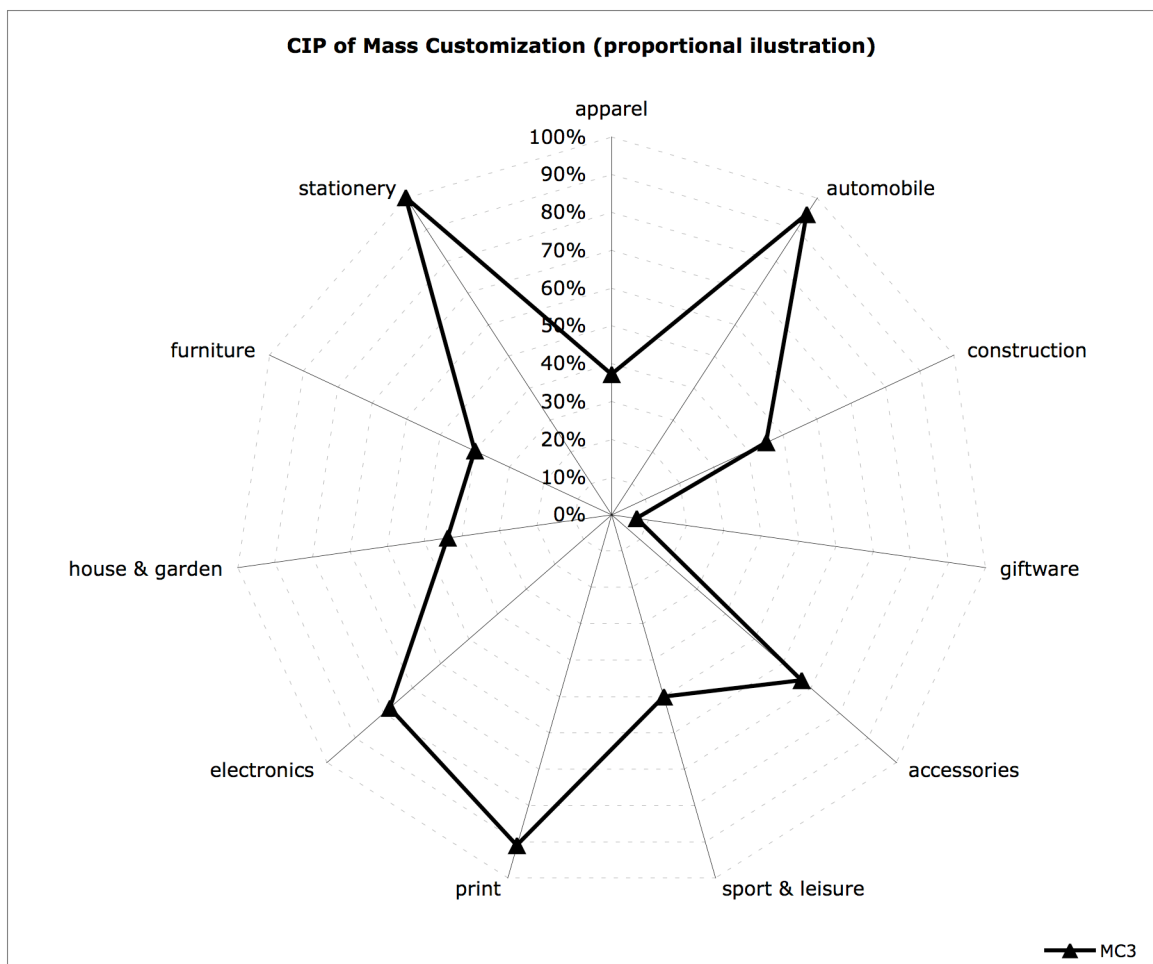


Figure 6-26 CIP of Mass Customization – MC3

6.13.2 Overall level of mass customization over the entire supply chain

The previous chapter presented values for CIP – maximal level of MC reached for each industry and its proportional allocation between MC1, MC2, and MC3. This chapter shows relative values of mass customization development in each sector.

Values are presented relatively in order to compare each industry. High values represent high intensity of mass customization over the entire supply chain. The charts show clearly differences between industries.

Figure 6-27 shows that the automobile and print industry master all the level of mass customization in order to produce the goods according to the customers' wishes. These industries should be considered as a benchmark for another industries.

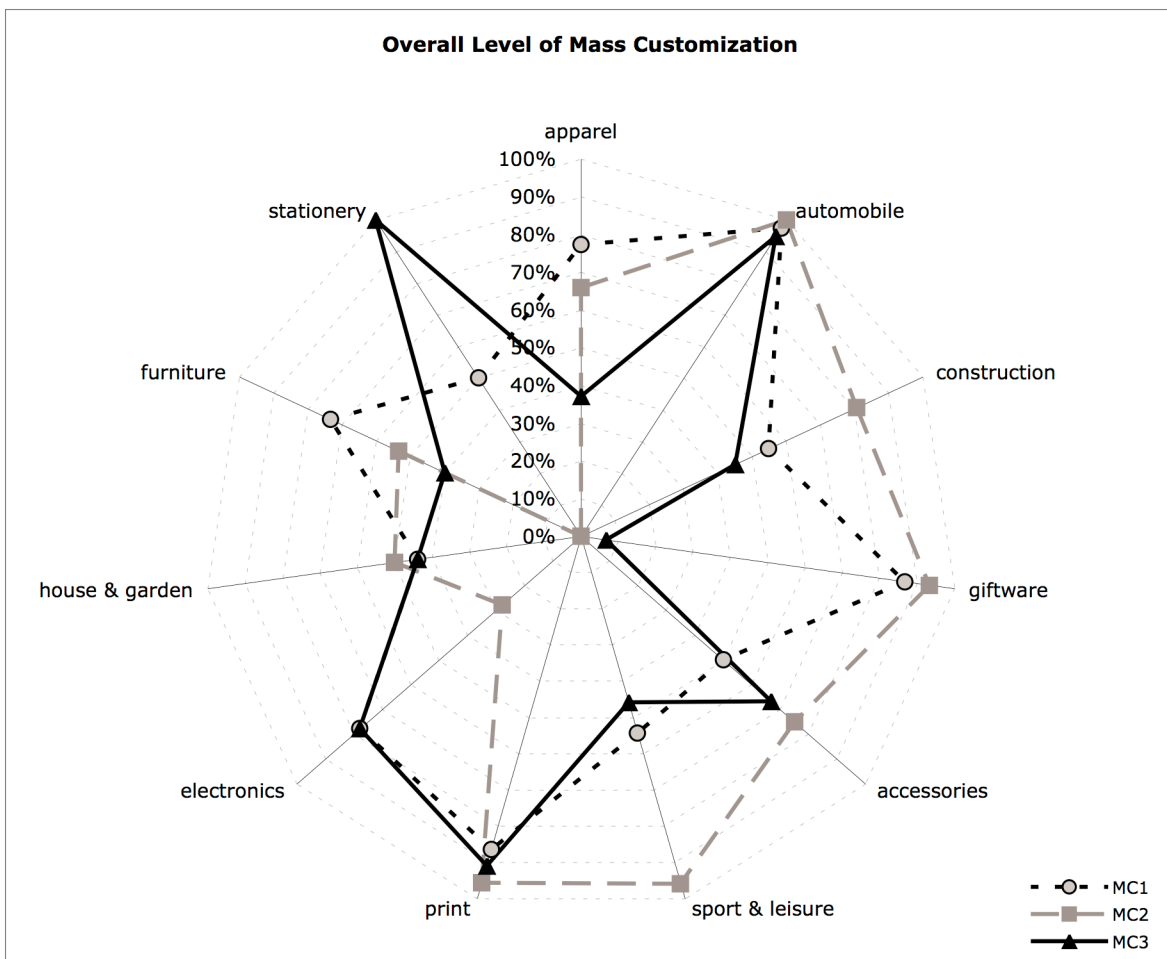


Figure 6-27 Level of MC for each Industry – entire supply chain

MC1 is most used level of mass customization closely followed by MC2. Most companies offer the customization of distribution, which is mostly represented by the payment methods, distribution channel, packaging and financing support. Customization of distribution is mostly provided by post services, which differ by the country same as the financing possibilities. The payments options are mostly provided worldwide are same for every producer.

Higher level of mass customization MC2 and MC3 coexist together or only one is provided. Coexistence of several level of mass customization was observed in automobile or print industry. Usage of only one level of mass customization could be seen for example by stationary industry (only MC3 is offered) or giftware industry (only MC2 is offered).

7 SUMMARY

This thesis describes the mass customization as a new production strategy, which will take over after the strategy of mass production. Mass production utilizes the production resources and allows producing a high quantity of the goods for a low price. This strategy was implemented first time in automobile industry in twentieth century. After almost a hundred years modern technologies allow the producers to focus on customer and produce goods in low quantity – “quantity of one” still in low price.

This new modern strategy was named mass customization. Several characteristic of the mass customization are mentioned in Chapter 2.5.6. Chapter 2.5.1 provides own definition of mass customization and includes the review of MC frameworks. They are projected to a supply chain in Chapter 5.1 and give a basic overview of current frameworks of MC (G2).

Modern technologies, information systems and Internet created an environment for mass customization. Self-service – integrates customer in the production processes. A customer is not anymore passive consumer of produced goods, but takes an active role as a co-designer.

Customer as a key element of mass customization was analyzed in Chapter 5.2.1. Eurostat - The Statistical Office of the European provided data to confirm Hypothesis H1 (customer part). Customers have knowledge to use self-service solutions and enter the production process. More then a technology breaks this integration their shopping habits [Table 5-1, Table 5-2 and Table 5-3].

Companies are aware of necessity of customer integration. They entered the era of digital economy [Table 5-4, Table 5-5, Table 5-6 and Table 5-7] and they are ready to open their information systems to the customers (confirmed hypothesis H1 company part).

This thesis defines a new framework for mass customization based on CIP (Chapter 5.3, Goal G3). CIP is an important indicator of mass customization. CIP changes the nature of a supply chain to a demand chain. CIP determines the point of uncertainty of the customer order, since the customer design and purchase the final product.

Companies considering MC need several adjustments of the key elements for successful implementation [5.3]. Mass customization changes dramatically the company, product, supply chain and the customer. MC provides flexibility and the ability of reaction to the customers' requirements.

Chapter 6 is dedicated to the evaluation of 366 companies (Goal G4). Those companies are evaluated base on the CIP and the intensity of MC. This analysis confirmed hypothesis H2. Figure 7-1 presents the CIP over the analyzed industries sorted by MC3.

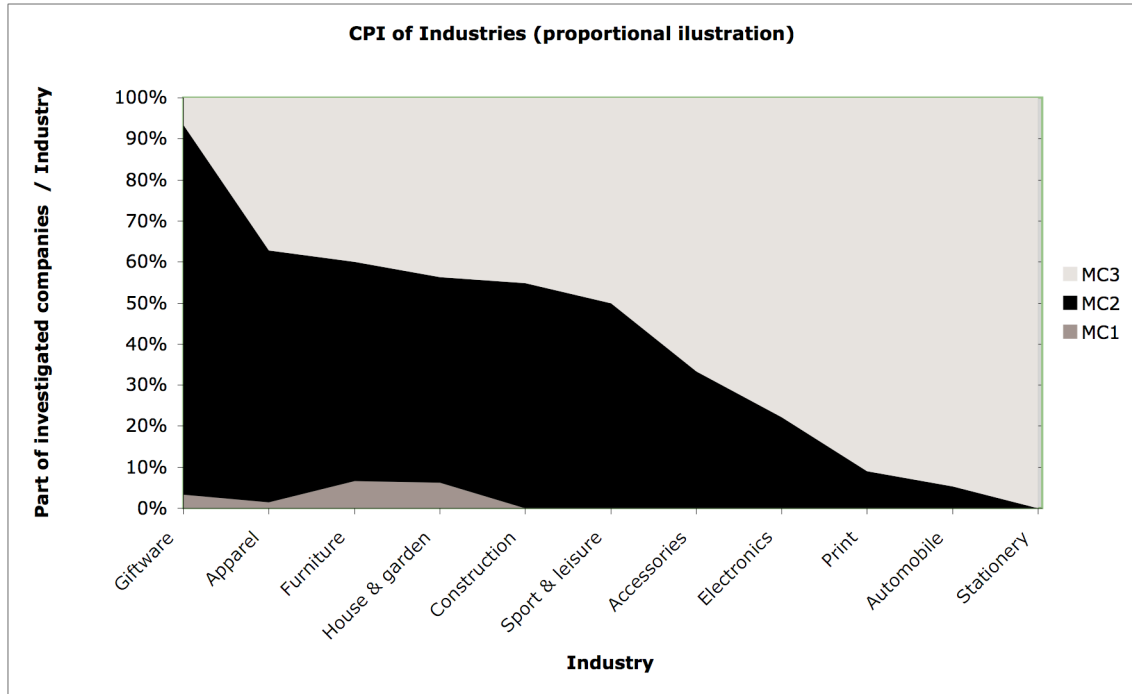


Figure 7-1 CPI of the analyzed industries

The research showed that the level of customization or reached CIP is not common for every product, but there are some similarities within each industry.

The level of CIP and the customer service during the entire customization / configuration processes are key elements of a successful company in the era of digital economy.

Several products with different CIP could be produced within the same company. Even the co-existence of mass customization and mass production is possible, since the selected CIP / strategy is based on the specific product.

Each company should evaluate possibilities to implement mass customization strategies in order to gain competitive advantages. There is no right implementation of the MC in the industries but the automobile industry and electronic industry should be analyzed for best practices and experience.

8 SHRNU TÍ

Následující kapitoly jsou částečným souhrnem celé disertační práce v českém jazyce. Kapitoly neobsahují obrázky, tabulky a odkazy na literaturu. Tyto elementy jsou referencovány z anglické části práce.

8.1 Současný stav zkoumané problematiky

Globální ekonomika změnila současný styl života. Konkurence nezná hranice, legislativy jednotlivých zemí umožňují globální soutěž a demografické bariéry padají. Lokální asijské firmy uspívají na západních trzích, kde tradiční výrobci jsou vytlačeni z trhů.

Globální konkurence nutí firmy porozumět přání zákazníků a věnovat se jejich plnění. Moderní firmy implementující tradiční výrobní postupy jako masovou produkci, výrobní linky, JIT, Kanban, TQM nemají žádnou konkurenční výhodu. Současní zákazníci vyžadují výrobky, které vyhovují jejich představám, za nízkou cenu a krátkou dobu doručení. Tato práce popisuje masovou kustomizaci, výrobní strategii, která je odpovědí výrobců na potřeby zákazníků. Masová kustomizace je dalším vývojovým stádiem produkčních strategií, která navazuje na principy masové produkce.

Prof. Zelený definuje deset dimenzí paradigmat globálního managementu, kde masová kustomizace, self-service a integrace dodavatelů a zákazníků má své místo [Figure 2-1 Internal, External and Customer integration]. Integrace dodavatelů a zákazníků do výrobních sítí je hlavním znakem masové kustomizace.

K tomu, aby byla tato integrace možná, je nutné přenést všechny členy sítě do éry digitální ekonomiky, jak ji definuje Tapscott. Z dvanácti témat digitální ekonomiky jsou následující předpokladem pro masovou kustomizaci: digitalizace, virtualizace, integrace, odstranění prostředníků, inovace a globalizace. Digitální ekonomika utvořila podmínky pro dokonalou konkurenci, na kterou se musí současné firmy adaptovat.

Internet, celosvětová komunikační síť umožňuje komunikace mezi výrobcem a zákazníkem / dodavatelem [Figure 2-2 Mass customization strategy – connecting customers and suppliers], a tvorbu produkčních sítí. Self-Service neboli „samoobsluha“ umožňuje zákazníkům přímý vstup do výrobních systémů, kde zákazníci mohou navrhovat a plánovat své výrobky.

8.1.1 Změna chování zákazníků – výrobce

80. léta jsou ve znamení masové výroby, kde společnost konzumuje velké množství masově vyráběných produktů. Individualita není vyžadována, spíše se jedná o to, mít to, co mají ostatní. Koncem minulého století se posunula společnost k individualismu, kde výrobky přizpůsobené na míru jsou požadovány. Zákazníci jsou více kritičtí a vyžadují individuální řešení v ceně masové výroby. Nové firemní systémy (CRM) zpracovávají informace o zákaznících a firmy se snaží předpovědět jejich potřeby. Tradiční marketingové průzkumy poskytují informace o možných potřebách, které se, ale v současné době dramaticky vyvíjejí a mění v čase. Tyto tradiční metody nemůžou být využity v turbulentních dobách, kde zapojení zákazníka do výrobního procesu je správnou reakcí.

Self-Service s využitím konfiguračních systémů a poradenských systémů (advisory systems) propojuje zákazníky s výrobními systémy [Figure 2-4 Self-service as an interface between customer and company]). Samoobslužné systémy jsou známy převážně z bankovníctví či call center, kde si podniky "outsourcovali" práci bez přidané hodnoty na zákazníky. Self-service má různé komunikační kanály (SMS, Aplikace pro mobilní telefony, telefonní systémy, samoobslužné kiosky a Internetové aplikace [Figure 2-3 Communication channels for Self-service]). S rozvojem Internetu a počítačové gramotnosti zákazníků převládá v dnešní době self-service přes Internet.

Rozvoj Internetu jako komunikačního média smazal geografické bariéry a vytvořil předpoklady pro globální konkurenci. Globální komunikační systémy jako VoIP, Web 2.0 (blogs, společenské sítě, wiki, podcasting, RSS feed) umožňují zpracování a poskytování informací mezi výrobcem a zákazníkem. Tvorba komunity zákazníků a vytvoření platformy pro jejich vzájemnou komunikaci, výměnu názorů a rad patří k současným trendům.

Globální obchodní platformy (E-bay, Alibaba) vytvořily prostor pro virtuální prodej, kde se střetává nabídka s poptávkou. Tyto obchodní platformy mají napojení na platební systémy zprostředkující platby za prodané zboží.

Globální zasilatelské služby (DHL, UPS) dodávají celosvětově produkty. Propojení výše uvedených globálních služeb tvoří podmínky pro podnikání v prostředí globální konkurence.

8.1.2 Masová kustomizace

V současné době existují dva přístupy k výrobě individuálních výrobků. První je založen na kombinaci vhodných modulů, jejichž spojením je dosaženo výsledné funkce výrobku. Druhým je individuální výroba s vysokou účinností výrobních zdrojů a cenou podobnou jako u masové výroby.

Masová kustomizace je definovaná v této práci jako: Intervence zákazníka do výrobních procesů za účelem návrhu výrobků, které pokrývají potřeby zákazníka. Bod intervence výrobních procesů [Chapter 5.3] a stupeň masové kustomizace [Table 6-1 Definition of CIP and the Intensity of mass customization] hrají v tomto procesu hlavní roli.

Masová kustomizace je definována světovými badateli dle různých kritérií: Definice dle produktu a jeho reprezentace [2.5.1.1] , Definice dle vykonavatele masové kustomizace [2.5.1.2], Definice dle výrobní perspektivy [2.5.1.3], Definice dle úrovně masové kustomizace [2.5.1.4].

Příznivý ekonomický dopad masové kustomizace na výrobní náklady je možno vidět na Figure 2-7 Economic implication of Mass Customization. Strategie masové kustomizace umožňuje kusovou výrobu při nákladech srovnatelných s masovou produkcí. Blecker dokonce výrobu, jejíž rozdíl od masové kustomizace je větší jak 15%, nepovažují za formu masové kustomizace, ale za zakázkovou výrobu.

Flexibilní výrobní systémy umožňují rychlou reakci v turbulentních dobách a zvyšují šanci na přežití v globální konkurenci. Moderní výrobní systémy [Figure 2-8 Production with flexible and inflexible manufacturing systems] (řízené informačním systémem podniku) eliminuje náklady na seřízení výroby a jsou podmínkou pro implementace masové kustomizace.

Masová kustomizace nemusí celkově nahrazovat masovou produkci. Masová produkce a masová kustomizace mohou fungovat současně [Kotha] ve stejné firmě a jejich propojením se vytváří konkurenční výhody. Výzkumníci definovali mnoho různých faktorů pro úspěch masové kustomizace. Tyto se dají shrnout z pohledu výrobního řetězce. Připravenost zákazníka, distribuce, výroby a dodavatelů, jejich vzájemná spolupráce a informovanost jsou klíčem k úspěchu masové kustomizace.

Masová kustomizace má specifickou charakteristiku, která spoří výrobní a skladovací náklady a napomáhá ke konkurenceschopnosti výrobního podniku. Mezi nejvýznamnější charakteristiky masové kustomizace patří: před započítáním výroby je již výrobek prodán určitému zákazníkovi, žádné neprodané výrobky (při objednávce je již výrobek zaplacen), žádné sklady s dokončenými výrobky (po výrobě je výrobek přímo distribuován zákazníkovi), zákazníci platící za výrobu (žádný svázaný kapitál pro výrobní zdroje), žádní anonymní zákazníci, integrovaný a uvědomělý zákazník, žádní zprostředkovatelé a prodejní místa nejsou potřeba, JIT produkce bez možnosti dlouhodobého plánování produkce, dynamická tvorba výrobních sítí (vznik po objednávce zákazníka).

8.2 Hypotézy a cíle

8.2.1 Hypotézy

H1 - Pro implementaci masové kustomizace neexistují technologické bariéry.

Zákazníci jsou schopni využívat self-service systémy k interakci s výrobním podnikem, výrobci vstoupili do éry digitální ekonomiky, kde mohou být implementovány principy masové kustomizace.

H2 - Výrobní podniky implementující strategii masové kustomizace mají podobnou úroveň implementace, která je specifická pro dané odvětví průmyslu. Existují rozdíly mezi průmysly.

8.2.2 Cíle

G1 - Potvrdit hypotézy H1 a H2

G2 - Zpracovat přehled literatury a definovat systém masové kustomizace dle dodavatelského řetězce.

G3 - Zpracovat systém pro hodnocení masové kustomizace z pohledu G2, a definovat požadavky na firmu a její okolí.

G4 - Použít definovaný systém v G3 pro hodnocení firem z vícero odvětví průmyslu, za účelem nalezení společných charakteristik implementace masové kustomizace.

8.3 Výsledky výzkumu

8.3.1 Přehled literatury

Výzkumníci definovali několik systémů masové kustomizace, které jsou zobrazeny z pohledu dodavatelského řetězce v obrázku Figure 5-1 Different models of Mass Customization. Tyto systémy jsou založeny na empirických výzkumech, průzkumu literatury a případových studií. Toto zobrazení je později rozvedeno do systému masové kustomizace dle bodu intervence zákazníka (Customer intervention point - CIP).

8.3.2 Klíčové elementy masové kustomizace

Klíčovými elementy masové kustomizace jsou zákazník, organizace, produkt a dodavatelský řetězec. Každý element musí být připraven na vstup do masové kustomizace a plnit svou roli v celém systému.

8.3.2.1 Zákazník

Heslo T. Baťa "Náš zákazník, náš pán" bylo v posledních dekáдах zanedbáváno. Teprve masová kustomizace si klade plnění přání zákazníků za své. Tak, jak se Baťa staral o celý dodavatelský řetězec od práce s dodavateli, přes výrobu až po maloobchodní prodej a tedy přímý styk se zákazníky, naplňuje systém masové kustomizace stejné myšlenky.

Každá firma musí analyzovat své zákazníky a nalézt odpovědi na následující otázky:

- Jsou naši zákazníci připraveni na komunikaci přes Internet využitím systémů pro self-service?
- Jsou naši zákazníci ochotni podílet se na návrhu výrobků?
- Jsou zákazníci připraveni čekat na výrobu jejich produktu?
- Jsou zákazníci připraveni zaplatit více za pro ně uzpůsobené produkty?

Údaje statistického úřadu Evropské unie - Eurostat poskytují odpověď na první otázku. Skoro téměř jedna třetina dotazovaných objednala zboží on-line přes Internet [Table 5-1]. Jedna pětina dotazovaných nenakupuje přes Internet, protože nechce měnit své návyky a preferuje nakupování v tradičních kamenných obchodech [Table 5-2]. Pouze 5% z dotázaných nenakupuje přes Internet, protože nemají potřebné schopnosti [Table 5-3]. Podle dostupných informací můžeme usuzovat, že zákazníci nemají technologické bariéry pro vstup do éry masové kustomizace.

Účast zákazníků při návrhu výrobku je výzvou pro výrobní podnik. Zákazníci musí být správně informováni o výrobě a jejich možnostech. Čas od ukončení návrhu, do doručení hotového výrobku musí být co nejkratší a musí být akceptován zákazníkem. V automobilovém průmyslu je akceptovatelná měsíční čekací doba, kdežto v počítačovém průmyslu rozhodují dny.

8.3.2.2 Organizace

Tradiční podnikové disciplíny se musí transformovat do nové formy, která je vhodná pro éru masové kustomizace. Marketing, plánování, určování cen, cash-flow, logistika a práce v týmech se změnila od základu. Chybějící hotové produkty, které by mohly být obsahem marketingu, chybějící střednědobé a dlouhodobé výrobní plány s plánovanými dodávkami od dodavatelů. Zvýšený tlak na dodávku specifického produktu určitému zákazníkovi jsou podněty, na které je potřeba flexibilně reagovat.

Firma vyrábějící dle strategie masové kustomizace je:

- procesně orientovanou firmou, kde jednotliví zákazníci spouštějí produkční procesy.
- optimalizovaná, protože každá nová objednávka je analyzovaná a naplánovaná tak, aby výrobní kapacita byla co nejlépe využita.
- flexibilní a má dobře připravené zaměstnance, kteří jsou schopni reagovat na změny ve výrobním plánu
- orientovaná na zákazníky, kteří spouštějí výrobní procesy.

E-commerce je prvním krokem k masové kustomizaci. Prostředníci jsou vyloučeni z dodavatelského procesu a přímý vztah se zákazníky je vytvořen. Výzkum firmy Accenture, eEurope Connecting the Dots, poskytuje informace o e-commerce a její budoucnosti. Třetina respondentů potvrzuje významný vliv eCommerce na to, jak jejich firma funguje [Table 5-4]. Polovina respondentů přisuzuje eCommerce rozvoj vztahu se zákazníky a dodavateli [Table 5-5]. Dvě třetiny dotázaných souhlasí, že eCommerce přináší lepší porozumění potřebám zákazníků a umožní firmám přinést nové produkty rychleji na trh [Table 5-6, Table 5-7].

Výzkum potvrdil připravenost firem na vstup do éry masové kustomizace a potvrdil hypotézu H1.

8.3.2.3 Zaměstnanci

Masová kustomizace přináší nové výzvy pro zaměstnance a management firmy, kteří se musí vypořádat s dynamickou a flexibilní výrobou, která je řízena zákazníky.

8.3.2.4 Produkt

Produkty v době masové kustomizace mají buď modulární skladbu, nebo jsou vyráběny moderními CNC stroji řízené přímo informačním systémem firmy. Modulární design výrobků umožňuje vhodnou skladbou modulů docílit výsledné funkcionality a nízké ceny, protože zákazník platí jen ty moduly, které potřebuje.

8.3.3 Bod intervence zákazníka (CIP)

Výzkumníci definovali různé body v dodavatelském řetězci. Eloranta definuje bod, kde je, jak zákazník uzavírá koupi. Rudberg a Winker definují bod v dodavatelském řetězci, který rozděluje rozhodnutí učiněná v tomto řetězci za nejistoty a jistoty zákaznickovy poptávky.

Bod intervence zákazníka rozšiřuje oba dva pohledy a je definován jako: bod v dodavatelském řetězci, ve kterém vstupuje zákazník do výrobního procesu a přebírá aktivní roli při formování výsledného produktu. Od tohoto bodu je zákazník zodpovědný za všechna rozhodnutí a je návrhářem svého produktu, který uspokojí jeho potřeby.

CIP promítnutý do dodavatelského řetězce zobrazuje úroveň masové kustomizace v tomto řetězci a definuje požadavky na firmy a zákazníky.

Pohyb CIP zprava doleva, mění povahu dodavatelského řetězce zřízeného nabídkou na řetězec řízený poptávkou. Tento pohyb umožňuje firmám efektivní výrobu a hospodárnost při výrobě.

8.3.4 Soustava dle bodu intervence zákazníka

8.3.4.1 *Cd - kustomizace provedená zákazníkem po doručení výrobku*

Cd není v této práci vnímána jako stupeň masové kustomizace, pokud není kombinovaná s dalším vyšším stupněm. Tato kustomizace obsahuje změnu parametrů produktu, které jsou podporovány jeho designem. Příkladem můžou být mobilní telefony, jejíž pozadí, zvonění si může zvolit sám zákazník. Zákazník nepotřebuje žádné speciální znalosti, tuto kustomizaci musí umožňovat design výrobku. Tradiční dodavatelský řetězec je použit pro výrobu a distribuci těchto produktů.

8.3.4.2 *MC1 - kustomizace distribučních kanálů*

MC1 je kustomizací, která se odehrává za branami podniku, nejčastěji distribučním partnerem. MC1 vyžaduje implementaci eCommerce a CRM systémů k vytvoření vztahů k jednotlivým zákazníkům. Zákazníci zaujímají aktivní roli, a podílejí se na změnách během distribuce výrobku. Tyto změny, převážně realizované dodatečnými službami, musí být umožněny vhodným designem výrobku. Většina změn má charakter kosmetických změn. Standardní dodavatelský řetězec, rozšířený o informace o jednotlivých zákaznicích realizuje výrobu a distribuci produktů.

8.3.4.3 *MC2 - kustomizace dodatečné výroby*

MC2 je vytvořena výrobcem potom, co převážná část výrobku byla vyprodukována systémy masové produkce. MC2 umožňuje vstup zákazníků do výrobního procesu a specifikaci doplňkových výrobních aktivit. Zákazník hraje aktivní roli a potřebuje částečné znalosti pro kustomizaci výrobků. Firmy musí propojit CRM a ERP systémy a umožnit zákazníkovi částečný vstup do výroby. Co-existence masové produkce a masové kustomizace je možná a projevuje se v designu výrobků, které profitují z obou dvou strategií.

8.3.4.4 MC3 - kustomizace výroby

MC3 je jádrem masové kustomizace, kde zákazník hraje ústřední roli. Celý výrobní proces je spuštěn po návrhu výrobku zákazníkem a výsledkem procesu je specifický výrobek, který je určen specifickému zákazníkovi. Zákazníci musí mít hlubší povědomí o výrobku a jeho vlastnostech. Výrobce musí vybavit zákazníky vhodnými nástroji pro design. Masová kustomizace klade nároky na procesní řízení produkce. Firmy procházejí transformací, protože vnitřní výrobní procesy jsou řízeny zákazníky. Zákazníci mají možnost návrhu výrobků buď modelárním designem nebo úplnou volnost designu. Dodavatelský řetězec musí akceptovat výzvu pro JIT produkci rozdílných výrobků, bez střednědobých, či dlouhodobých plánů. Zákazník řídí celý dodavatelský řetězec (zapojené firmy) tvorbou svých výrobků.

8.3.4.5 MC4 - kustomizace celého dodavatelského řetězce

MC4 je speciálním případem masové kustomizace, kde celý dodavatelský řetězec se podílí na masové kustomizaci. Kustomizace není provedena pouze "hlavním" výrobcem, ale je rozdělena po celém dodavatelském řetězci. V praxi mohou existovat dvě realizace: dodavatel jako spoluvýrobce, nebo dodavatel jako poskytovatel kustomizovaných modulů.

8.3.5 Analýza firem podle CIP

Firmy vyrábějící pomocí strategie masové kustomizace nejsou zatím uváděny ve speciálních kategoriích jako TOP 100 nebo "Nejlepší firmy ...". Následující předpoklad byl učiněn při výběru vhodných firem k analýze: Firmy implementující strategie masové kustomizace musí být přítomny na Internetu a jejich stránky musí obsahovat konfigurační systémy pro self-service.

Firma cyLEDGE poskytuje informace o firmách používající konfigurační systémy. Tento seznam byl v nezměněném uspořádání použit v této práci. Výše uvedený systém masové kustomizace dle CIP je využit pro hodnocení firem. Každá firma byla vyhodnocena, co se týká jejich poskytování masové kustomizace, bodu intervence zákazníka a úrovni masové kustomizace. MC3 a MC4 je pro konečného zákazníka transparentní, proto byly obě úrovně MC sloučeny do MC3.

Firmy z následujících odvětví byly analyzovány: oděvní průmysl, automobilový průmysl, stavebnictví, hračky, módní doplňky, sportovní potřeby, domov a zahrada, tiskové produkty, elektronika, nábytek a papírnický průmysl.

Pro každé odvětví jsou uvedeny podrobné údaje a grafy v kapitolách 6.2 - 6.12. První graf: úroveň masové kustomizace v průmyslu znázorňuje přítomnost masové kustomizace v průmyslu a bod intervence zákazníka (nejvyšší dosaženou formu masové kustomizace pro daný výrobek). Druhý graf: Intenzita masové kustomizace znázorňuje graficky intenzitu masové kustomizace pro její jednotlivé formy (Cd, MC1, MC2, MC3).

8.3.6 Souhrn výsledků

8.3.6.1 Bod intervence zákazníka pro jednotlivé odvětví

Analýza 366 firem z různých oblastí průmyslu určila CIP pro papírnický průmysl, elektroniku, tiskařství, módní doplňky, sportovní vybavení a automobilový průmysl v oblasti MC3 - masová kustomizace ve výrobě.

CIP v oblasti MC2 je typický pro oděvní průmysl, nábytek, domov a zahrada, dárky a stavební průmysl.

Žádná ze zkoumaných firem neumístila CIP do oblasti MC1 a Cd. Graf [Figure 6-23 CIP of Mass Customization – entire supply chain] shrnuje proporcionální výsledky pro jednotlivé odvětví (osa znázorňuje vždy 100% firem daného odvětví).

Grafy (Figure 6-24 CIP of Mass Customization – MC1, Figure 6-25 CIP of Mass Customization – MC2, Figure 6-26 CIP of Mass Customization – MC3) znázorňují CIP v oblasti MC1, MC2, MC3.

8.3.6.2 Celková úroveň masové kustomizace v celém dodavatelském řetězci

CPI prezentuje vždy maximální úroveň masové kustomizace, bez ohledu na nižší formy masové kustomizace. Graf [Figure 6-27 Level of MC for each Industry – entire supply chain] znázorňuje celkový proporcionální přehled masové kustomizace. Z grafu vyplývá, že automobilní, tiskárenský průmysl ovládá masovou kustomizaci a měly by být zvažovány jako benchmark pro jiné odvětví.

MC1 je nejčastější formou masové kustomizace, většinou reprezentována různými distribučními kanály a platebními metodami. Vyšší formy masové kustomizace MC2 a MC3 jsou buď provozovány společně nebo jsou nabídnuty jen v jedné formě.. Společné používání MC2 a MC3 bylo pozorováno v automobilovém a tiskařském průmyslu. Používání jen jedné formy masové kustomizace je například v papírovém průmyslu (MC3) nebo v dárkových produktech (MC2).

8.4 Závěr

Tato práce popisuje masovou kustomizaci jako novou výrobní strategii, která následuje po strategii masové produkce. Masová produkce efektivně využívá výrobní zdroje, při výrobě velkého množství výrobků za nízkou cenu. Tato strategie byla poprvé použita v automobilovém průmyslu na začátku dvacátého století. Po sto letech moderní technologie umožňují výrobcům znovu se zaměřit na zákazníka a produkovat výrobky v malém množství za stále nízkou cenu.

Tato nová moderní strategie se jmenuje masová kustomizace. Několik charakteristik masové kustomizace bylo zmíněno v Chapter 2.5.6. Vlastní definici masové kustomizace poskytuje Chapter 2.5.1 a předkládá zhodnocení dosavadní literatury. Systémy masové kustomizace jsou porovnány z perspektivy dodavatelského průmyslu v Chapter 5.1.

Moderní technologie, informační systémy a Internet vytvořili podmínky pro masovou kustomizaci. Self-service integruje zákazníky do výrobních procesů. Zákazníci už nejsou jen pasivními konzumenty produktů, ale stávají se jejich spoluvůrci.

Zákazník jako klíčový prvek masové kustomizace byl analyzovaný v Chapter 5.2.1. Eurostat - Statistický úřad Evropské Unie poskytl data pro potvrzení hypotézy H1 (zákaznická část). Zákazníci mají znalosti pro self-service a vstup do výrobních procesů. Více než technologické bariéry je pozastavují jejich nákupní zvyky [Table 5-1, Table 5-2 and Table 5-3].

Firmy jsou si vědomy nutnosti integrovat zákazníka do svých procesů. Firmy vstoupily do éry digitální ekonomiky [Table 5-4, Table 5-5, Table 5-6 and Table 5-7] a jsou připraveni otevřít své informační systémy zákazníkům - potvrzena hypotéza H1 (část týkající se firem).

Tato práce definovala systém masové kustomizace založený na bodu intervence zákazníka (Chapter 5.3, Goal G3). CIP je důležitým indikátorem masové kustomizace. CIP mění vlastnosti dodavatelského řetězce a mění jej na řetězec řízený poptávkou. CIP přináší do dodavatelského řetězce jistotu koupě vyráběného produktu, protože v tomto bodě dochází k objednávce a všechny následující operace koordinuje zákazník.

Kapitola 6 je věnována analýze 366 firem (cíl G4). Tyto firmy jsou hodnoceny dle CIP a intenzity masové kustomizace. Analýza potvrdila hypotézu H2. Obrázek Figure 7-1 CPI of the analysed industries, představuje CIP v analyzovaných odvětvích (třídít dle MC3).

Výzkum prokázal, že CPI je specifický pro každý výrobek, ale podobná pozice CIP může být identifikována pro jednotlivé odvětví.

Úroveň CPI a podpora zákazníka během výrobního procesu jsou klíčem k úspěchu v éře digitální ekonomiky.

Jedna firma může vyrábět produkty s různou úrovní CPI, kde společná existence různých úrovní MC je možná.

Každá firma by měla zhodnotit přínos MC a její implementací získat konkurenční výhodu. Není žádná nejlepší forma implementace masové kustomizace ve firmě, vše je hodnoceno na úrovni výrobků.

9 CURRICULUM VITAE

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Work Experience

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During my work at Credit Suisse I was working in different roles from development, integration, configuration and change management, 2nd level support to my last position, where I work as Java Application Platform consultant. I supported IT projects migrating to the new swiss-banking platform. Currently I work as a project manager responsible for implementation and integration of modern UML modeling tools into Credit Suisse Process Assets Library.

2001 – 2004 Accenture AG, Switzerland

I worked as a consultant on two major projects within Accenture; IT in a private banking and financial controlling.

2000 – 2001 Agilent Technologies, Germany (6 months)

I worked in global services team. We provided intranet based applications and intranet portals to internal customers.

1999 – 2000 General Adjutant Office, Texas Army National Guard, USA

I developed and launched web server for use of Environmental office of National Guard. Server informs and educates environmental staff in Texas.

1996 – 1999 Antus Agency, Czech Republic

I prepared advertising planes for Husqvarna, Jonsered, Partner and Flymo. I launched servers husqvarna.cz and jonsered.cz.

1995 – 1999 AIESEC Zlin (student organization), Czech Republic

One year I was member of executive board of Local Committee responsible for projects and developing an information system of local and national committee of AIESEC.

Education

2002 – University of Tomas Bata in Zlin, PhD Program, Topic: Mass Customization

1996 – 2001 University of Tomas Bata in Zlin, master degree in management and marketing, Master Thesis: Digital Economy

- 1996 – 2000 Palacky University in Olomouc, bachelor degree in computer science, bachelor thesis: Information System of Texas Army National Guard
- 1995 – 1998 Technical University Brno, Bachelor degree in management and marketing, bachelor thesis: Information system of FaME
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- 2008 Credit Suisse Project methodology and processes (CMMI ML2)
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- 2007 CARNOT: Business Process Management Tool
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- 2005 Sun Solaris Admin Course
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LIST OF ABBREVIATIONS

CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
DSS	Decision Support Systems
DW	Data Warehouse
EIS	Executive Information Systems
IS	Information System
MC	Mass Customization
MIS	Management Information Systems
OLAP	On Line Analytical Processing
RFID	Radio Frequency Identification
CIP	Customer Intervention Point
VOP	Value offering point
MC	Mass Customization
ERP	Enterprise Resource Plannig
CRM	Customer Relationship Management
SCM	Supply Chain Management
VoIP	Voice over IP - Internet telephony
CNC	Computer Numerical Control – Manufacturing machines controlled by computer
Cd	Customization (Cd) done only by the customer after purchase
MC1	Customization of delivery channel
MC2	Mass customization of post production
MC3	Mass customization of a product
MC4	Mass customization over of the entire network

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ATACHEMENT I: EUROSTAT DATABASE DETAILS

Internet purchases by individuals

Last update: 21.11.2006

Oldest data: 2002

Most recent data: 2006

Number of values: 179978

Perceived barriers to buying/ordering over the Internet

Last update: 21.11.2006

Oldest data: 2002

Most recent data: 2006

Number of values: 63928

ATACHEMENT II: MASS CUSTOMIZATION VISUAL PRESENTATION

The screenshot displays the Apple Store's checkout process for adding a gift package. The navigation bar at the top includes links for Store, Mac, iPod + iTunes, iPhone, Downloads, Support, and a search bar. Below the navigation, the main heading reads "Choose the Apple Gift Package for just \$5.00." The page is divided into two columns. The left column, titled "No, thanks.", explains that the order will ship without the gift package but offers a free gift message during checkout. It also states "Ships: Within 24 hours Free Shipping" and includes a "Continue" button. The right column, titled "Yes.", prompts the user to "Enter a message for the greeting card." with a text input field. It notes that if no message is provided, a blank card will be sent. Shipping information for this option is "Ships: 1-2 business days Free Shipping" and the price is "\$5.00". A "Add gift package" button is located at the bottom of this section. To the right of the text is an image of a white gift box with a red ribbon. Below the main content area, there is a promotional section titled "Exclusive gift wrapping. Presentation is everything." which features an image of an iPhone and a gift box. The text describes the "Signature gift box" and "Add a special touch" options. The footer contains copyright information, terms of use, privacy policy, and contact information.

Figure 9-1 Apple.com – MC1 Addition service during distribution

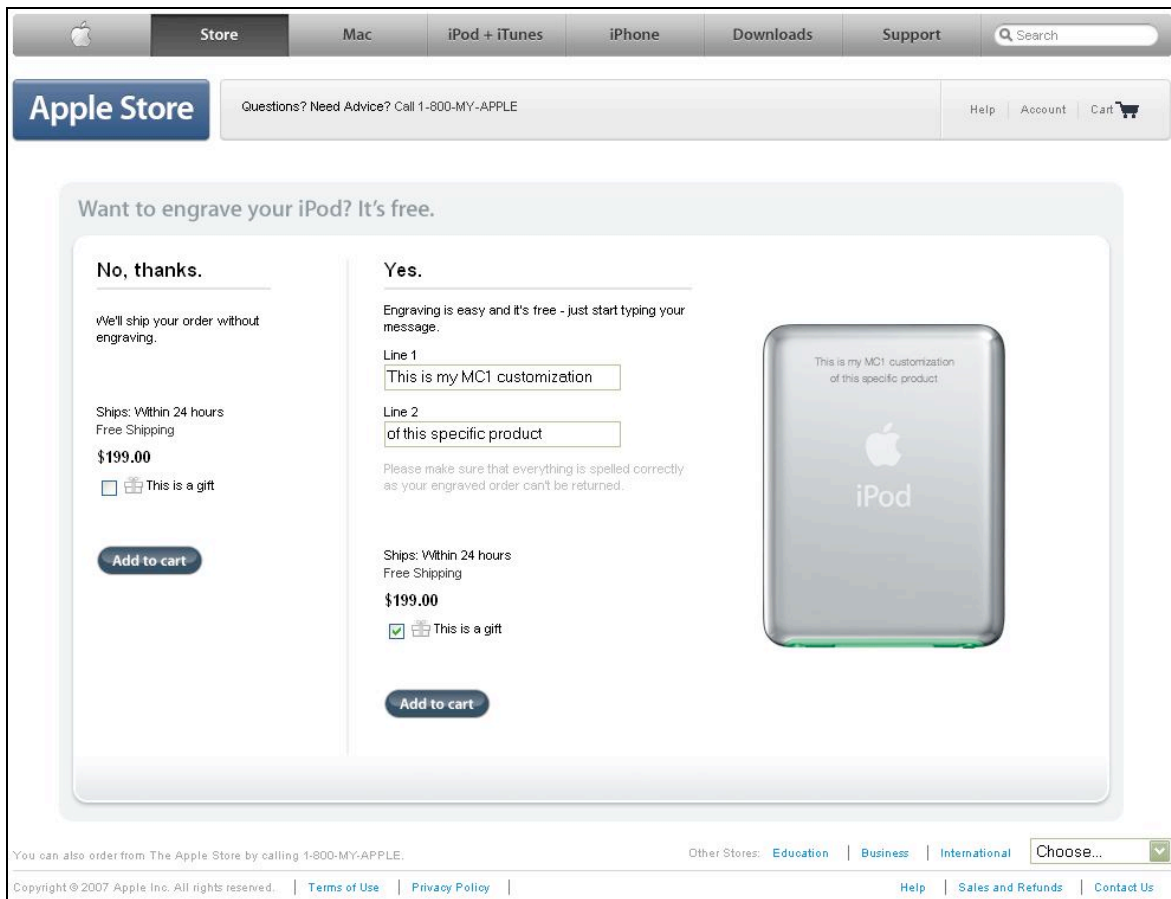


Figure 9-2 Apple.com - MC1 Addition work during distribution

Apple Store Questions? Need Advice? Call 1-800-MY-APPLE Help Account Cart

Customize your Mac.

Use the options below to build the system of your dreams.

Summary
Subtotal \$1,449.00
 Estimated Ship: **2-4 business days**
Free Shipping

Add to cart

Specifications

- 2.2GHz Intel Core 2 Duo
- 2GB 667MHz DDR2 SDRAM - 2x1GB
- 120GB Serial ATA Drive @ 5400 rpm
- Superdrive 8x (DVD±R DL/DVD±RW/CD-RW)
- Keyboard/Mac OS - U.S. English
- AirPort Extreme Card & Bluetooth

Memory
 More memory (RAM) increases overall performance and enables your computer to run more applications at the same time. The MacBook supports up to 4GB of RAM.
[Learn more](#)

The more memory your computer has, the more programs you can run simultaneously, and the better performance you get from your computer. How much memory is right for you?

- Select the standard 1GB of memory (two 512MB modules) to support day-to-day tasks such as email, word processing, and web browsing as well as more complex tasks such as editing photos, creating illustrations, and building presentations.
- Upgrade to the 2GB option (two 1GB modules) if you plan to use your system regularly for more intensive tasks, such as video editing and DVD authoring.
- Max out your memory with the 4GB option (two 2GB modules) to enjoy the greatest possible performance for all your computing tasks.

The MacBook uses one of the fastest memory technologies available today — 667MHz, Double Data Rate (DDR2), synchronous dynamic random-access memory (SDRAM). It ensures high performance and reliability by synchronizing memory speed with the speed of the central processor so that data can be delivered continuously and more rapidly to the processor. And if both slots are loaded with an equal amount of RAM — which is strongly recommended — you can take advantage of the system's dual-channel memory architecture for an additional performance boost. With a dual-channel memory interface, both banks of SDRAM can be addressed at the same time, enabling MacBook to reach a memory throughput of up to 10.7 GBps.

1GB 667MHz DDR2 SDRAM - 2x512MB [Subtract \$150]

2GB 667MHz DDR2 SDRAM - 2x1GB

4GB 667MHz DDR2 SDRAM - 2x2GB [Add \$700]

[Close](#)

Figure 9-3 Apple.com - MC2 Modular mass customization with customer support

ATACHEMENTS III: OVERVIEW

Count of Product	Country	evaluated																			Grand Total			
		AT	AU	BE	BM	CA	CH	CN	DE	FI	FR	GB	Global	IN	IT	LU	MU	NL	no	NZ		SE	TH	US
Industry	AT	6	2	1		3	3	2	35	2	18	9	1	3	1	1	1	1	1	4	4	4	57	153
apparel		4						31	1	1	1	1											7	45
automobile		5						26		2	2	3										20	32	37
construction		2	1		1			3		2	1											24	29	32
giftware		2	1					1		1	1											13	26	29
accessories		5						6		1	1											13	26	29
sport & leisure								1		3	2								1			13	23	26
print								1		1												2	23	23
electronics		8						12		1												3	22	22
house & garden		3						15														6	19	19
house & garden furniture		1						9														6	19	19
furniture								7		1	1											6	17	17
stationery								7		1	1											6	17	17
footwear								3	1		2											10	16	16
equipment for children																						14	15	15
equipment for children																						8	11	11
food								3														6	6	6
equipment for pets																						2	5	5
advertising material								3														1	5	5
advertising material																						1	5	5
service		1																				1	5	5
entertainment								2		1	1											5	5	5
entertainment																						4	4	4
music		1						1			1											3	3	3
music																						2	3	3
transportation								3														2	3	3
transportation																						1	3	3
optician								1														1	3	3
optician																						1	3	3
steel								1														1	3	3
steel																						1	3	3
health		2																				1	3	3
health																						2	3	3
industry								1														1	2	2
industry																						1	2	2
beauty																						1	1	1
beauty																						1	1	1
chemistry		1																				1	1	1
chemistry																						1	1	1
safety system								1														1	1	1
safety system																						1	1	1
Grand Total		38	5	1	1	1	8	10	2	165	1	4	31	22	1	3	1	1	2	2	6	4	200	510

ATACHEMENTS IV: ANALYSED COMPANIES

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
1a-Werbung	T-shirt	apparel	DE	-	high	high	-
99dogs.com	T-shirt	apparel	Global	0	0	0	0
Advantage Products Group, LLC.	t-shirt	apparel	US	-	-	small	-
Agentur Zwo	T-shirt	apparel	DE	-	high	high	-
Artapart.com	T-shirt	apparel	Global	-	high	high	-
AsitUSA	T-shirt	apparel	US	-	small	middle	-
Banana Moon Workshop	clothes	apparel	GB	-	-	small	-
Baur Versand	shirt	apparel	DE	-	small	small	high
Beau Ties Ltd.	shirt	apparel	US	-	small	-	high
BERDA CompuGraphix	T-shirt	apparel	US	-	small	middle	-
BestCustomShirt.com	shirt	apparel	US	-	middle	middle	high
BeyondFleece	jacket	apparel	Global	-	middle	-	high
Bielefelder Atelier	shirt	apparel	DE	-	small	-	middle
Bivolino.com	shirt	apparel	BE	-	small	-	high
BlueCotton	T-shirt	apparel	US	-	-	small	-
c/o xhappyx.com	shirt	apparel	TH	-	-	-	middle
Cafepress	T-shirt	apparel	US	-	middle	middle	-
Camericia Stefanelli	shirt	apparel	IT	0	0	0	0
Campe Ohff	shirt	apparel	DE	-	middle	-	high
CBS Sports, Inc.	T-shirt	apparel	US	-	small	small	-
CG - customizedgirl	T-shirt	apparel	US	-	small	high	-
CGS Co Internet Stores. Liberteeshirts.com CGSCO LLC	T-shirt	apparel	US	-	-	small	-
CharGrilled Ltd	T-shirt	apparel	GB	-	middle	middle	-
Choiceshirt	T-shirt	apparel	US	-	small	middle	-
Comboutique.com	T-shirt	apparel	FR	-	middle	middle	-
Corporate Casuals	clothes	apparel	US	-	small	middle	-
Create your own T shirt	T-shirt	apparel	US	0	0	0	0
Custom T-Shirts Quick	T-shirt	apparel	US	-	-	small	-
CustomGlamGirl.com	T-shirt	apparel	US	-	-	small	-
Customink	T-shirt	apparel	US	-	middle	high	-
Customized World	T-shirt	apparel	US	-	small	high	-
Dammitman Enterprizes, Inc.	T-shirt	apparel	US	-	small	small	-
Dann Clothing	shirt	apparel	Global	-	middle	-	high
DaWanda GmbH	underwear	apparel	DE	-	small	-	middle
Design2tees.com	T-shirt	apparel	SE	-	small	high	-
DesignAShirt.com	T-shirt	apparel	US	-	small	high	-
Designathong.com	underwear	apparel	Global	-	small	middle	-
Designkabine - Georg Schütz und Joachim Kromes GbR	T-shirt	apparel	DE	-	small	high	-
Deutsche Textildruck und	T-shirt	apparel	DE	-	small	small	-

Handelsgesellschaft (DT) GmbH i. Gr.							
DeZyna Gift	T-shirt	apparel	GB	-	small	small	-
Dietrich Maßhemden	shirt	apparel	DE	-	small	-	middle
Divine Digitizing	T-shirt	apparel	CA	-	small	small	-
DNA Style Lab	T-shirt	apparel	US	0	0	0	0
Dolzer Maßkonfektionäre	shirt	apparel	DE	-	middle	-	high
DressByDesign, Inc.	clothes	apparel	US	-	middle	-	high
DT clothes	underwear	apparel	AU	-	small	small	middle
Eshirt.it	T-shirt	apparel	IT	-	middle	middle	-
Eterna	shirt	apparel	DE	0	0	0	0
event-shirts.co.uk.	T-shirt	apparel	GB	-	small	small	-
Evlove Intimates	lingerie	apparel	US	-	small	-	middle
Expertshirt	T-shirt	apparel	US	0	0	0	0
Express Design Group, Inc	T-shirt	apparel	US	-	middle	small	-
Fanmarkt	T-shirt	apparel	DE	-	small	small	-
Filharmonie	shirt	apparel	FR	-	small	-	high
Fitley	shirt	apparel	DE	-	small	-	high
Foghorn	T-shirt	apparel	AU	-	small	middle	-
Funny tshirt store	T-shirt	apparel	US	-	-	small	-
FunnyUndies.com	underwear	apparel	US	-	-	small	-
Garnet	pullover	apparel	SE	-	-	-	high
Hemdwerk::Ihr Masshemd	shirt	apparel	DE	-	middle	-	high
IDCOM	T-shirt	apparel	DE	-	small	high	-
ILoveAnything.com	T-shirt	apparel	US	-	small	small	-
Indishirt	T-shirt	apparel	DE	-	small	middle	-
innerTee	T-shirt	apparel	US	0	0	0	0
Ivo Clothing Webmaster	T-shirt	apparel	NZ	-	small	small	-
Jadnet Designs	T-shirt	apparel	GB	-	small	middle	-
Just Jen, Inc.	t-shirt	apparel	US	-	small	middle	-
Lage000.at	T-shirt	apparel	AT	-	small	small	-
Landsand	clothes	apparel	US	-	small	-	-
Liste Rouge	shirt	apparel	US	0	0	0	0
Logiprint.com	T-shirt	apparel	DE	-	small	small	-
Lowertown Printing Co	clothes	apparel	US	-	-	middle	-
Luna Art	T-shirt	apparel	DE	-	-	small	-
Made 2 Measure	shirt	apparel	GB	-	middle	-	high
Make your own jeans	clothes	apparel	IN	-	small	-	high
Make your own shirt	T-shirt	apparel	Global	-	-	small	-
Marks and Spencer plc	shirt	apparel	GB	-	middle	-	high
Maskerade copy center	T-shirt	apparel	GB	-	-	small	-
Maßhemden Perleth Classic Design	shirt	apparel	DE	-	middle	-	high
MeJeans	jeans	apparel	Global	-	middle	small	high
Metzger & Lampert	shirt	apparel	CH	0	0	0	0

Micamisa	shirt	apparel	DE	-	middle	-	high
Mortonshirts.com	shirt	apparel	US	-	small	small	high
Mosquitoshirts	T-shirt	apparel	DE	-	-	high	-
MyTailor.com Custom tailoring by Hemrajani	shirt	apparel	US	0	0	0	0
Müller Maßhemden GmbH	shirt	apparel	DE	-	middle	-	high
Neighbourhoodies	clothes	apparel	US	-	-	middle	-
North Shore Shirts	T-shirt	apparel	US	-	-	small	-
O'neill	diving-suit	apparel	US	-	small	-	high
Oberzier Werbetechnik	T-shirt	apparel	DE	-	-	middle	-
Pixeltees	T-shirt	apparel	US	0	0	0	0
Plus	shirt	apparel	IT	-	middle	-	high
Pmnm Preiswerte Mode nach Maß	clothes	apparel	AT	0	0	0	0
PrinceHenry.Biz	clothes	apparel	TH	-	small	middle	middle
Printshop Gmunden	T-shirt	apparel	AT	0	0	0	0
Promotees.com	T-shirt	apparel	US	-	-	small	-
Public Styles New Media	T-shirt	apparel	DE	-	small	middle	-
PurpleFishes	T-shirt	apparel	GB	-	middle	small	-
Ralph Lauren	shirt	apparel	US	0	0	0	0
RavisTailor, Internet and Mail Order Co	shirt	apparel	Global	-	small	-	middle
Route One Design	clothes	apparel	GB	-	small	-	middle
Running Banana	T-shirt	apparel	US	-	small	small	-
Safari Sun, Llc	T-shirt	apparel	US	-	small	middle	-
Sandi's T's	T-shirt	apparel	US	-	small	middle	-
Seven Buttons GmbH	shirt	apparel	CH	-	middle	-	high
Shirt Magic	T-shirt	apparel	US	0	0	0	0
Shirtalarm	T-shirt	apparel	DE	-	small	high	-
ShirtArt	T-shirt	apparel	DE	-	small	middle	-
Shirtcreations	shirt	apparel	US	-	small	-	high
Shirtfather	T-shirt	apparel	DE	-	small	middle	-
ShirtPainter	T-shirt	apparel	DE	-	small	middle	-
Shirtsweb.com	T-shirt	apparel	CA	-	small	small	-
Siam Leather Goods	clothes	apparel	TH	-	small	-	middle
Signatures Network Inc.	T-shirt	apparel	US	0	0	0	0
Spamshirt.com	T-shirt	apparel	GB	-	small	small	-
Spreadshirt	T-shirt	apparel	DE	-	small	middle	-
Stoffhaus Alois Reich	dirndl	apparel	DE	-	small	-	high
Sumosam	T-shirt	apparel	GB	-	-	small	-
T-Shirt-Total.de	T-shirt	apparel	DE	-	small	middle	-
T-ShirtHumor.com	T-shirt	apparel	US	-	-	small	-
T-Shirts.com, Inc.	T-shirt	apparel	US	-	-	small	-
T41	T-shirt	apparel	GB	-	small	-	-
Tailorcut.com	shirt	apparel	SE	-	small	-	high

Tailored Shirts	shirt	apparel	CN	-	small	-	high
Tailorstore	shirt	apparel	SE	-	small	-	high
TakeOutTees.com	clothes	apparel	US	-	small	high	-
Teeki hut custom tees Inc.	clothes	apparel	US	-	small	high	-
Teeshirtsdirect.com	T-shirt	apparel	GB	-	small	high	-
The EC Store, LLC	underwear	apparel	US	-	-	-	small
The Eton T-Shirt Company	T-shirt	apparel	GB	-	small	small	-
The Shirt Printer.com	T-shirt	apparel	US	-	small	high	-
TJ's Tailor Made Jeans Wear	jeans	apparel	MU	-	small	-	high
Trashic.ch	shirt	apparel	CH	-	small	-	high
TShirt Studio Limited	t-shirt	apparel	GB	-	small	middle	-
UberPrints, Inc.	T-shirt	apparel	US	-	-	high	-
Ujeans	jeans	apparel	CA	-	middle	-	high
VictoryStore.com	clothes	apparel	US	-	small	-	middle
WE Europe	shirt	apparel	NL	-	small	-	high
Webshirt.de	T-shirt	apparel	DE	-	-	small	-
You design it	T-shirt	apparel	US	-	-	middle	-
Zafu	jeans	apparel	Global	0	0	0	0
Zazzle	clothes	apparel	US	-	small	high	-
Ziami	shirt	apparel	CN	0	0	0	0
Zickshirt	T-shirt	apparel	DE	-	small	middle	-
ic3d	trousers	apparel	US	0	0	0	0
Atelier Goldener Schnitt	clothes	apparel	AT	0	0	0	0
Engelbert Strauss	business clothes	apparel	AT	-	small	-	middle
Internet and Mail Order Co., Ltd.	shirt	apparel	TH	-	-	-	middle
Islandwolle Versand	pullover	apparel	DE	-	-	-	small
MackyALive	T-shirt	apparel	DE	-	-	small	-
Reva	poloshirt	apparel	AT	-	small	-	high
T-shirtme.com	T-shirt	apparel	GB	-	-	small	-
The CELDirect Group	T-shirt	apparel	GB	0	0	0	0

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Böckmann Fahrzeugwerke	car	automobile	DE	-	-	high	small
Continental	car wheel	automobile	DE	0	0	0	0
Adam Opel	car	automobile	DE	-	small	high	middle
AEZ Leichtmetallräder	car wheel	automobile	DE	0	0	0	0
Alpha Romeo	car	automobile	DE	small	small	high	middle
ATB Austria Antriebstechnik	engines	automobile	AT	0	0	0	0
Audi Deutschland	car	automobile	DE	small	small	high	middle
Automobile Friedenseiche	car	automobile	DE	small	middle	high	middle
BMW Deutschland	car	automobile	DE	small	small	high	middle
BMW Mini	car	automobile	DE	small	small	high	middle
BMW Mini Roof	car	automobile	DE	small	small	high	middle
Bugatti	car	automobile	FR	small	small	middle	middle
Cadillac Europe	car	automobile	DE	small	small	middle	middle
Chevrolet Deutschland	car	automobile	DE	0	0	0	0
Citroen	car	automobile	GB	small	small	high	middle
Daihatsu Deutschland	car	automobile	DE	small	small	high	middle
DaimlerChrysler	car	automobile	DE	small	small	high	middle
Dunlop	car wheel	automobile	DE	0	0	0	0
Fiat	car	automobile	DE	small	small	high	middle
Fiat / Lancia	car	automobile	DE	0	0	0	0
Ford-Werke	car	automobile	DE	small	small	high	middle
General Motors Corporation	car	automobile	Global	small	small	middle	small
Harley Davidson Michigan, Inc.	motor cycle	automobile	US	small	small	small	small
Honda Motor Europe	car	automobile	DE	small	small	middle	middle
Hyundai	car	automobile	DE	small	small	small	small
Isuzu	car	automobile	US	small	small	high	-
Jaguar	car	automobile	US	small	small	high	-
Lexus	car	automobile	US	-	middle	high	middle
Maserati	car	automobile	AT	small	high	middle	small
Mazda Motors Deutschland	car	automobile	DE	small	middle	high	small
Mercury Vehicles	car	automobile	US	small	small	small	small
Nissan Deutschland	car	automobile	DE	small	small	middle	small
Peugeot Austria	car	automobile	AT	small	small	middle	small
Peugeot Deutschland	car	automobile	DE	small	small	middle	small
Porsche	car	automobile	DE	small	small	middle	small
Renault Deutschland	car	automobile	DE	small	small	high	middle
Saab Deutschland	car	automobile	DE	small	small	middle	middle
Saturn	car	automobile	US	small	small	middle	small
Seat Deutschland	car	automobile	DE	small	small	high	small
Smart GmbH	car	automobile	DE	small	middle	high	high
Suzuki Austria Automobil	car	automobile	AT	small	small	small	small
Toyota Deutschland	car	automobile	DE	small	high	high	middle
Volkswagen	car	automobile	DE	0	0	0	0
Volvo Car Germany	car	automobile	DE	small	middle	high	middle
VW of America	car	automobile	US	small	middle	middle	high

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Alco	winter garden	construction	AT	small	middle	-	middle
Kern-Haus	prefabricated house	construction	DE	-	small	-	middle
Paul Wolff	garbage can	construction	DE	-	small	-	small
Regiohaus Bau	prefabricated house	construction	DE	-	small	-	small
Regnauer Hausbau	prefabricated house	construction	DE	0	0	0	0
Schäfer Ausstattungs	network engineering cupboards	construction	DE	high	small	middle	small
Winkhaus Holding, Aug. Winkhaus	access control	construction	DE	high	small	high	-
Alno	kitchen color design	construction	DE	small	middle	high	small
Kaefer Isoliertechnik	Door	construction	DE	-	small	middle	middle
Keller&Kalmbach	storage system	construction	DE	high	small	high	-
Kenngott Treppen	Stairs	construction	DE	-	small	middle	-
Mahrenholz Fenster	Door	construction	DE	-	small	high	middle
Oculus Optikgeräte	oculist office	construction	DE	small	-	high	-
Bayerwald Fenster Hautüren	Window	construction	DE	-	small	middle	-
Betonwerk Rieder	noise barrier	construction	AT	-	small	-	high
Brüggemann TraumGarten	Playground	construction	DE	-	-	middle	-
Clopay	garage door	construction	US	-	small	middle	-
Connectad	Door	construction	GB	-	-	middle	-
Elk Fertighäuser	prefabricated house	construction	AT	-	-	small	-
Feather-river- door-comp.	Door	construction	US	-	-	middle	-
Hedde Bauuntern.	house color system	construction	DE	-	-	small	-
Hera GmbH	Luminaire	construction	DE	-	small	middle	high
Jely Haus	House	construction	DE	0	0	0	0
Krines	Window	construction	DE	0	0	0	0
Moen	Kitchen	construction	US	-	small	high	-
Nagel	Garage	construction	DE	-	-	small	-
NovEx Hausbau	prefabricated house	construction	DE	-	-	small	-
Re-Bath, LLC	Bathroom	construction	US	0	0	0	0
SSI-Schaefer	tool cabinets	construction	DE	0	0	0	0
Stokke	Nursery	construction	GB	small	-	middle	-
Streif	cladding colour	construction	DE	-	-	small	-
Tchibo Holding AG	Kitchen	construction	DE	0	0	0	0
Teckentrup	garage door	construction	DE	-	-	small	small
Thermopal	construction mat.	construction	DE	-	-	-	middle
ThyssenKrupp	Elevator	construction	AT	-	-	middle	-
Topic	Door	construction	AT	-	-	middle	small
Witec	winter garden	construction	DE	-	small	high	small

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Beaucoup Wedding Favors	Giftware	giftware	US	-	high	middle	-
Brewtopia	beer coaster	giftware	AU	-	small	small	-
Chip-N-Dough Cookie Company	gift tin	giftware	US	-	small	-	-
Custom GelPaxs Inc.	gel pack	giftware	CA	-	-	small	-
Design-her Gals, LLC.	Giftware	giftware	US	-	small	high	-
eFavorMart.com	Giftware	giftware	US	-	middle	high	-
Fluidforms Walter & Williams OEG	peper mill	giftware	AT	-	small	-	small
Genometri	picture frame	giftware	US	-	-	middle	small
Gifts Passion	Giftware	giftware	US	-	middle	high	-
Kleenex	tissue box	giftware	Global	0	0	0	0
KoolPrint.co.uk	Giftware	giftware	GB	-	middle	high	-
LASERPARTNER GmbH	laser-crystal	giftware	DE	0	0	0	0
Memorable Gifts, Inc	Giftware	giftware	US	-	middle	high	-
My custom Product	Giftware	giftware	US	-	middle	high	-
MyBambino	Giftware	giftware	US	-	small	middle	-
myJones	label for bottle	giftware	US	-	-	small	-
NameMaker Inc.	gift wrap	giftware	US	-	small	small	-
OrnamentShop.com	christmas ornament	giftware	Global	-	small	small	-
Personalization mall	Giftware	giftware	US	-	small	middle	-
Personalized by Annette	Giftware	giftware	US	-	small	small	-
Personalized Creations	Giftware	giftware	US	-	small	small	-
Personello	Giftware	giftware	DE	-	small	high	-
Picture Paper	gift wrap	giftware	US	-	small	small	-
PrintPlanet GmbH	Giftware	giftware	DE	-	small	middle	-
Sendgiftbaskets	gift basket	giftware	US	-	small	small	-
Shirtland	Giftware	giftware	AT	-	small	middle	-
Snapfish	Giftware	giftware	US	-	small	small	-
The Stationery Studio	Giftware	giftware	US	-	small	small	-
Tim's Bumper Stickers	Sticker	giftware	Global	-	-	small	-
Unique Products	Giftware	giftware	US	-	small	middle	-
Weddingstar Inc.	Giftware	giftware	US	-	small	small	-
Your design	Giftware	giftware	GB	-	small	small	-

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
1154 LILL LTD. Trade Dress	Bag	accessories	US	-	small	small	middle
Bluenile	Ring	accessories	US	-	small	-	middle
Brown Eyed Baby Boutique	Bag	accessories	US	-	-	middle	high
Debra Jo Handbags, LLC	Bag	accessories	US	0	0	0	0
Design your tie	Tie	accessories	US	0	0	0	0
DesignYourWeddingRings.com	Ring	accessories	US	-	small	-	high
Ella-Bags	Bag	accessories	US	-	-	middle	middle
Factory121 SA	Watch	accessories	CH	small	small	middle	high
Freddy & Ma	hand-bag	accessories	US	-	-	small	middle
Freitag	Bag	accessories	CH	-	-	small	small
Gilletts Jewellers	Ring	accessories	AU	-	small	-	middle
Jupiterbyjo	Bag	accessories	US	-	-	-	small
Lids create your own	baseball cap	accessories	US	-	small	high	-
Limoges Jewelry	Jewellery	accessories	US	-	-	high	small
Longcamp	Bag	accessories	US	-	small	small	middle
Mandy b. Bags	Bag	accessories	US	0	0	0	0
PaulJulia Designs	Bag	accessories	US	-	small	-	small
Personalized Boutique, Inc	Jewellery	accessories	US	-	-	small	-
Petra Diegel	Bag	accessories	DE	-	-	-	small
Ponypics.co.uk	Bag	accessories	GB	-	-	middle	-
Rich Company	Watch	accessories	US	-	small	middle	-
Snaptotes.com	Bag	accessories	US	-	-	middle	-
Stein Diamonds	Ring	accessories	US	-	small	small	-
The fedora store.com	Hat	accessories	US	-	small	small	middle
The Sak	Bag	accessories	US	0	0	0	0
Timbuk2	Bag	accessories	US	-	-	small	high
Walmart	Ring	accessories	US	-	-	middle	-
Zales	Ring	accessories	US	-	small	high	-
A Diamond IsForever.com	Ring	accessories	US	0	0	0	0

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
American Golf Corporation	golf ball	sport & leisure	US	-	-	small	-
Austad's Golf, Inc.	golf equipment	sport & leisure	US	-	small	small	-
Best for Balls Ltd	golf ball	sport & leisure	GB	-	-	middle	-
Boarddesigner	Snowboard	sport & leisure	AT	-	small	high	high
BoardPusher, LLC.	Skateboard	sport & leisure	US	-	small	high	middle
Customized Golf Balls	golf ball	sport & leisure	US	-	-	small	-
Dynamic Search Marketing	golf tees	sport & leisure	US	-	-	high	-
Edelwiser	Ski	sport & leisure	AT	-	-	high	-
Golfballs.com, Inc	golf ball	sport & leisure	US	-	-	small	-
Golfjoy.com	golf ball	sport & leisure	US	0	0	0	0
Golfsmith International, Inc.	golf equipment	sport & leisure	US	-	-	middle	-
Mark 14 Ltd.	Clublink	sport & leisure	US	-	-	small	-
Name It Golf, Inc.	golf equipment	sport & leisure	US	-	small	small	-
Olly's Bicycle Factory Shop	Bicycle	sport & leisure	DE	0	0	0	0
Orisa Software	hot air balloon	sport & leisure	DE	-	small	high	high
Plantaplast Ges.m.b.H.	golf equipment	sport & leisure	AT	0	0	0	0
Revolution Snowboard Manufacturing	Snowboard	sport & leisure	US	-	small	high	high
Stevens Vertriebs	Bicycle	sport & leisure	DE	-	middle	high	high
SW Sport&Marketing	Bicycle	sport & leisure	DE	-	middle	high	middle
Wessely Gerwald / zeltstadt.at	Tent	sport & leisure	AT	small	small	high	middle
Acushnet Company	golf ball	sport & leisure	US	-	middle	high	-
Brunswick	pool table	sport & leisure	US	-	high	middle	-
Gator	Goggles	sport & leisure	DE	small	small	high	middle
Jan Koba	Bicycle	sport & leisure	CH	-	middle	high	middle
MAXX Bikes & Components	Bicycle	sport & leisure	DE	-	-	middle	small
Simplon Fahrrad	Bicycle	sport & leisure	AT	-	-	middle	small

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Barrels & Bottles	wine label	print	GB	-	middle	high	high
Candybarwrapper	candy bar wrapper	print	US	-	middle	high	high
Created 4 Me	children's book	print	US	-	small	high	small
Custom Storybooks, Inc.	children's book	print	US	-	small	high	small
Custom Wine Source	wine label	print	CA	-	middle	high	high
Customized Classics	Book	print	US	-	high	middle	small
Gloria J Designs LLC	wine label	print	US	-	small	high	-
Imbibo Inc.	cell phone print	print	LU	-	-	high	high
My Create-A-Book	children's book	print	US	-	small	middle	small
PersonalNOVEL	Book	print	DE	-	small	high	high
Pervino Inc.	wine label	print	US	-	middle	high	high
Primis	Book	print	US	-	middle	high	high
Printakid Inc.	calendar, book	print	CA	-	small	high	high
RestaurantBags.com	restaurant bag	print	US	-	small	high	middle
Storytime Personalized Books	children's book	print	US	-	small	middle	small
Tas Valley Vineyard	wine label	print	GB	-	small	high	small
Thats my name gifts	children's book	print	US	-	small	middle	small
Unique Wine Gifts	wine label	print	GB	0	0	0	0
Winelabel.Co	wine label	print	NZ	-	small	high	small
Yournovel.com inc.	Book	print	US	-	small	high	high
fd's Flickr Toys	Wallpaper	print	Global	-	small	middle	-
Fellowes, Inc.	cell phone print	print	US	-	-	high	small
Starbucks Corporation	Wallpaper	print	Global	-	-	-	middle

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Aberdeen Inc	computer	electronics	US	high	small	-	high
AkkuLine, David Bech&Torsten Spindler	rechargeable battery	electronics	DE	-	-	high	-
ATELCO Computer Event	computer	electronics	DE	high	middle	-	high
chiliGREEN Computer	computer	electronics	AT	high	middle	-	high
Conrad Electronic	computer	electronics	AT	high	-	-	high
D i T e c h Daten- & Informationstechnik	computer	electronics	AT	high	high	-	high
DELL Inc.	computer	electronics	US	high	high	-	high
Ecotec Computer	computer	electronics	AT	high	middle	-	high
Heizstrahlershop	radiant heater	electronics	DE	small	-	small	-
MINDFACTORY	computer	electronics	DE	0	0	0	0
proTECH professionelle Technologien	computer	electronics	AT	high	-	-	middle
Raisl Elektronik	computer	electronics	AT	high	small	-	middle
Reboxx GmbH	computer	electronics	DE	high	middle	-	middle
Transtec	computer	electronics	AT	high	middle	-	middle
Loewe	television	electronics	DE	-	small	middle	-
Rittal GmbH & Co. KG	comfort panel	electronics	DE	-	small	small	high
Software Partner GmbH	USB stick	electronics	DE	-	middle	high	-
Stratec Medizintechnik	medical technology	electronics	DE	0	0	0	0
DGE Computer Systems	computer	electronics	AT	0	0	0	0
Hella KGaA Hueck & Co.	electronics	electronics	DE	0	0	0	0
Helukabel	signal circular connector	electronics	DE	0	0	0	0
Ricoh	office hardware	electronics	GB	small	small	-	high
Werma Signaltechnik	signal pillar	electronics	DE	-	small	-	small

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Custom Marine Carpet	floor mat	house & garden	US	-	small	middle	-
Dorby & Zell Warenhandels	trolley	house & garden	DE	0	0	0	0
Inmod.com.	bed-linen	house & garden	US	-	small	-	middle
Karibu Holztechnik	sauna	house & garden	DE	-	-	small	-
OBI@OTTO	beach chair	house & garden	DE	-	-	-	small
Pflanzmich	garden plant	house & garden	DE	-	-	small	-
Pool power shop	swimmingpool	house & garden	DE	0	0	0	0
Sonnenschutz24	roller blind	house & garden	DE	-	-	-	small
Strandkorb & Co	beach chair	house & garden	DE	-	small	-	middle
Wackymats.com	floor mat	house & garden	US	-	-	small	-
Westfalia Werkzeugco.	sauna	house & garden	DE	-	-	middle	-
ALCO Interieur	beach chair	house & garden	AT	-	small	-	middle
Alulux Beckhoff	roller blind	house & garden	DE	-	-	middle	-
DekoVries	beach chair	house & garden	DE	-	small	-	middle
Hase Kaminofenbau	oven	house & garden	DE	-	-	small	-
Röhren- und Pumpenwerk Bauer	irrigation system	house & garden	AT	-	-	small	-
Sonnenkorb Eschle	beach chair	house & garden	CH	-	small	-	middle
BGT Thermotechnik	heater	house & garden	DE	0	0	0	0
Konrad Kraus Metallwaren	fence	house & garden	DE	0	0	0	0
Schlotterer Rollladen-Systeme	roller blind	house & garden	AT	0	0	0	0
Schlotterer Rollladen-Systeme	roller blind	house & garden	DE	-	small	-	-
Tischlerei Jagsch	floor mat	house & garden	DE	0	0	0	0

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Access Artisans	Lamp	furniture	US	-	small	small	-
AluOffice	storage rack	furniture	CH	small	small	-	small
Bemz	Furniture	furniture	SE	-	small	-	-
Grennan's Murphy Beds	fold-away bed	furniture	US	-	small	-	middle
Inwerk	Furniture	furniture	DE	0	0	0	0
Lampus Plus Inc.	Lamp	furniture	US	-	small	middle	-
Masstisch GmbH & Co. KG	Table	furniture	DE	-	small	-	small
Masswelt	Bed	furniture	DE	-	small	-	middle
Regalsystem Max	storage rack	furniture	DE	0	0	0	0
Smart Furniture	storage rack	furniture	US	small	small	small	-
Varistyle individual design online	Hangings	furniture	DE	-	-	-	small
Wasserbetten Center Merzig	Waterbed	furniture	DE	0	0	0	0
Moormann	storage rack	furniture	DE	small	small	small	-
Wogg	rack system	furniture	CH	small	-	small	-
A.H.Beard Pty Ltd.	bed	furniture	AU	0	0	0	0
Baisch	furniture	furniture	DE	-	-	small	-
Bio Fit	Chair	furniture	US	-	-	-	small
Custom-Lamps.com	Lamp	furniture	US	-	small	small	-
Holzmanufaktur	Bed	furniture	DE	-	small	small	-

Company	Product	Industry	Country	Cd	MC1	MC2	MC3
Buchbinderei Obermeier	Notebook	stationery	DE	-	-	-	small
Design your own card	office equipment	stationery	US	-	small	-	middle
DigiLabs	greeting card	stationery	US	-	-	-	middle
Gimbel & Leucht Mediengesellschaft bR	office equipment	stationery	DE	-	small	-	high
Harmony Designs, Inc.	Bookmark	stationery	US	-	-	-	small
iPrint	office equipment	stationery	US	-	-	-	small
LovelyLabels.com	business card	stationery	US	-	-	-	small
Omega HTC.	Pen	stationery	US	-	-	-	small
Partybox Ltd	greeting card	stationery	GB	-	small	-	small
Poobies Europe BV	greeting card	stationery	NL	-	small	-	middle
Saxoprint GmbH	office equipment	stationery	DE	-	small	-	middle
Vista Print	office equipment	stationery	BM	-	small	-	middle
wfb - Werbeartikel GmbH	Pen	stationery	DE	0	0	0	0
Pelikan Vertriebsgesellschaft mbH & Co. KG	Pen	stationery	DE	-	small	-	middle
Schwan-STABILO Promotion Products	Pen	stationery	DE	-	-	-	small
time and date.com	Calendar	stationery	NO	0	0	0	0
Werbe- und GeschenkARTikel	Pen	stationery	DE	0	0	0	0