LOUVAIN
School of Management

UNIVERSITE CATHOLIQUE DE LOUVAIN

LOUVAIN SCHOOL OF MANAGEMENT

IS IT POSSIBLE TO BE SUCCESSFUL IN MASS CUSTOMIZATION IN IMPERFECT CONDITIONS? IF YES, HOW DO COMPANIES MANAGE THESE? A CASE STUDY OF BIVOLINO AND MY M&M'S

Supervisor: Professor Mathieu Van Vyve

Research Master Thesis submitted by

Alexandra Hanet

with a view to obtaining the degree of Master in Business Engineering and Master in International Management

ACADEMIC YEAR 2014-2015

Acknowledgments

I would like to express my sincere gratitude to my thesis supervisor, Professor Mathieu Van Vyve, for his precious guidance that helped me bring this Master's thesis to a good end.

My sincere thanks also go to Louise for her insightful comments.

Finally, I would like to thank my family and friends for their support throughout the entire process of writing my thesis.

Table of content

1 INTRODUCTION

A century ago, mass produced standard goods gained a lot of success as a consequence of attractive low prices. This does not imply, however, that the uniqueness of individual customers went away. On the contrary, the only reason why customers were willing to settle for standard products was because of these low prices. The concept of uniqueness of customers surfaced again after companies started segmenting the market in the 1950s and discovered niche marketing in the 1980s. This, along with other factors such as new technology (Pine, 1993) and increased flexibility in manufacturing systems (da Silveira, Borenstein & Flogliatto, 2001), made the emergence of mass customization possible. (Gilmore and Pine, 1997)

The purpose of this thesis is twofold. Firstly, it aims at determining whether mass customization is viable even though not all success factors of this strategy are present. The literature has extensively described all these factors, but failed to discuss the possibility of success without some of these. Secondly, if it is indeed possible, how do mass customizers tackle this lack of success factors in order to be successful?

This thesis is divided into three parts, literature review, case study research, and a conclusion. The purpose of the literature review is, first of all, to have a thorough understanding of the concept of mass customization. To do so, the origins, the challenges and benefits, and the different types of mass customization will be discussed. Second, extensive research will be done about all the success factors. The result of this will be used in the second part of this thesis, namely the case study research. Indeed, in order to determine whether mass customizers can be successful without certain success factors, those factors need to be identified. It was decided to undertake a case study research to answer the two research questions, as it revealed to be the best method for this thesis according to Yin (2014). The case study research is about two successful mass customizers, namely Bivolino

and My M&M's. In the third part, the conclusion, the key takeaways of this thesis will be described.

The motivation of doing research about this topic comes from a personal interest after being exposed to the concept of mass customization during a class of supply chain management. After some initial research, studying the success factors of the strategy seemed interesting to help managers understand what they should undertake in order to be successful. However, later in the research process, the list of success factors appeared to be very extensive. So extensive, that it seemed unfeasible to fulfill all of them. That is why it was decided to study the possibility of success in a situation where not all factors are present, which is the first part of this thesis' research question. The step towards the second part, namely 'how to manage these imperfect conditions', comes from the ambition to not only answer the question, but to provide a solution as well.

The fact that there has been done little to no research on the possibility of being successful in mass customization in imperfect conditions alone makes this thesis interesting. However, there are two managerial implications that make this thesis truly relevant. Firstly, if the answer to the first part of the research question is yes, it is possible to be successful in imperfect conditions, more managers will be encouraged to adopt a mass customization strategy despite the lack of success factors. The strategy could become more widespread and could indeed be the future of retail as stated by the literature (Gilmore & Pine, 1997 and Weintraub, 2013). Secondly, based on case study research, it will also discussed how to manage this lack, which will result in concrete solutions to help managers decide on how to tackle imperfect conditions.

2 LITERATURE REVIEW

2.1 What is mass customization?

The term mass customization was invented by Davis in 1987. He defines mass customization as when "*the same large number of customers can be reached as in mass markets of the industrial economy, and simultaneously treated individually as in the customized markets of pre-industrial economies*" (Davis, 1987, p. 169). Pine (1993, p. 7) further popularized the term and refers to it as "*providing tremendous variety and individual customization, at prices comparable to standard goods and services*". Hart (1995) defines mass customization by using two definitions. The first one is visionary: "*the ability to provide your customers with anything they want profitably, any time they want it, anywhere they want it, any way they want it*" (p. 36). As the name suggests it, this definition is an ideal that mass customizers want to achieve. That is why a practical definition better approaches the real world: "*the use of flexible processes and organizational structures to produce varied and often individually customized products and services at the low cost of a standardized, mass production system*" (p. 36). All above mentioned definitions are similar in the way that they all state that mass customizers pursue both product differentiation and cost leadership, which, in theory, are two incompatible strategies. That is part of what makes mass customization so new. (Blecker & Friedrich, 2007).

The problem with these definitions, according to Piller (2005), is that they could also explain non-mass customization strategies that are connected to high variety, personalization, and flexible production. So despite all the attempts to conceptualize mass customization, the term seems to be a "*fuzzy buzzword*". To avoid this, Piller (2005) refers to the term as "*a customer co-design process of products and services, which meet the needs of each individual customer with regard to certain product features. All operations are performed within a fixed solution space, characterized by stable but still flexible and responsive*

processes. As a result, the costs associated with customization allow for a price level that does not imply a switch in an upper market segment" (p. 315).

Piller's definition is the only one defining mass customization with all its characteristics, namely:

- customer co-design;
- meeting the needs of each individual customer;
- stable solution space; and
- adequate price and cost levels.

Customer co-design implies that there is an interaction between customer and manufacturer. The interaction is not necessarily at the design level, but could also be at the fabrication, the assembly or even the delivery level (Duray, 2002). Furthermore, this contact between manufacturer and customer can build long-term relationships as reordering is made much easier, which results in increased barriers when switching supplier. (Piller, 2005)

Meeting the needs of each individual customer is referring to the fact that if a product or service is mass customizable, it will most likely better fit the needs than a standard product. This is especially true when there is a large heterogeneity among customers' needs. (Piller, 2005)

A manufacturer's production system needs to limit the customization of a product to a certain number of product features in order to still have flexible and responsive processes. This is what Piller calls a stable solution space. (Piller, 2005)

The last characteristic of the definition, adequate price and cost levels, insists on the fact that, although customers are willing to pay a premium price for a mass customized product, mass customizers should ask for similar prices as standard goods as they want to target the same market segment. Low prices demand cost-savings. This is when economies of integration play a role. Economies of integration are a set of cost-saving potentials that

"*arise from three sources: from postponing some activities until an order is placed, from more precise information about market demands and from the ability to increase loyalty by directly interacting with each customer*" (Piller *et al.*, 2004, p. 439).

True mass customizers are those that have all four characteristics of Piller's definition. This is also the definition that will be remembered throughout this study. (Piller, 2005)

2.2 Origins of mass customization

Since Davis invented the term mass customization in 1987, the concept grew popular as both marketing and supply chain strategies. In order to truly understand the term, it seems necessary to discuss why the term was invented in the first place. Pine (1993) described it as a paradigm shift. Since the end of the nineteenth century, mass production was the paradigm. It is characterized by homogenous markets, low costs and prices, economies of scale, product standardization, degree of specialization, and operational efficiency. The competitive landscape was shaped by large manufacturers and service providers, and a few small craft-based shops. However, from the 1960s until the 1980s a paradigm crisis occurred. Markets, consumers, and technology changed in such a way mass production could not come up with solutions to those problems. Manufacturers started to realize that they were no longer able to compete with only standardized products and services (Kotha, 1995). (Pine, 1993)

The changes that caused the paradigm shift from mass production to mass customization are the following:

- The first reason is the fragmentation of the mass market (Hart, 1995). Homogeneous needs, which are crucial to the existence of mass production, are changing into heterogeneous needs. Uniqueness of customers has always been present. However, it only surfaced after companies started segmenting markets in the 1950s and when they starting doing niche marketing in the 1980s (Gilmore

and Pine, 1997). Demand for variety and customization is increasing in such a way that segmented markets have become too broad (Kotler, 1989).

- Second is the increased flexibility of manufacturing systems and processes which makes it easier and less costly to deliver product variety (da Silveira *et al*., 2001).

- A third reason is technology, such as Computer-Aided Design[1] and Computer-Aided Manufacturing[2], which makes it easier to achieve production goals (Pine, 1993) but it also…

- …, and this results into a fourth reason, affects product life cycle (Hart, 1995 and Pine, 1993). New technologies, allow to create new products with better features. However, these products and their features become more quickly obsolete as new technologies arise more quickly.

- The last reason is new management methods. Methods like just-in-time production[3], lean production[4], and setup and changeover time reduction allow companies to add product features in an easy and low cost way (Pine, 1993).

To sum up, the paradigm crisis occurred because of fragmentation of the mass market, flexible manufacturing systems, technology, short product life cycles, and new management methods. "*When one paradigm fails, it is time to shift to another*" (Pine, 1993, p. 32). All these changes paved the way to mass customization. Whereas mass producers see an unpredictable, changing market as a threat, mass customizers see this as an opportunity (Hart, 1995).

---

[1] Computer-Aided Design is a software "*used […] to create precision drawings or technical illustrations*" (Rouse, 2011)
[2] Computer-Aided Manufacturing "*is an application technology that uses computer software and machinery to facilitate and automate manufacturing processes*" (Janssen, 2015)
[3] Just-in-time production is "*a production model in which items are created to meet demand, not created in surplus or in advance of need*" (Rouse, 2015)
[4] Lean production is "*finding efficiencies and removing wasteful steps that don't add value to the end product*" (Manktelow, 2015)

2.3 Challenges

Although the existing literature argues that mass customization is the future of retail (Gilmore & Pine, 1997 and Weintraub, 2013), the strategy comes with many challenges that may dissuade companies to adopt it.

A first challenge for mass customizers is the **high complexity level** in operations and manufacturing due the high variety in product features, which leads to "*high setup times and costs, expanded supplier base, a high diversity of production processes on the shop floor, production planning and scheduling difficulties, longer production cycle times, etc.*" (Blecker & Friedrich, 2007, p. 6). Furthermore, mass customization, requires highly flexible production technology to handle the variety. This technology can be very costly and time-consuming. (Zipkin, 2001)

Not only operations and manufacturing are very complex but also the customers themselves raise complexity concerns. This type of complexity is called **mass confusion** (Huffman & Kahn, 1998) and occurs because customers are overwhelmed by the variety offered by the company. There are three reasons why customers get confused when confronted with variety. The first reason is because humans have a limited capacity to process information. This is not something that can be influenced as it is inherent to all human beings. The second reason is that the customer might not have the technical knowledge about the product. Making rational choices between two options for a certain feature is much harder for a customer when he or she does not possess the technical knowledge as they need that knowledge to reduce the number of choices to a manageable amount. The third and last reason is the customers' ignorance of their real needs, which makes it is difficult for them to describe what they want. (Blecker & Friedrich, 2007)

The **heterogeneity of the market** is not questioned by the literature. Indeed all the literature agrees on the unique needs of customers. However, the problem with this is that companies need to offer a very large range of different product features in order to answer to those

unique needs. This means that usually the product does not answer all customers' specific preferences. Indeed, Franke and Piller (2004) showed that even to satisfy only fifty percent of customers with the level of customization, a company needs a very high number of product variants.

Another challenge of mass customization is all the **time and effort** customers have to spend on designing and waiting for the delivery of the product. It is especially difficult to motivate customers to spend a lot of time on customizing low-cost products like fast moving consumer goods. Concerning mid-range products, customers generally do not mind spending time on designing their own product. However, they are not willing to wait more than a few days to receive it. (Broekhuizen & Alsem, 2002)

Psychological reasons are also an additional cost of mass customization due to **uncertainty**. The uncertainty for customers is caused by several reasons. The first reason is because they do not know if the product will be consistent with what they ordered. This means that customers have to trust the supplier to pay in advance for a product they cannot see (Piller, 2005). Uncertainty can also be caused by the second reason for mass confusion, namely the lack of knowledge about the product (Blecker & Friedrich, 2007). Customers do not know if they have the ability to select the right features that suit their needs. A last reason for uncertainty comes from the difficulty in judging the value of the end product. (Broekhuizen & Alsem, 2002)

Having an **elaborate system for the elicitation of customers** is another challenge for mass customizers. An elicitation process is a means to help customers identify exactly what they require. The more information required, the more need for a thorough elicitation system. For instance, if a company offers to engrave a name in a wallet, the only information required is the customer's name which does not require an elaborate elicitation system. The same cannot be said for all mass customized products. For instance clothing requires information about measurements – height, sleeve length, waste, collar, etc. – and style. (Zipkin, 2001)

The last challenge of mass customization is one that is borne by the mass customizers themselves and concerns **accounting procedures**. Variety comes with overhead costs which are hard to assign to one product variant. The allocation of costs to the right product variant is thus much more time and cost intensive than it is for standard products. (Blecker & Friedrich, 2007).

2.4 Benefits

The literature does not only present challenges to mass customization, but also numerous benefits and even states that most companies can benefit from mass customization as long as it is implemented the right way (Salvador, de Holan & Piller, 2009).

A first benefit of mass customization are **economies of integration** that allows for cost-savings potentials. Economies of integration are influenced by the setting of a postponement point and the degree of customer interaction, and results from three sources already named before, namely postponement of some activities until order placement by the customer, easier access to "sticky information", and better utilization of its customer base (Piller *et al.*, 2004).

Postponement of activities until the order is placed means that certain activities are delayed to later stages of the production process. This means that the production process is split into a standardized and a customized part (Feitzinger & Lee, 1997). On the standardized part, a company will not make more benefits in a situation of mass customization than in mass production, however, on the customized part, savings are possible in different areas. First of all, inventories of end products are completely eliminated (Blecker & Friedrich, 2007) and safety stocks for raw materials are reduced. It also allows the elimination of a possible bullwhip-effect[5]. Second, by postponing some activities, instead of using a pure customization strategy like ETO companies, planning complexity is reduced. Furthermore,

[5] "*The bullwhip effect describes the phenomenon of information distortion as ordering information percolates upstream, which means that a downstream demand fluctuation will lead to larger fluctuations in the variance of upstream ordering*" (Ma *et al.*, 2015, p. 816).

planning complexity is also reduced compared to mass production regarding fashion risk. A standardized product can rapidly be out of fashion, whereas a mass customized product can easily be adapted to the latest trends which reduces the time to plan ahead to spot trends in the market. Third, sales are better managed as out-of-stock items are avoided, and discounts at the end of the season are prevented. (Piller *et al.*, 2004)

"*The stickiness of a given unit of information in a given instance [is] the incremental expenditure required to transfer that unit of information to a specified locus*[6] *in a form usable by a given information seeker. When this cost is low, information stickiness is low; when it is high, stickiness is high*" (von Hippel, 1994, p. 3). In this case, economies of integration are the costs saved through easier access to the sticky information. In order to have access to sticky information, it is important that the execution of the co-design process by the customer is easy. That is why companies need design tools and configurators that not only help the customer design a customized product, but that have the ability to make customers specify their needs implicitly as well. Once a company has access to the sticky information, it can transfer it to explicit knowledge which can be used for better market research. Better market research reduces costs in three ways, namely by reducing market research costs, by preventing market research biases, and by the gain in information quality. Furthermore, better market research can result in improved forecasting of trends in the market. (Piller *et al.*, 2004)

The third source of economies of integration is efficient utilization of the customer base. In this case, economies of integration are a type of economies of scope. However, instead of a better utilization of manufacturing resources, it is a better utilization of the customer base through customer loyalty. Once a customer has bought a product from a company, that company will have to make less efforts to involve the customer in other revenue-generating opportunities. Although this source of economies of integration is not specific for mass customizers, they do benefit from the closer relationship with the customer created through customer integration. Customer loyalty is a result of three types of costs, the first type being

[6] A locus is "*A particular position or place where something occurs or is situated*" (Oxford dictionaries, 2015)

switching costs. Switching costs increase due to the fact that finding a supplier that delivers a standard product that answers to a customer's specific needs as well as a mass customized product is challenging. The second type of costs are sunk costs. If a customer invested a lot to familiarize himself with a certain design tool, this can be seen as a sunk cost. The last type of costs, opportunity costs, can increase when customers are satisfied with the customization. The increase would come from the risk of losing the benefits of the relationship with that specific supplier. (Piller *et al.*, 2004)

Besides economies of integration, mass customizers also benefit from the **closer match** between a customer's needs and the product (Blecker & Friedrich, 2007). A better answer to more customers' needs is necessary as it is argued that every individual customer represents at least one market (Gilmore & Pine, 1997). One customer could even represent a different market at different times, for instance a person traveling for business does not have the same needs when traveling for pleasure (Gilmore & Pine, 1997).

Although many definitions in the literature state that mass customized products should not be sold with a price premium compared to similar standard products (Davis, 1987; Pine, 1993; Hart, 1995), practice shows that, because of this closer match between customers' requirements and the products, customers are **willing to pay a price premium** for a mass customized product. Nevertheless, this price premium should not be too high. A price premium that is too high can easily dissuade customers from buying the product as this price range would target another market segment. The rule is that mass customizers should set a product's price at a level that targets the same market segment as mass producers that offer similar standard goods. (Piller, 2005)

A **reduction of prices** is in some cases possible as a standard product may include features the customer does not need, whereas a customized product only includes those features the customer requires. This reduces the cost of adding useless features and therefore also reduces the end price for the customer. (Blecker & Friedrich, 2007)

The **shopping experience** is an important factor for customers (Novak *et al.*, 2000). That is why it can be seen as a benefit for mass customizers, and customers as well, when well executed. To do so, mass customizers should make the shopping experience enjoyable in order to increase the perceived value of the product (Broekhuizen & Alsem, 2002). The experience can be made enjoyable by giving the customer a sense of control over the decision-making (Huffman & Kahn, 1998), by giving them a sense of creativity that makes them proud (Piller, 2005), and by adding an entertainment value (Broekhuizen & Alsem, 2002).

A last benefit for mass customizers is that offering personalized products can improve its customers' **brand image** of the company (Blecker & Friedrich, 2007). To keep this positive brand image, the mass customization should of course be well executed, i.e. on time and corresponding to the customers' specifications (Broekhuizen & Alsem, 2002).

After having analyzed both challenges and benefits, it can be concluded that, even though mass customization is a challenging strategy, it should not necessarily dissuade companies to adopt it. Indeed, many of the benefits can counterbalance the challenges, provided that the strategy is well implemented (Piller *et al.*, 2004). The same can be said for customers. Those that are discouraged to purchase mass customized products due to the challenges should also take into account the benefits. Ultimately, companies should be aware that the perceived customer value is the net perceived cost/benefit equation of purchasing a mass customized instead of a standard, mass produced product (Broekhuizen & Alsem, 2002), and should therefore make sure all the benefits are indeed exploited to the fullest.

2.5 Different types of mass customization

Even though companies possess outstanding information technology and flexible manufacturing systems, unnecessary cost and complexity can be an unfortunate consequence of mass customization (Gilmore & Pine, 1997). Managers realize that this is because they never thought about what type of mass customization would suit their company and their customers best. Both research articles from Gilmore & Pine (1997) and

Duray, Ward, Milligan & Berry (2000) propose different types of customization companies could or should pursue.

Gilmore and Pine (1997) argue that companies should choose their type of mass customization based on the nature of the sacrifice gap of their customers. This customer sacrifice gap occurs when customers have diverging needs for a certain dimension of a standard product and thus the standard product only responds to the average needs of customers. In other words, the sacrifice gap is the difference between what the standard product offers and the actual needs of the customers (Gilmore & Pine, 1997). Gilmore and Pine (1997) identified four different types or approaches, namely:

- Collaborative customization;
- Adaptive customization;
- Cosmetic customization, and;
- Transparent customization.

When applying **collaborative customization** it is all about directly dialoguing with each individual customer in order to help them define their needs, especially when they have a hard time defining those themselves. It is a strategy often used in industries such "*as apparel, windows, news services, and industrial valves*" (Gilmore & Pine, 1997, p. 9). The reason for this is that all these industries' customers have to make onetime decisions based on an "*either/or sacrifice gap*", meaning that they have to make a choice between either one option or the other at one specific moment. A good example of this is Custom Foot, a shoe manufacturer. The company enters in direct dialogue with its customers by making a digital image of their feet and through one-to-one conversation in order to make a shoe that exactly fits the customers' feet. By doing so, the company eliminates this either/or sacrifice gap customers have when choosing between, for instance, perfect fit for one foot but tightness or looseness for the other. (Gilmore & Pine, 1997)

The second type of mass customization according to Gilmore & Pine (1997) is **adaptive customization**. This type of mass customizer offers one standard product that is easily

customizable once the customer already pursued the product. It is the perfect type of mass customization for clients that would like to use the product differently at different occasions. Davis (1987) and Pine (1993) refer to this as "*point of sale customization*". Lutron Electronics Company is a good example of adaptive customization. The company offers lighting systems that are customizable by the user depending on, for instance, the mood they want to create in a certain room or the color of the walls. That way the lighting could be adapted to the atmosphere the customer wants to create for a certain occasion, such as a party or a romantic evening. (Gilmore & Pine, 1997)

The third type is **cosmetic customization**. Cosmetic customizers offer the same product to all clients with the only difference being the presentation of this product. This type is useful when all customers' sacrifice gap is only about how they want the product to be presented. So they do not differ in the way they use the product. Consider the Planters Company, which sells peanuts and mixed nuts. It used to do this in either small, medium or large batches. When realizing its clients do not all require the same packaging as they display products differently and do not all use the same amount of shelf space, Planters chose cosmetic customization to offer any size to its customers. (Gilmore & Pine, 1997)

The fourth and last type of mass customization according to Gilmore & Pine (1997) is **transparent customization**. When applying transparent customization, a company offers customized goods without its customers' explicit knowledge of it. This type of mass customization is used when a company has sufficient information about its customers to offer a product that responds exactly to their individual needs and when the customers do not want to be bothered with specifying their preferences. ChemStation, a company that mass customizes industrial soap, observed its customers to learn about their usage pattern and about the right mixture of soap required. This company shows how a company can customize a product to its customers' specific requirements without the need of direct collaboration. (Gilmore & Pine, 1997)

The most obvious thing to customize is the product itself. However, when looking at the four types of mass customization offered by Gilmore & Pine (1997), companies can also mass customize the representation of the product. Each type mass customizes one or the other, both or neither of them. This all depends on the needs of the customers and should be taken into account when choosing an approach to mass customization (Gilmore & Pine, 1997). Figure 1 below is an easy model to use when choosing the right type of mass customization.

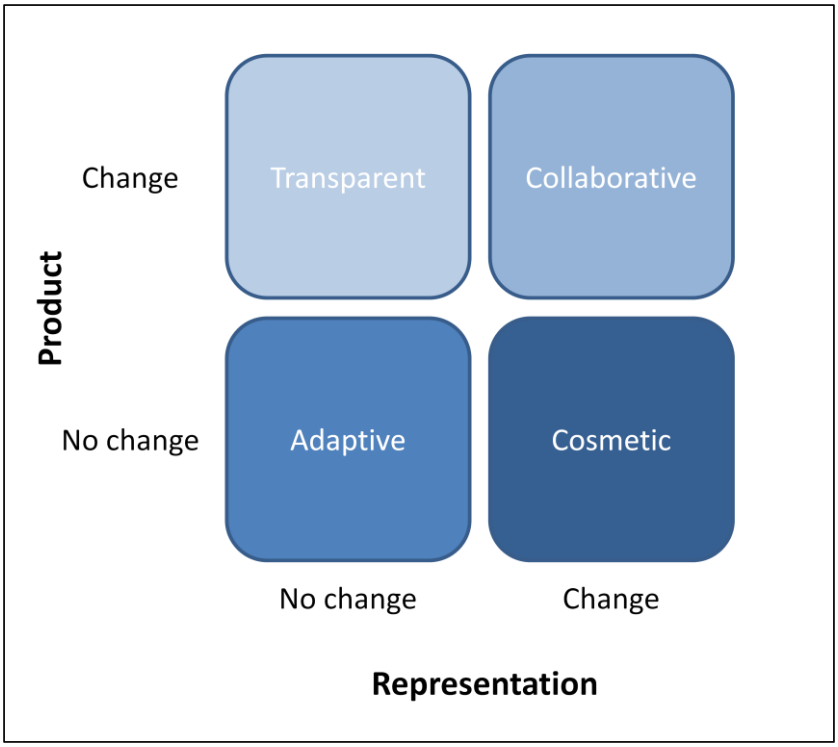

Figure 1: The Four Approaches to Customization (Gilmore & Pine, 1997, p. 7)

Collaborative customizers change both the product and its representation as its customers participate in the customization process, unlike transparent customizers who's customers are not aware of the customization and where only the product changes and not its representation. Indeed ChemStation adapts the soap to its customers' needs but the packaging is the same for all. Adaptive customizers neither mass customize the product, nor its representation. Indeed, it is the customer who adapts these once he or she purchased the product. Cosmetic customizers only change the representation of the product as its customers all use the product the same way. In the example of Planters company, only the

packaging is changed, not the peanuts nor the mixed nuts. It is not unimportant to say that the representation of a product is not only the packaging but could also be marketing materials, placement ("where, when, how, and to whom" (Gilmore & Pine, 1997, p. 8)), terms and conditions, product names, and stated use. (Gilmore & Pine, 1997)

Not only Gilmore & Pine (1997) propose different types of mass customization, so do Duray *et al.* (2000). The article proposes four 'archetypes' of mass customization based on point of customer involvement and modularity. Point of customers involvement is the moment in the production process where customers are involved in specifying the product (Duray *et al*., 2000). Companies that use modularity use modules, which are standard pieces that can be combined with components or other modules, or (slightly) adapted before combining them for one specific customer (Duray *et al*., 2000). Duray (2002) refers to these as the two critical identifiers, where point of customer involvement determines the 'customization part' of mass customization, whereas modularity determines its 'mass part'. Customers can be involved during the design, the fabrication, the assembly, and the use of the product, but also the type of modularity depends on these four stages of the production cycle (Baldwin & Clark, 1994). Modules in the design and fabrication stage enable the modification of components whereas modules in the assembly and use stage are just added or interchanged, but not modified (Duray *et al.*, 2000). The four stages and the two critical identifiers define the four archetypes (see Figure 2 below).

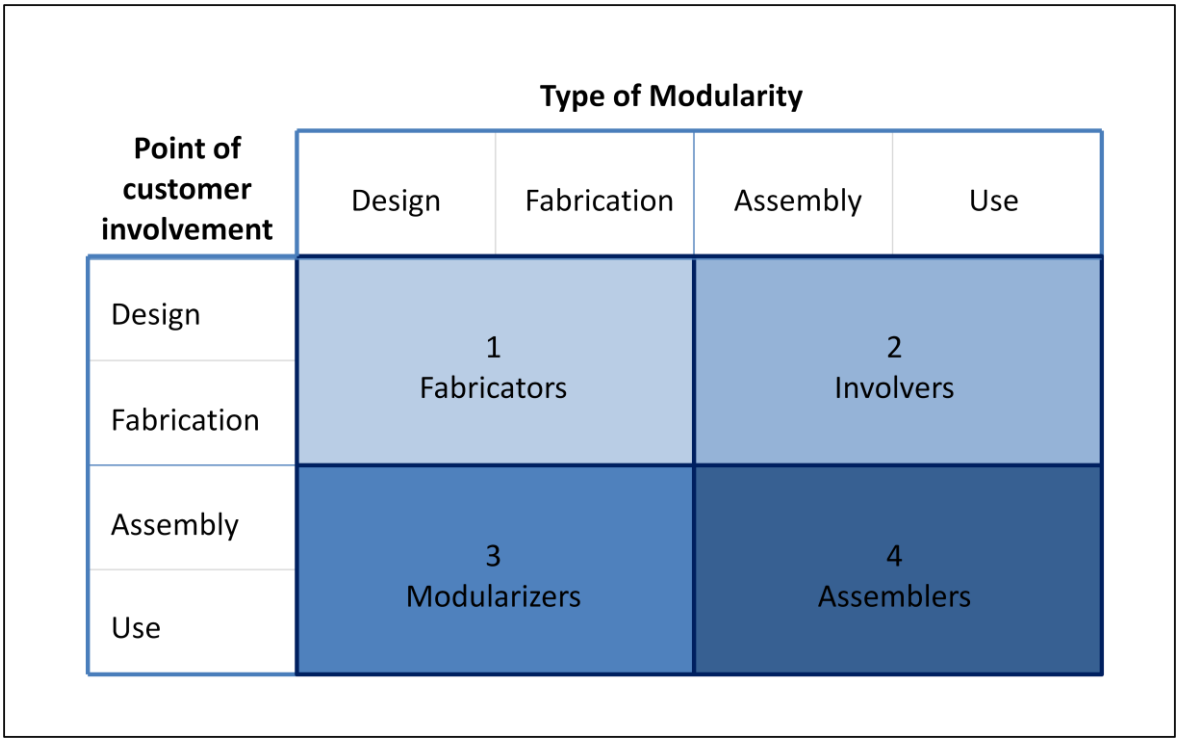

Figure 2: Matrix grouping of mass customization configurations (Duray *et al.*, 2000, p. 612)

The **fabricators**, are the ones with the strategy that most resembles a pure customization strategy. Indeed both point of customer involvement and modularity occur in the design and/or fabrication stage, so both of them require fabrication of components. That is why this group was given the name fabricators. As they use modularity to have common components, they cannot be considered as pure customizers. (Duray *et al.*, 2000)

The second group, **involvers**, just like the fabricators, involve customers in the design and/or fabrication stage but they use modularity only in the assembly and/or use stage. So no new modules are made specifically for one customer. Here customization is accomplished through combinations of standard modules. Involving customers earlier could be used to give them a bigger sense of customization by, for instance, offering the use of a design tool and based on that design, assemble a product with existing components. (Duray *et al.*, 2000)

Modularizers is the third group of mass customizers. In this group, modularity occurs before involvement of the customer. This type of modularity is called component-sharing modularity. It is not used for customization but to provide common components. When

using this type of modularity, the product is unique in the sense that the design is unique but it is built around a base of common components (Ulrich & Tung, 1991). Modularizers use modularity not only in the design and/or fabrication stage, but also in the assembly and/or use stage. In these stages modularity is used for customization, unlike in the two other stages. (Duray *et al.*, 2000)

Group four is the group of **assemblers**. Their strategy most resembles that of mass producers but is considered a mass customization strategy because customers can design a product based on an existing set of components. (Duray *et al.*, 2000)

Now that both Gilmore & Pine's (1997) and Duray *et al.*'s (2000) models have been discussed, it seems appropriate to consolidate them in order for companies to understand which type of Gilmore & Pine is compatible with one of Duray *et al.*'s archetypes.

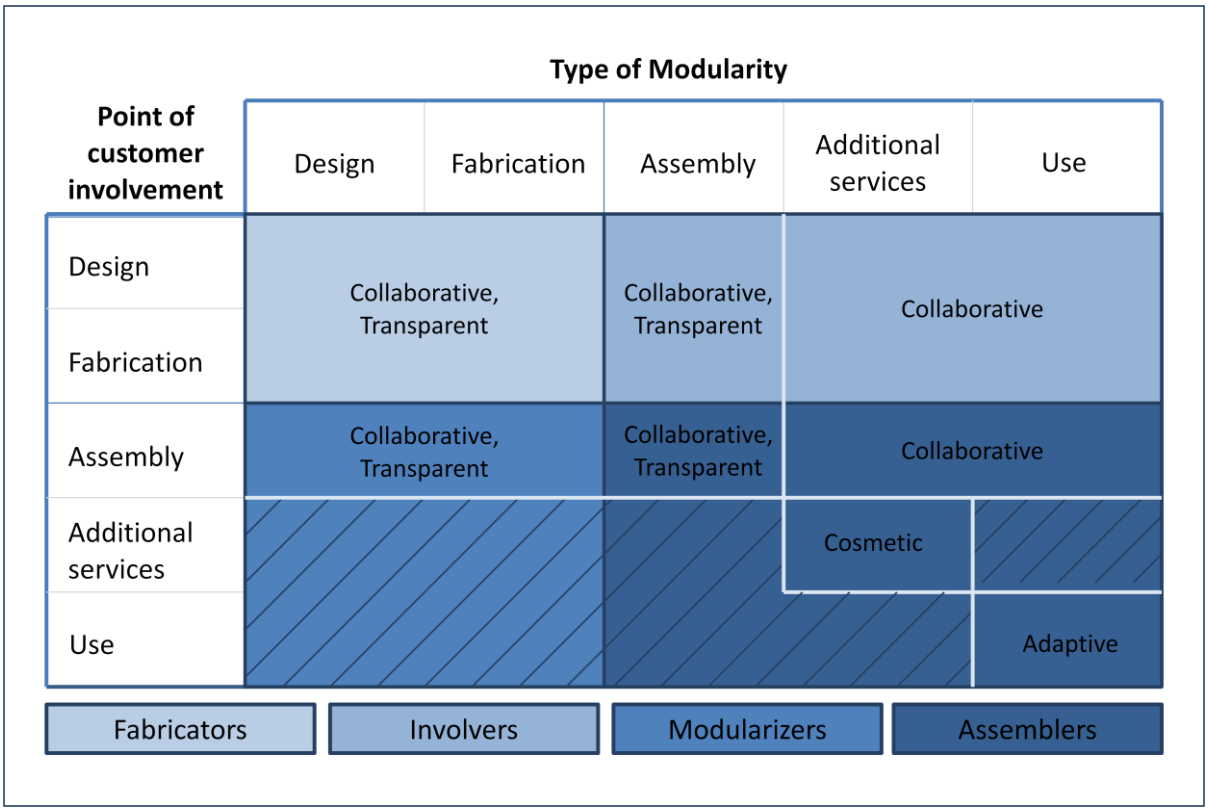

Figure 3: Matrix of the different types of mass customization, based on Gilmore & Pine (1997) and Duray *et al.* (2000)

The matrix in Figure 3 resembles the matrix offered by Duray *et al.* (2000) with the difference that it includes one more stage, namely the one of additional services. Examples of additional services are delivery (Duray, 2002) and packaging (Gilmore & Pine, 1997). The four archetypes of Duray *et al.* (2000) are still present in the matrix as well and are each represented by a different color as indicated by the legend. The aim of this matrix is to help managers, who decided on which type of mass customization suits their customers' needs best, decide when to involve customers and which type of modularity to apply.

Collaborative customizers directly communicate with their clients to design a product that corresponds to their needs. Not only the representation of the product is changed for the customer, but also the product itself. That is why customer involvement is necessary in either the design, fabrication or assembly stage, as in the two remaining stages, additional services and use, no changes are made to the product itself by the mass customizer. Regarding modularity, it can be implemented in any phase. Regardless of the customer involvement, modularity can be introduced in the design, fabrication, or assembly but also in the additional services or use phase. Modularity in the last three phases would just be about adding or interchanging existing modules whereas in the first phases modularity enables the modification of existing modules (Duray *et al.*, 2000). So collaborative customizers can be any of the four archetypes as long as customer involvement is not later than the assembly phase.

The same reasoning can be used for **transparent customizers** a part from the fact that the representation of the product does not change when applying transparent customization as customizers are not supposed to know the product is adapted just to their needs (Gilmore and Pine, 1997). So transparent customizers has the same result as collaborative customizers. The only difference is that modularity cannot be implemented after the assembly phase in order not to change the representation of the product.

All **cosmetic customizers**' clients are satisfied with the standard product itself. It is only the representation of it that requires customization (Gilmore and Pine, 1997). This means that

there is no need for customer involvement before the additional services phase. Furthermore, customer involvement in the use phase would be too late to customize the representation of the product. So cosmetic customization is only possible when the customer is involved in the additional services. Concerning modularity, if the product was customized, it would make sense to modularize before customer involvement as modularity would be used for component-sharing (Duray *et al.*, 2000). However, cosmetic customizers only customize the representation of the product, where component-sharing is not necessary, so modularity before customer involvement does not make sense. Modularity after customer involvement is used to give customers a greater sense of customization of the product (Duray *et al.*, 2000). As cosmetic customization only concerns the representation of it, modularity will not be used after customer involvement. This means that cosmetic customizers can only be one of the archetypes, namely assemblers and this only when modularity and point of customer involvement are both implemented in the additional services phase.

Adaptive customizers only involve customers in the use phase as they offer one standard product to all their customers, and it is only the use of the product that creates the sense of uniqueness (Gilmore and Pine, 1997). Modularity in a standard product is not necessary as it is used to make components that are useful for other products as well (Duray *et al.*, 2000). This implies that modularity is only required in the use phase. To conclude, adaptive customizers can only be assemblers, just like cosmetic customizers. However, in this case point of customer involvement and modularity are both implemented in the use face.

2.6 Defining success factors of mass customization

Defining the success factors of mass customization is necessary to help managers decide whether to adopt the strategy, and if they do, to help them define which capabilities they already have and which ones they still need to acquire in order to be successful in mass customization. These success factors, capabilities, or requirements are needed to undertake action against the challenges, but also to reinforce the benefits as without some of the prerequisites, benefits can turn into challenges (Blecker & Friedrich, 2007).

2.6.1 External success factors

2.6.1.1 Customers

The ultimate reason for companies to exist is to fulfill customers' needs (Tedesco, 2013). Customers are the ones that will buy and use the mass customized product, so if they do not need it, and thus probably will not be willing to pay for it, mass customizing its products is not viable for a company. Furthermore, even if they need the product, many factors influence their willingness to buy it, for instance price and delivery time. Including customers in the analysis of success factors of mass customization, is thus crucial.

Demand – sacrifice gap

Piller (2004) argues that standard products only meet the mean preference of customers, and thus that many customers are unsatisfied. But is this true for all standard products? Companies should ask themselves whether there is a demand to mass customize the product before implementing the strategy. Hart (1995) describes the demand for mass customized products as customer customization sensitivity, which is based on uniqueness of customers' needs and customer sacrifice gap (Gilmore & Pine, 1997). Companies need to identify the common uniqueness (Gilmore & Pine, 1997). In other words, they need to identify the option or feature of the product for which customers have unique needs. If customers have deferring needs for a certain option of a product, a standard product creates a customer sacrifice gap between what it offers and what the customers require, and thus the product requires customization to truly answer the customers' needs (Gilmore & Pine, 1997). However, if customers do not have deferring needs, there is no need to customize a product. Companies that want to mass customize should thus be present in heterogeneous markets and not in homogeneous markets. Commodities, e.g. oil, gas, and wheat, are a good example of products for which customers have homogenous needs (Pine *et al*., 1993). These products do not require customization. The apparel industry on the other hand, offer products for which customers have very heterogeneous needs based on size, fit, taste, etc. These products need customization. This explains why mass customization is often used in the apparel industry (Gilmore & Pine, 1997).

Suppose there is a common uniqueness for a certain option of a companies' product, and that there is thus a demand for the mass customization of this product. Even then customers might be deterred from buying the product, and this for several reasons.

Technical knowledge

The first one is the lack of technical knowledge about a product. It is difficult for a person to evaluate one product feature against another when he or she does not understand how it works or what exactly it is used for (Blecker & Friedrich, 2007).

Certainty about own preferences

Uncertainty about own preferences and needs could also deter customers from buying a product (Blecker & Friedrich, 2007 and Salvador *et al*., 2009). Although this is part of the external factors that influence mass customization, and thus factors that are not directly influenced by mass customizers, those companies can help customers through the process of determining their preferences, which makes it an internal factor as well.

Willingness to pay a price premium

Another reason depends on the price of the mass customized product. Although customers are willing to pay a price premium for a product that answers their specific needs, this price premium should be such that the product targets the same segment as a similar mass produced good, and thus the price should not deter customers from buying the mass customized product (Piller, 2004).

Time and effort for the customer

The last reason that influences the decision to buy a product was mentioned by Broekhuizen and Alsem (2002) and is the time and effort for customers to make and receive it. Customers do not want to spend a lot of time customizing low-cost products like fast moving consumer goods and even if they do want to spend a bit more time on this for mid-range products, they would not want to wait more than a few days to receive it. So the more costly a product is, the more effort a customer would be willing to put into the mass customization of the

product, and the more they are willing to wait for the product. Companies should take this into account when considering making mass customized products. (Broekhuizen & Alsem, 2002)

To conclude, in order for companies to be successful in mass customization, they should make sure there is a demand for customization by looking for a customer sacrifice gap between a standardized product and the actual needs of the customers. When there is no demand, companies should not engage in such a strategy. However, even when there is a demand, companies should take into account other factors that will determine whether the customer will buy the mass customized product or not. Companies should engage with a mass customization strategy only when customers have sufficient technical knowledge about the product to be able to choose between different options, when they can help customers that do not know their own preferences, when the price of the mass customized product is comparable to similar standard products, and when they can ensure that the time and effort (including waiting time) for customers is reasonable compared to the cost of the product.

2.6.1.2 Market

Market conditions influence the success of all companies, regardless of their strategy, that is why they also influence the success of mass customizers. There are many conditions that affect businesses, but the focus here is on those that specifically affect mass customizers.

The more turbulent the business environment, the more need for variety and customization (Hart, 1995), and thus the more likely a company's adoption of a mass customization strategy will be beneficial. Mass produced goods are preferable in markets with homogenous needs with a stable (growing) demand and with long product life cycles. A mass customization strategy, on the other hand, is suitable in a market with heterogeneous preferences, with unstable demand because of the increasing expectations of customers due to technology shocks, and thus also with shorter product life cycles. Mass customizers will be able to respond more quickly to new expectations than their mass producer competitors,

because they produce many product variants, which means they already have a flexible manufacturing system that can easily adapt to new features. In other words, a mass customization strategy is successful in a market where new product introduction occurs regularly to be able to answer to customers' expectations. (Pine, 1993)

2.6.1.3 Technology

The last external factor influencing the success of a company's mass customization strategy is technology. Companies should ask themselves a few questions regarding this factor. The first question is: does the technology required to mass customize the products exist in the company's industry? The second question is: how complicated would it be to implement this technology? The third and last question concerns financials, and is: how much will it cost to implement this technology? Hart (1995) argues that, regardless of complexity and cost, a company should adopt a mass customization strategy anyway, if the technology is available, so that it can benefit from all the advantages the strategy has to offer. Provided that all other external and internal factors are in the company's favor of course. (Hart, 1995)

2.6.2 Internal success factors

2.6.2.1 Product

The nature of the product influences the level of customization. As discussed in the previous section, customers do not require customization for every product. Indeed, for some products, customers have homogeneous needs, such as commodities (Pine *et al.*, 1993). For other products only the packaging needs to be customized – in which case companies apply cosmetic customization (Gilmore & Pine, 1997). For others, for instance the apparel industry (Gilmore & Pine, 1997), customers have very heterogeneous needs. The success of a mass customization strategy depends on customer preference, but also on the nature of the product as these preferences are based on it. For instance, if a company sells commodities, they should not even bother themselves with thinking of implementing a mass customization strategy because it would not make sense in the eyes of the customers and thus it would not be successful. If the company is active in the apparel industry however,

considering the implementation of a mass customization strategy makes more sense because of the heterogeneous needs of customers.

Another aspect of the product that could determine the success of a mass customization strategy is the variety offered by the company. Too much variety can lead to mass confusion (Huffman & Kahn, 1998) which is caused by the limited capacity of people to process information, by the lack of technical knowledge, and/or by the customers' ignorance of his or her real needs (Blecker & Friedrich, 2007). Again, this is an aspect that is much influenced by the customers, however, it also depends on the number of different product features the company decides to offer. Unfortunately, no research has been done about the ideal number of product features a company should offer to avoid mass confusion and at the same time have enough variety to respond to all customers' needs. Nevertheless, mass customizers should keep in mind that humans have a capacity to receive, process, and remember data of around only seven units (plus or minus two) (Miller, 1955), to at least tackle the first cause of mass confusion, namely the limited capacity of people to process information.

2.6.2.2 Organizational factors

Salvador *et al.* (2009) described three main capabilities mass customizers should have in order to be successful. These capabilities are solution space development, robust process design, choice navigation. However, the literature describes many more capabilities or factors that affect the success of a mass customization strategy, which are also discussed in this section, namely modularity, customer order decoupling point, postponement, first mover advantage, and a marketing department that knows how to excite customers for personalized products.

Solution space development based on customers' needs

The first capability is solution space development. As already discussed in the section about external success factors, mass customizers need to identify its customers' common uniqueness. This is where, among other factors, mass customizers differ from mass

producers. Unlike mass customizers, mass producers standardize their products to serve universal needs. Once a company knows the common uniqueness, it can define what it will and will not offer. This is the solution space. (Salvador *et al*., 2009)

Although the common uniqueness depends on the customers and is thus an external success factor, there are three approaches that companies can use to determine the solution space that depends on the common uniqueness, which are success factors that are internal to a company. The first one is using innovation tool kits. It is a design tool with an easy to use interface through which customers can easily choose from modules and functionalities that articulate their preferences. In other words, it enables customers to highlight their possibly unsatisfied needs by translating their preferences into a specific product variant. The result from this process will be evaluated by the company in order to determine the common uniqueness of its customers and based on that, determine the company's solution space. (Salvador *et al.*, 2009)

The articulation of a company's customers' unsatisfied needs can often result into a large number of prototype variants that all need to be reviewed. To avoid unnecessary costs, companies can implement an approach called virtual concept testing, which is the second approach to achieving a solution space. Instead of making physical prototypes, companies make virtual prototypes for customers to efficiently give scores and evaluate the prototype. (Salvador *et al.*, 2009)

The third approach to achieve a solution space is customer experience intelligence. It is a tool to continuously collect data on customers about their transactions, behaviors, or experiences. By analyzing this data, companies can refine their solution space. After having analyzed the information, companies can, for instance, delete a certain product feature that is rarely used or add more options to one that is often used. (Salvador *et al.*, 2009)

Robust process design

The second capability mass customizers should have is a robust process design. It is important for mass customizers that their operations and supply chain are not significantly changed whenever there is an increased variability in customers' requirements. To avoid this, companies need "*the capability to reuse or recombine existing organizational and value-chain resources to deliver customized solutions with near mass-production efficiency and reliability*" (Salvador *et al*., 2009, p. 5). That capability is a robust process design that can be reached in three different ways; by implementing flexible automation, through process modularity, and by having adaptive human capital. (Salvador *et al*., 2009)

The first way of reaching a robust process design, flexible automation, "*is the ability for a robot or system to be quickly and easily re-tasked to change product design*" (Charles, 2014). It is the opposite of fixed automation where a robot or system is used for only one specific task. Flexible automation is particularly useful for mass customizers. As they make numerous different product features, a system that can easily adapt to make a certain feature is thus crucial. However, it can also be useful for mass producers to avoid the need of a different robot or system for each product or even each task. Furthermore, flexible automation takes care of the two most straightforward dimensions of flexibility for mass customizers, which are product mix and changeover flexibility. Product mix flexibility enables a system to adapt to different orders of customers with diverging needs, whereas changeover flexibility enables companies to switch from one product or component to another in a cost- and time-efficient way (Blecker & Friedrich, 2007). Both are present when implementing flexible automation. Companies can be deterred from implementing such systems as in the short term it is more expensive than fixed automation, however, on the long run they could save costs on new product lines or new product features. (Charles, 2014)

The second approach to a robust process design is complementary to the first one and is called modularity. In order to sell mass customized products at price levels similar to standard goods, like all the definitions of mass customization suggest, the products need a certain level of reusability and not only differentiation (Blecker & Friedrich, 2007). This is

why modularity is necessary. It enables a company to reuse or recombine certain modules in such a way that it creates a new product variant that responds to a customer's needs. (Salvador *et al.*, 2009)

A last important point in achieving a robust process design is adaptive human capital. A company may have all it requires to successfully implement mass customization, if its employees and managers are not able to deal with new and ambiguous tasks, the implementation will not be successful as machines are not able to determine the company's customer's future common uniqueness. (Salvador *et al.*, 2009)

Choice navigation

Choice navigation is the third capability required for the implementation of mass customization. Mass customizers use choice navigation when they "*support customers in identifying their problems and solutions while minimizing complexity and the burden of choice*" (Salvador *et al*., 2009, p. 6). It can reduce mass confusion. The concept of mass confusion, arises from the paradox of choice. Indeed, the cost of evaluating many options can be higher than the benefits of having this much choice, and thus customer value is reduced instead of increased. Choice navigation is used to avoid this confusion, and as a result the mass customizer will not have the image of the product as difficult and undesirable. Mass confusion is again an external factor depending on customers, but there are three approaches companies can adopt to avoid it and lead to choice navigation, namely; assortment matching; fast-cycle, trial-and-error learning; and embedded configuration. (Salvador *et al*., 2009)

Assortment matching ensures that when a customer specifies its needs, these are matched with characteristics of existing solution spaces. This match is translated into a few configurations that customers have to evaluate. This reduces the number of choices, but the end product will nevertheless respond to the customer's needs. An example of this is what My Virtual Model is doing. Customers can build avatars of themselves by giving up height, body type, hair style etc. and based on this avatar, the software will recommend certain

items of the full assortment. Assortment matching also avoids the ordering of inconsistent product features (Blecker & Friedrich, 2007). (Salvador *et al.*, 2009)

Even though assortment matching reduces the number of choices, some customers will still find it hard to choose as they are not sure of their real preferences. Another problem could be that the configurations given by the software does not entirely match taste or fit. When companies cope with problems like these, they could implement a software that incorporates fast-cycle, trial-and-error learning. This allows customers to experiment with the different available options to learn about their preferences. The difference with assortment matching is that, when taking the example of My Virtual Model, instead of just receiving recommendations based on an avatar, customers can combine different colors and styles to see for themselves how it affects the end product. This is how they get to learn about their preferences. (Salvador *et al.*, 2009)

The most advanced approach to choice navigation is embedded configuration. This type of choice navigation is useful for adaptive customizers who produce standard products that are adjusted, modified or reconfigured after they have been purchased (Gilmore & Pine, 1997), either by the customer or automatically when they are equipped with embedded configuration. Take Adidas 1 for instance, it is a running shoe equipped with a system that makes the shoe more rigid or pliable after having calculated if the shoe is too soft or too firm for the runner. (Salvador *et al.*, 2009)

Choice of modularity

Although modularity has already been briefly discussed in this section, it is important to discuss the topic in more detail. The reason for this is because there are different types of modularity. Choosing the right type will have an impact on the success of the mass customization strategy. The type of modularity depends on the stage of production where the modularity occurs. According to Baldwin and Clark (1994), modules can be implemented in the design, production, and use stage. The three types of modularity are consequently: modularity-in-design, modularity-in-production, and modularity-in-use. Duray *et al.* (2000)

calls the second stage ‘fabrication’ instead of production, and adds a fourth stage, namely assembly. In this work an additional stage has been added based on Gilmore and Pine’s four types of mass customizers, namely additional services. Modules in the design and fabrication stage enable the modification of components whereas modules in the assembly, additional services, and use stage are just added or interchanged, but not modified (Duray *et al.*, 2000). An example of a type of modularity in the design or fabrication stage is cut-to-fit modularity. Modules are adjusted in the design or fabrication stage before combining them with other dimensions of the product. This type is used in products for which customers have different needs in, for instance, length, width, and height. It is used in customized eyeglasses. (Ulrich & Tung, 1991) An example in the assembly, additional services, or use stage is component-swapping modularity. Modules are not adjusted before adding them to other dimensions. On the contrary, they are part of a list of which customers can choose and are added to a standard product. This type is used for mass customized personal computers. (Ulrich & Tung, 1991) As discussed in the section about the different types of mass customizers and as it is shown on Figure 3, each type of mass customizer requires a different type of modularity because of the different stage of production in which modularity is implemented. Collaborative customizers can choose to implement modularity in any stage. Transparent customizers can also implement modularity in any stage except the use stage. Indeed the customers are not supposed to be aware of the customization with this type of mass customization (Gilmore and Pine, 1997). Cosmetic customizers can only implement modularity in the additional services stage, and adaptive customizers can only implement it in the use stage. The importance of modularity in mass customization is thus twofold. To reduce costs, as discussed before, but the success also depends on the right choice of stage in which to implement modularity. This entirely depends on the type of mass customization.

Choice of CODP

Customer order decoupling point (CODP) is another factor that depends on the type of mass customization adopted by the company. CODP or order penetration point (OPP) or point of customer involvement “*defines the stage in the manufacturing value chain, where a particular product is linked to a specific customer order*” (Olhager, 2003, p. 319). This means

that before this point, a company produces based on forecasting and after this point it produces for one particular customer (Hedenstierna & Ng, 2011). Four CODPs are most frequently applied, namely engineer-to-order (ETO), make-to-order (MTO), assemble-to-order (ATO), and make-to-stock (Haug, Ladeby & Edwards, 2009). Companies applying ETO adopted a strategy of pure customization. Indeed, unlike mass customizers, a customer of ETO companies enters the production process at the very beginning, and thus every part of the product is specifically manufactured for that customer. Companies applying MTS, adopted a strategy of mass production. Customers enter the production process at the very end, when the product is finished. In between those two extremes, there is MTO and ATO. Both are a type of mass customization. (Haug *et al.*, 2009) Like the names suggest it, customers of companies applying MTO, enter the production process in the design or fabrication stage, while customers of companies applying ATO enter it in the assembly stage. As shown on Figure 3, mass customizers can also involve customers in other stages of the production process, namely the additional services stage and the use stage. Companies applying the former have the CODP after companies applying ATO, companies applying the latter have the CODP after companies applying MTS. Although MTS is described as the limit or as an extreme (Salvador *et al.*, 2009), the CODP when applied in the use stage is even beyond MTS. This is because companies who adopted this CODP, and who are consequently adaptive customizers, involve its customers after they have purchased the product, whereas MTS companies sell it when it is finished, which is before the use stage. An overview of the four most frequently used CODPs and when exactly they occur in the production process is given in Figure 4.

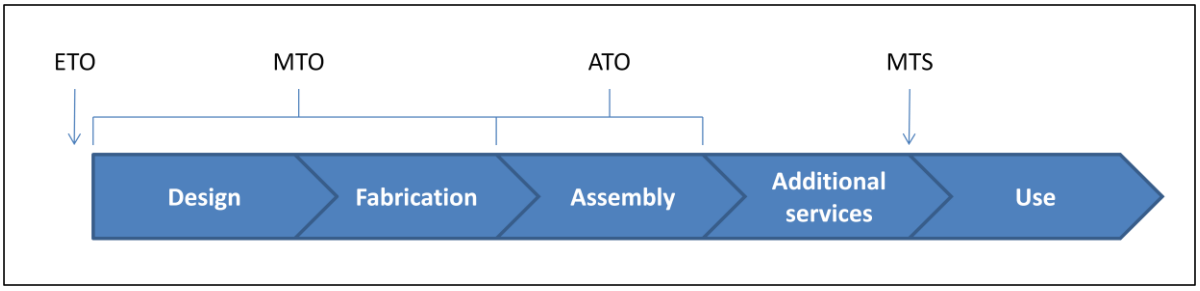

Figure 4: The four most frequently used CODPs and their position in the production process

In order to be successful, a mass customizer should choose the right CODP depending on the type of mass customization it wants to adopt. Collaborative customizers involve its customers no later than the assembly stage as it is a type of mass customization that changes the product according to a customer's needs (Gilmore & Pine, 1997). The same reasoning is true for transparent customizers. Customers of cosmetic customizers are involved in the additional services stage as only the representation of the product is adapted to the customers' requirements (Gilmore & Pine, 1997). Adaptive customizers only involve customers in the use phase. Indeed, they offer one standard product to all their customers, and it is only the use of the product that creates the sense of uniqueness for customers (Gilmore & Pine, 1997).

Postponement

Another important success factor of mass customization is postponement. On the one hand, customers demand highly customized products, on the other hand they want their orders to be ready more quickly (Feitzinger & Lee, 1997). This is where postponement is important. Postponement "*is [delaying] the task of differentiating a product for a specific customer*" (Feitzinger & Lee, 1997, p. 1). The later this task of differentiation occurs, the more a company benefits from postponement. Indeed, the later the differentiation, the more standard parts, thus the more economies of scale and the quicker the delivery as companies would not have to make the product from scratch upon order (Feitzinger & Lee, 1997). Furthermore, as already discussed in the section about the benefits of mass customization, postponement eliminates inventory of end products (Blecker & Friedrich, 2007), reduces the safety stock for raw materials (Piller *et al.*, 2004), and reduces planning complexity (Piller *et al.*, 2004). Postponement is one of the causes of economies of integration and is thus a must to be able to sell mass customized products at prices comparable to similar standard goods (Piller *et al.*, 2004).

First mover advantage

Mass customizers could greatly benefit from a first mover advantage. "*The basis of first-mover advantage is simple: by being the first to enter a new market, the business gains an*

advantage over its actual and potential rivals" (Pearson Education, 2015). In this section it is not necessarily about the first to offer the type of product, but about the first to mass customize the product in a certain market. The advantage of being the first in a market for a mass customizer specifically, is the relationship it can build with its customers and the gain in customer share based on knowledge about their individual needs and their trust won because of the company's adequate response to these needs (Hart, 1995). Gaining customer share for mass customizers is much different than for mass producers who do this through non-personalized transactions with their targeted customers (Hart, 1995). It is thus an advantage for a company to be the first to mass customize as it would enable it to build a trust-based relationship with customers that might deter them from buying products from any other supplier (Piller, 2005).

Marketing department

A last success factor of mass customization is having a marketing department that knows how to motivate customers to buy personalized products (Kotha, 1995).

To conclude, in order to be successful when implementing a mass customization strategy, companies should thus take into account many organizational factors. They should develop a solution space, have a robust process design, help customers through choice navigation, choose the right moment when to implement modularity, choose the right CODP, postpone differentiation activities, benefit from a possible first mover advantage, and have a marketing department that can motivate customers to buy personalized products. There are many more factors affecting the success of mass customizers, such as access to a supplier network nearby, access to trained employees (Broekhuizen & Alsem, 2002), customer loyalty, company credibility, and position in the marketplace (Hart, 1995). However, these factors are also true for any other type of company, which is why they are not taken into account in this analysis. Nevertheless, this does not mean mass customizers should not take these factors into account.

2.6.3 Summary table of all success factors of mass customization (Table 1)

<table>
<tr><th colspan="3">External success factors</th></tr>
<tr><td>Customers</td><td>Market</td><td>Technology</td></tr>
<tr><td>– Demand
➢ Customer sacrifice gap
– Technical knowledge
– Certainty about preferences
– Willingness to pay for a price premium
– Low time and effort for the customer</td><td>– Turbulent business environment
➢ Heterogeneous preferences
➢ Unstable demand
➢ Short product life cycles</td><td>– Available for the company’s industry
– Low complexity to implement
– Low cost</td></tr>
<tr><th colspan="3">Internal success factors</th></tr>
<tr><td>Product</td><td colspan="2">Organization</td></tr>
<tr><td>– Customers generally have heterogeneous needs for the company’s type of product
– Variety
➢ High enough to respond to customers’ needs
➢ Low enough to avoid mass confusion</td><td>– Solution space development based on customers’ needs
➢ Innovation toolkit
➢ Virtual concept testing
➢ Customer experience intelligence
– Robust process design
➢ Flexible automation
➢ Modularity
➢ Adaptive human capital
– Choice navigation</td><td>➢ Assortment matching
➢ Fast-cycle, trial-and-error learning
➢ Embedded configuration
– Right choice of modularity
– Right choice of CODP
– Postponement
– First-mover advantage
– Marketing department that is capable of exciting customers for personalized products</td></tr>
</table>

3 CASE STUDY RESEARCH

3.1 Methodology

The first part of this thesis consists in reviewing the literature in order to understand the current knowledge about the topic of mass customization and its success factors. The second part consists in finding out whether companies can be successful in mass customization without fulfilling all success factors, and if yes, how companies manage these imperfect conditions. In order to answer these questions, research needs to be done. Yin (2014) proposes five different research methods; experiment, survey, archival analysis, history, and case study. To find out which method suits this thesis best, three conditions need to be checked; "*the type of research question posed, the extent of control a researcher has over actual behavioral events, and the degree of focus on contemporary as opposed to entirely historical events*" (Yin, 2014, p. 9). The relationship between the three conditions and the five research methods is shown in Appendix 1. The type of research question in this thesis is 'how' which excludes the survey and archival analysis (Appendix 1). In this thesis contemporary events are analyzed and manipulation of behaviors is not possible, which leaves only case study as the relevant research method (Yin, 2014 and Appendix 1).

The first step in this case study research was to select companies to analyze. Before selecting companies, it was decided to look for companies situated in Belgium to avoid loss of information due to a language barrier. In order to find successful mass customizers, Sander De Vriese from Centexbel was contacted. Centexbel is a Belgian textile research centre that promotes and supports innovation within textile companies (Centexbel, 2015a). Sander De Vriese works in the company as a consultant in intellectual property (Centexbel, 2015b) and has done research about mass customization (Miseur, 2015). He suggested a few examples of companies in Belgium. Out of the six examples given by Mr. De Vriese, only one replied positively, namely Bivolino. Bivolino sells mass customized shirts online (Bivolino, 2014). In 2010 the company was the European market leader with its concept (Kalmès, 2010). In order to find another example of successful mass customization, more research was done. By

reading articles about mass customization, companies like Nike, Dell, Chocri, Levis, My M&M's, etc. often came up. Even though most of these companies are present in Belgium, it was clear after contacting one of them, namely Nike, that it would not be easy to receive a positive answer. That is why a family member working at Mars (My M&M's) was contacted in order to increase the chances on a positive answer. In 2013, My M&M's saw an increase of 22% in revenue and of 31% in return on investment ("My M&M's Boasts ROI", 2013), which is why the product can be considered as successful.

The second step was making a list of questions in order to interview Bivolino and My M&M's. First of all, the questionnaire was structured per success factor in order to easily deduct the information required for this thesis. Second, the questions needed to be informative as not all companies are familiar with terms like flexible automation or modularity. Third, and last, the questions had to be not too rigid, in order to have the possibility to ask more detailed questions when needed (Yin, 2014).

The third step were the actual interviews. The interview with Bivolino was done through Skype and the one with M&M's was done one on one. The way of communication was chosen by the companies themselves in order to give them more freedom which avoids refusals of interviews. A recording device was used to ensure accuracy of information as opposed to taking notes (Yin, 2014).

Other sources were used as well as a good case study relies on more than one source (Yin, 2014). According to Yin (2014) there are six main types of sources, interviews being one of them. The five others are direct observation, participant-observation, documentation, archival artifacts, and physical artifacts (Yin, 2014). The first two could unfortunately not be used due to confidentiality reasons and the last two were not used because they do not prove useful in these case studies. This only leaves documentation. Within this category, company websites, company presentations, and previous studies were used as sources of evidence in the case studies.

The last step consisted in writing the case studies, cross-case analysis, and drawing conclusions (Yin, 2014).

3.2 Case studies

3.2.1 Bivolino

3.2.1.1 The company

Bivolino is a Belgian company active in the apparel industry. The name Bivolino comes from the combination of 'Byvoet', which is the name of the two founding fathers of the company, and 'linnen', the Dutch word for linen. Linen was sold by their grandfather Jacques since 1900. The company was founded in 1954 in Hasselt, where many squirrels live. Which is also the reason why they chose a squirrel as the logo of the company. Today the company compares itself to the squirrel in the sense that the product, like a squirrel, has its own personalized style, moves fast and is elegant. (Bivolino, 2014a ; Bivolino, 2014b)

Bivolino started mass customizing ten years ago. The company mainly mass customizes men's and women's shirts, which accounts for 95% of its sales (M. Byvoet, personal communication, June 3rd, 2015). Furthermore the company also mass customizes children's shirts and accessories such as boxer shorts, ties, and handkerchiefs. Scarves and cufflinks are also sold but as standard products. In this study only the mass customized men's and women's shirts will be discussed. (Bivolino, 2014c)

The company's main strengths are, first of all, that a customer only needs to give four pieces of data. For men these are: age, weight, height, and the circumference of the neck (M. Byvoet, personal communication, June 3rd, 2015). For women the latter is replaced by cup size (M. Byvoet, personal communication, June 3rd, 2015). Thanks to the company's technology, called Linosoft, it can determine a customer's entire body measurement just with these four pieces of data (Bivolino, 2014d and Bivolino, 2015). Its second strength is the 100% fit guarantee. If the shirt does not fit, which is true in 5% of the cases (M. Byvoet,

personal communication, June 3rd, 2015), the company will send a second shirt for free without any return charges. In fact, a customer can keep the shirt that does not entirely fit. The second shirt is made based on extra measurements asked by the company. In case that customer wants to reorder a shirt, the company stores the information so that he or she does not have to enter all his or her measurements again (M. Byvoet, personal communication, June 3rd, 2015). That last fact is also true for the other 95% for which the shirt does fit, this is the third strength of the company. The last strength is that the product is delivered within ten days, which makes Bivolino one of the fastest of the market (M. Byvoet, personal communication, June 3rd, 2015). (Bivolino, 2014d)

3.2.1.2 Customers

Bivolino offers its mass customized shirts directly to customers (business to consumer), but also has a corporate dimension on its website (business to business) where companies can buy mass customized shirts for their employees with the company logo. (Bivolino, 2014e)

Sacrifice gap

As Bivolino sells shirts, customers have diverging needs for its products based on their size, weight, fit, and taste. It can be concluded that customers have a sacrifice gap for several features of the company's product.

Technical knowledge

In general clothing does not require technical knowledge, however, shirts have some technical features with which not all customers are familiar. Terms such as two-fold or Egyptian cotton is not something all customers know (M. Byvoet, personal communication, June 3rd, 2015). Up to a certain extent, customers need a certain technical knowledge, which some do not have. Unfortunately, the company does not explain the technical terms on its website. However, while customizing on the website, customers get to see on an image how the shirt will look like with a certain option (Bivolino, 2014f), which could help customers make the right choice.

Certainty about own preferences

M. Byvoet explains that generally its customers know their own preferences and if they do not, the company put in place some tools to guide them to their preferences (M. Byvoet, personal communication, June 3rd, 2015) which will be discussed below.

Willingness to pay a price premium

The price range of Bivolino's shirts is comparable to Hugo Boss and Tommy Hilfiger, €80 to €100. In the shirt industry the brand is seen as one of the better ones but not the highly luxurious ones that cost €200 or more. Because the company offers mass customized shirts, the price is up to 15% higher than if it sold standard shirts. Customers accept this price premium according to M. Byvoet. (M. Byvoet, personal communication, June 3rd, 2015)

Time and effort for the customer

The time and effort put into the mass customization process by the customers is relatively low because, as explained before they only have to give four pieces of data and thus they barely need to take any measurements. The delivery time is ten days, which is relatively low considering that Bivolino is one of the fastest in the market. Nevertheless, some customers only realize they have to configure the product themselves and that they have to wait ten days while they are ordering. Part of these customers will be deterred from buying the mass customized product because they feel that it is too complicated for them. It can be concluded that Bivolino has a strong advantage on competitors regarding time and effort, but despite this, a small part of the customers will be deterred from buying the shirt. (M. Byvoet, personal communication, June 3rd, 2015)

3.2.1.3 Market

The business environment in which Bivolino operates is not considered as turbulent. Yes customers have heterogeneous needs, but demand is not unstable nor are the product life cycles short. M. Byvoet explains that basic wardrobe is 80% of their sales. With basic wardrobe he means white, blue, or blue and white striped shirts. What differentiates one

shirt to the other is size, fit, and details such as the collar and buttons. He further explains that the company has been working with the same 100 core fabrics since it started mass customizing shirts, because that is what customers demand. Some of its customers buy the same shirt every six months. These facts show that the demand at Bivolino is quite stable and that products rather have long life cycles. (M. Byvoet, personal communication, June 3rd, 2015)

3.2.1.4 Technology

The technology used by the company did not exist when it started mass customizing. Indeed, they had to build their own technology. The technology used by Bivolino was already briefly discussed before and is called Linosoft. Linosoft is a patented biometric sizing technology that was developed with the help of the Vrije Universiteit Brussel (VUB) and the Dutch organization for Toegepast Natuurwetenschappelijk Onderzoek (TNO). Based on a formula that combines the four pieces of data given by the customer – age, weight, height, and circumference of the neck or cupsize – Linosoft can make a shirt that fits perfectly. As already mentioned, the software works for 95% of the customers, while the other 5% need to give a few more measurements. (Bivolino, 2014d ; M. Byvoet, personal communication, June 3rd, 2015)

This technology enables the company to mass customize shirts. Indeed, first of all, there is no need for long collaboration between the customer and the company to find the right fit. Second, the reconfiguration of the system from one customer to another takes no time as the shirt is cut based on just those four pieces of data which are easily entered in that system. (M. Byvoet, personal communication, June 3rd, 2015)

The research took two years and a few million Euros to finally develop Linosoft, which makes the implementation of this technology complex and very costly. (M. Byvoet, personal communication, June 3rd, 2015)

3.2.1.5 Product

Customers in the apparel industry have very diverging needs because of their different size, weight, fit, and taste (Gilmore & Pine, 1997). As Bivolino sells shirts, and is thus active in the apparel industry, it can be concluded that customers generally have diverging needs for the company's product.

The customer can choose to customize size and style to build a unique shirt. Concerning style, customers can basically customize every aspect of the shirt. Indeed, they can customize the color, the print, the fabric, fit (slim fit or not), the collar, the sleeve, the pocket, buttons, and the place of the logo. For each of these features, different options are given. (Bivolino, 2014f)

Furthermore, customers can choose from approximately 100 different heights, 100 different weights, 100 different ages, and 19 different circumferences of the neck. This alone gives 19 million different variant. Combining this with all the options for style, the company probably offers over a billion different variants. M. Byvoet confirms that all needs are satisfied with the different options, however offering that much choice can be overwhelming and confusing for customers. Below is explained how the company helps customers reduce this confusion. (M. Byvoet, personal communication, June 3rd, 2015)

3.2.1.6 Organizational factors

Solution space development based on customers' needs

Bivolino defined their solution space based on what they had learned about the market before the company started mass customizing. With fifty years of experience in making standard shirts before implementing a mass customization strategy, the company knew what the customers' needs were. The company did not use a specific tool for this. Over ten years of mass customization the only thing the company added to their offer is the 'arty

collection', where customers can choose to have a shirt with a print made by an artist. (M. Byvoet, personal communication, June 3rd, 2015)

Robust process design

One of the success factors of mass customization is having a robust process design, which is achieved through flexible automation, modularity, and adaptive human capital (Salvador *et al*., 2009). As Bivolino uses a special technology, Linosoft, where you only need to enter four pieces of data to cut the right shape of shirt, it is easy to re-task the system from one product variant to the other. Consequently, Bivolino is capable of flexible automation. The company also uses modularity. Indeed, some features of the shirt are made even before the customer enters the production process. These features used as modules are: the collar, the pocket, and the cuff. Those are added to the shirt when this one is cut, with minor changes if necessary. As for the third element of a robust process design, adaptive human capital, Bivolino did not encounter any difficulties when transitioning to mass customization. M. Byvoet explains that the mentality of the management had to change completely but that his staff was flexible on this. Furthermore, he explained that the change from production line work, where each employee added one specific feature to the shirt, to mass customization, where each employee makes the entire shirt by himself, was not complicated as all employees where familiar with making shirts. (M. Byvoet, personal communication, June 3rd, 2015)

Choice navigation

Bivolino "*supports customers in identifying their problems and solutions while minimizing complexity and the burden of choice*" (Salvador *et al*., 2009, p.6), which means they apply choice navigation. The company does this by means of three different tools. The first one is chat. Customers can chat with someone from the company while configuring a shirt in case they have any questions. The second is filters. The first thing customers (can) do when configuring a shirt is filter depending on price – and the collection that goes with it – and color. Once that is done, the number of choices is reduced, which makes it less confusing for the customer to create a shirt he or she likes. The third tool used by the company is fast-

cycle, trial-and-error learning by showing customers an image of the shirt while configuring. When choosing a certain option for a certain variant, the customer can see what effect it has on the shirt on the image. (Bivolino, 2014f ; M. Byvoet, personal communication, June 3rd, 2015)

Type of mass customizer

Before discussing the two next organizational factors, namely right choice of modularity and right choice of customer order decoupling point, the type of mass customizer needs to be defined as both factors depend on this. Bivolino is a collaborative mass customizer because both the product and the representation of it is changed for each customer (see Figure 1). Indeed each shirt is different based on style and size, which means the product is changed. Each shirt also looks different from other shirts, which means the representation is changed. Furthermore, collaborative customizers are characterized by dialoguing with their customers (Gilmore & Pine, 1997) which Bivolino does through its website and by offering a chat possibility while customers are configuring their shirt. (Bivolino, 2014f; M. Byvoet, personal communication, June 3rd, 2015)

Choice of modularity

Now that the type is identified, the choice of modularity and CODP can be discussed. According to Figure 3, the company can use modularity in each of the stages of the production process, considering the fact that the company is a collaborative mass customizer. Bivolino uses modularity in the assembly stage. Indeed, the modules – in Bivolino's case the collar, the pocket, and the cuff – are put together with the rest of the shirt in the assembly stage. It can be concluded that the company made the right choice of modularity based on the type of mass customizer. (M. Byvoet, personal communication, June 3rd, 2015)

Choice of CODP

The customer order decoupling point, or the point where the customer enters the production process, is in the fabrication stage. The customer enters the production process

before the assembly stage as some components still need to be made, such as the shirt itself which needs to be cut based on the customer's size. The design stage can be excluded as components are not original designs or alterations of standard designs (Duray *et al*., 2000). Which means the CODP is in the fabrication stage. Having the CODP in the fabrication stage is a possible choice for collaborative customizers, which means Bivolino made the right choice of CODP. (Bivolino, 2014f ; M. Byvoet, personal communication, June 3rd, 2015)

Postponement

Bivolino postpones the task of differentiating the product for one specific customer to the fabrication stage. Indeed, nothing is designed specifically for one customer. It is only in the fabrication stage that the company starts differentiating the product for a unique customer. (M. Byvoet, personal communication, June 3rd, 2015)

First mover advantage

Bivolino benefited from a first mover advantage. Being the first enabled the company to build a better brand image and trust with its customers. (M. Byvoet, personal communication, June 3rd, 2015)

Marketing department

The last factor that needs to be discussed is marketing. The company only promotes its products online, so it does not have an offline marketing campaign. The way Bivolino does this is by offering to buy and customize shirts through other websites, for instance through the website of e5 mode en de Bijenkorf. E5 mode is Belgian retail-clothing company (e5 mode, 2015) and de Bijenkorf is a chain of department stores in the Netherlands (de Bijenkorf, 2015). Bivolino wants to promote custom shirts as much as possible through big clothing companies. (M. Byvoet, personal communication, June 3rd, 2015)

3.2.2 My M&M's

3.2.2.1 The company

My M&M's are mass customized M&M's which is a brand that belongs to Mars, Incorporated (Mars). Frank C. Mars made and sold its first butter cream candy in his own kitchen in 1911. Now the company is still owned by the Mars family and is thus a privately owned company. Mars' portfolio of products is divided into six categories. The first one is petcare and counts forty-one brands, including Pedigree and Whiskas. The second is food, for which the company has eleven manufacturing sites, including one in Belgium. Uncle Ben's and Royco are two examples. The third category is Wrigley, or gum and confections, for which Extra and Orbit are the most famous brands. Mars owns five brands in the fourth category which is drinks. The fifth category is Mars Symbioscience. It is the health and life sciences segment of Mars and its purpose is to develop products that have a positive impact on the health and well-being of people, pets, and our planet across all categories. The last category is chocolate. Mars owns twenty-nine brands in this category, including M&M's, Snickers, and Twix. (Mars, 2015a-h)

M&M's is the number one worldwide chocolate brand (V. Struye, personal communication, June 12th, 2015). The first M&M's, plain chocolate candies, were produced in 1940. Ten years later the company decides to print the 'm' on each M&M's to ensure the customers they get the real product. This is also when the slogan 'Look for the M on every piece' was created. In 1981, M&M's is chosen as the first candy included in astronauts' food supply. The company launched mass customized M&M's in 2004 ("My M&M's Boasts ROI", 2013). Only the choco M&M's, as the company calls them, are customized. These are plain chocolate candies, which are known as those with the brown-colored package. In this study these plain M&M's will often be referred to as pellets. (Mars, 2015a ; V. Struye, personal communication, June 12th, 2015)

3.2.2.2 Customers

Mars mass customizes M&M's for customers but for businesses as well as they all have different colors and logos which could be represented by M&M's. (V. Struye, personal communication, June 12th, 2015)

Sacrifice gap

The reason why Mars implemented a mass customization strategy was not to answer a sacrifice gap, but more because of a series of facts. V. Struye explains that M&M's already was a brand that attracts customers. Mars opened M&M's stores, makes t-shirts, and all other kinds of gadgets related to the brand, all to create a strong link with its customers. Furthermore, the brand stands for colorful fun. Customizing its M&M's would be another, possibly fun, way of interacting with the brand. Another fact is that the 'm' logo was already printed on each M&M's, which could be replaced by another logo or text. The last fact is that by the end of the nineties, the company felt the market was reaching saturation (Meyer & Luecke, 2011). All these facts lead to the reason why Mars started mass customizing M&M's. Yes, all customers have different needs concerning what they want to print on the pellets, but these needs were only a consequence of the existence of mass customized M&M's. There is thus no real sacrifice gap for any of the features of the product. The need of the customer can be seen as the wish to celebrate moments with a personal gift. (V. Struye, personal communication, June 12th, 2015)

Technical knowledge

Customers do not require any technical knowledge to configure the M&M's, besides the fact that there is only room for nine letters or numbers per line on a pellet. (V. Struye, personal communication, June 12th, 2015)

Certainty about own preferences

V. Struye believes customers know their own preferences and even when they do not, the company indirectly helps them determine these. This will be discussed below. (V. Struye, personal communication, June 12th, 2015)

Willingness to pay a price premium

The price of mass customized M&M's is much higher than the price of those sold in supermarkets. A pack of 400 gram in Carrefour, a French retailer (Carrefour, 2015), costs 4.05 Euros (Appendix 2), whereas a mass customized pack of 400 gram, which are ordered online, costs 36.90 Euros (My M&M's, 2015a). Those prices are thus not at all comparable to the retail price of standard M&M's. However, My M&M's do not target the same market segment as standard M&M's. My M&M's is in the gifting industry (V. Struye, personal communication, June 12th, 2015). When comparing this price for 400 gram of My M&M's to the price for 500 gram of Belgian pralines, it can still be considered as expensive. Indeed prices for 500 gram is 13.95 Euros for Leonidas (Leonidas, 2015), 32.00 Euros for Neuhaus (Neuhaus, 2015), and 45.00 Euros for Godiva (Godiva, 2015).

Time and effort for the customer

Time and effort put into the customization process by the customer is limited. Customers just need to choose a color, decide which text they want to put on the pellets or upload a picture, choose the quantity required, choose the type of packaging, and pay. This does not take much time. However, they have to wait nine days until the product is delivered, which could deter some customers from buying mass customized M&M's. (My M&M's, 2015a-d ; V. Struye, personal communication, June 12th, 2015)

3.2.2.3 Market

V. Struye explains that the business environment for My M&M's is turbulent in the sense that it is a very competitive environment. Indeed, there are many chocolate producers and My M&M's are also in competition with other types of gifts. However, the business environment is not turbulent in the sense that customers have heterogeneous needs, that the demand is unstable, and that product life cycles are short. Customers only have truly heterogeneous needs for what is printed on the pellets. Demand is stable because moments such as weddings, births, birthdays, and others occur all year round. The demand for customized M&M's peaks during certain periods of the year, such as Christmas, but as this

occurs each year, this cannot be considered as unstable. Product life cycles are long, the choices between which customers could choose when the company started mass customizing M&M's still exist, more options have been added but none have been deleted. (V. Struye, personal communication, June 12th, 2015)

3.2.2.4 Technology

The technology required to mass customize M&M's was not much more complicated than the one to produce standard M&M's. The company already knew how to work with consumable ink, one of the only things that needed to be changed was what is printed on the pellets. It was Neil Willcocks, Advanced Development Director at Mars, and its team who started experimenting with different ways to print (Meyer & Luecke, 2011). What was truly complex for the company was the change from production on a very big scale to production on a very small scale and not so much the technology itself. Mass customized M&M's require much more manual work. Concerning the cost, on the scale of Mars Inc, it was not considered as expensive. It is the cost of the operation that is considered as expensive. (V. Struye, personal communication, June 12th, 2015)

3.2.2.5 Product

Whether customers generally have heterogeneous needs for chocolate candies is unclear from the literature.

On the B2C website of My M&M's, customer can choose from fifteen different colors. The next step is choosing to put a text, a picture, or an existing clip art proposed by the company. The last choice the customer can make is the type of packaging for which customers can choose from fourteen different packages. The amount of options is low enough to avoid mass confusion as the company does not offer that much choice of color, packaging, and clip-art – maximum five options per category, for instance customers can choose between two clip-arts concerning babies. However, the amount of options offered by the company

might not be high enough to fulfill all customers' needs. Indeed some colors are not offered, such as brown and black. Customers requiring brown or black M&M's might not be satisfied with another color. Another restriction for customers is the amount of text they can put on the pellets. The company offers only two lines of text of each only nine characters. Couples getting married who both have very long first names, will not be able to offer their guests customized M&M's with both their names on it. (My M&M's, 2015c)

3.2.2.6 Organizational factors

Solution space development based on customers' needs

A solution space is supposed to be developed based on diverging needs of customers (Salvador *et al*., 2009). However, Mars decided to offer certain options for certain features based on the message the company wants to convey, on its capabilities, and on the market it wanted to enter. The company wanted to customize the color because colors play an important role for the brand. Furthermore, the company knew from its M&M's shops that choosing its own color blend was fairly popular (Meyer & Luecke, 2011). The company made the message printed on the pellets customizable because it has been printing the letter 'm' on the pellets for years so it guessed that it would be possible for any other print as well (Meyer & Luecke, 2011), and because it wanted to enter the gifting market which requires personalization regarding the occasion the gift is for. (V. Struye, personal communication, June 12th, 2015)

Robust process design

In order to have a robust process design, the company needs flexible automation, modularity, and adaptive human capital (Salvador *et al*., 2009). V. Struye explains that, although My M&M's require more manual work, the machine that prints the text or picture on the pellets is easily re-tasked from one print to the other, which means the company uses flexible automation. It also uses modularity. From the interview and literature it was not clear if the pellets are color-coated before the customer enters the production process or after, but the pellet itself is made before. Furthermore, also the packaging is a module. The

different types of packaging are ready before the customer enters the production process. Whether the company has adaptive human capital or not was not clear from the interview or literature, but what can be said is that the group within Mars who came up with the idea of mass customized M&M's, had a hard time convincing the marketing department and top management until the general manager of Mars USA showed interest in the project (Meyer & Luecke, 2011). (V. Struye, personal communication, June 12th, 2015)

Choice navigation

The company uses choice navigation, which means it helps customers identify their preferences. The first thing the company does to help its customers is indirectly giving ideas by showing examples on the website (My M&M's, 2015d ; V. Struye, personal communication, June 12th, 2015). The website is also adjusted according to the period of the year for which some colors might be more appropriate than others (V. Struye, personal communication, June 12th, 2015). Second is showing the color combinations that are most often used for a certain occasion. For weddings, for example, the color combination is pink, white, and purple (My M&M's, 2015e ; V. Struye, personal communication, June 12th, 2015). Lastly, the website is designed in such a way that the company guides the customer step by step through the configuration process (My M&M's, 2015a-c ; V. Struye, personal communication, June 12th, 2015).

Type of mass customizer

Before moving on to the next two factors, the type of mass customizer needs to be identified. It can be argued that the company is a cosmetic customizer because the product itself, the pellet, is not changed. Only the representation of the product is changed, namely the color, the print, and the packaging. However, the company considers the color as an important part of the product, which means that when the color is adapted for a certain customer, the product is changed specifically for him or her. In this case, both product and its representation are adapted, the company is thus a collaborative customizer. (Gilmore and Pine, 1997 and V. Struye, personal communication, June 12th, 2015)

Choice of modularity

The company uses modularity in the assembly stage where the pellets, the modules, are put together with the color and the print chosen by the customer. As said before, it is not clear if the pellets are color-coated specially for one customer or not. If it is, the color-coated pellets are the modules that are put together with the print in the assembly stage. Modularity is also used in the additional services stage. Indeed, the packaging is also a module. Although the packaging is chosen by the customer, it is ready made before he or she enters the production process. As the company is a collaborative mass customizer, it can use modularity in any stage of the production process which means that it made the right choice of modularity. (V. Struye, personal communication, June 12th, 2015)

Choice of CODP

When configuring M&M's, the customer customizes the design of the product. Indeed, each print is unique. The customer order decoupling point is thus in the design stage. The customer is involved in the production process before modularity is used which could result in a greater sense of customization (Duray *et al*., 2000). As a collaborative customizer, the company can choose to put the CODP in the design, fabrication, or assembly stage according to Figure 3, which means it made the right choice of CODP. (V. Struye, personal communication, June 12th, 2015)

Postponement

Although customers are involved in the design stage, the tasks of differentiating the product for one specific customer is postponed to the assembly stage. Indeed, the product is only differentiated for a unique customer once the text, picture, or clip-art is printed on the pellets, which happens in the assembly stage. (V. Struye, personal communication, June 12th, 2015)

First mover advantage

As Mars is operating in the food industry, which is very large, it is difficult to assess whether the company was the first mover in the industry or not.

Marketing department

The company has a marketing department that is responsible only for My M&M's. They mainly promote the product online because it is only available through the internet. They also occasionally promote it on standard M&M's packages available in supermarkets. My M&M's are not promoted through television commercials as the company does not want to convey too many messages. TV commercials are exclusively used to promote the brand M&M's. (V. Struye, personal communication, June 12th, 2015)

3.3 Summary table of Bivolino and My M&M's

Red: company does not fulfill success factor; Green: company fulfills success factor; Orange: company partly fulfills success factor; Question mark: the information is not available.

Categories	Success factors	Bivolino	My M&M's
Customers	Sacrifice gap	Yes	No
	Technical knowledge	Intermediate	Yes
	Certainty about preference	Yes	Yes
	Willingness to pay for a price premium	Yes	Intermediate
	Low time and effort for customers	Yes	Yes
Market	Turbulent business environment	Intermediate	No
Technology	Available for the industry	No	No
	Low complexity to implement	No	Yes
	Low cost	No	Yes
Product	Customers generally have heterogeneous needs for the company's type of product	Yes	?
	Variety (too high, too low, just enough)	Too high	Just enough
Organizational factors	Solution space development based on customers' needs	Yes	No
	Robust process design	Yes	Yes
	Choice navigation	Yes	Yes
	Right choice of modularity	Yes	Yes
	Right choice of CODP	Yes	Yes
	Postponement	Yes	Yes
	First-mover advantage	Yes	?
	Marketing department	Yes	Yes

Table 2: Summary of the presence or absence of success factors of mass customization at Bivolino and My M&M's

3.4 Discussion

After having analyzed Bivolino and My M&M's, it can be concluded that not all success factors of mass customization need to be fulfilled in order to be successful. The question is, how did they manage being successful despite the lack of certain success factors? In this section all the success factors that were not, or only partly, fulfilled will be discussed in order to understand how companies can manage a mass customization strategy under 'imperfect conditions'.

Sacrifice gap

The first success factor that is not fulfilled by both companies is the sacrifice gap. Bivolino's customers have a sacrifice gap for size, fit, and taste of the shirts. My M&M's' customers however, do not have diverging needs for certain aspects of the pellets, and thus do not have a sacrifice gap. The need for the customized product comes from the willingness to offer a personal gift to celebrate a certain moment. The company played on the attractiveness of the brand among its customers to develop My M&M's. The company created a need for personalized M&M's among its customers. (V. Struye, personal communication, June 12th, 2015)

Technical knowledge

My M&M's' customers do not require any technical knowledge. However Bivolino uses some technical vocabulary to describe certain options of the shirts, which not all customers understand. To avoid mass confusion, the company uses an image of a shirt on its website that changes every time a customer chooses a certain option for a certain feature. (Bivolino, 2014f)

Willingness to pay for a price premium

Bivolino sells its shirts at a price premium of 15% for which customers are willing to pay (M. Byvoet, personal communication, June 3rd, 2015). Mars on the other hand, sells its customized pellets at prices nine times higher than the retail price of standard pellets (see

Appendix 2). It is clear from the analysis that My M&M's are not sold at prices comparable to similar standard goods, such as the literature suggests for mass customized products (Davis, 1987; Pine, 1993; Hart, 1995 and Piller, 2005). In spite of this high price, the company still manages to sell personalized M&M's because of two reasons. The first reason is that My M&M's does not target the same market as standard M&M's. Indeed, My M&M's targets the gifting industry. Therefore, prices should be compared to prices of chocolate sold mainly as a gift. As discussed before, the price of My M&M's is still relatively expensive compared to Belgian pralines, but the difference is smaller compared to the difference with the retail price of standard M&M's. The second reason that justifies these high prices is that My M&M's is a niche business for the company; not all customers are willing to pay such a high price premium for chocolate candies and, compared to the number of standard M&M's sold, the number of My M&M's sold is small. Nevertheless, My M&M's are sold in mass. This can be explained by the fact that M&M's is a brand that is well-known internationally and is sold in numerous quantities. Even though My M&M's are sold as a small percentage of all M&M's, this small percentage still represents mass quantities. (V. Struye, personal communication, June 12th, 2015)

Turbulent business environment

Neither Bivolino, nor My M&M's operates in a turbulent business environment., which is characterized by a higher need for variety and customization (Hart, 1995).

The only factor of a turbulent business environment Bivolino can count on is heterogeneous needs. Demand is stable and product life cycles are long, which makes the company's business environment stable. The company manages to be successful in mass customization by offering made to measure shirts at prices comparable to standard shirts which do not perfectly fit. (M. Byvoet, personal communication, June 3rd, 2015)

My M&M's fulfills none of the three requirements for operating in a turbulent business environment. The only feature customers have very different needs for is the print on the pellets. Indeed, every customer requires a unique print depending on the occasion and the

people involved. The need for the product comes thus from the willingness to offer a personal gift and not from heterogeneous needs, unstable demand, nor short product life cycles. (V. Struye, personal communication, June 12th, 2015)

Technology

The technology for mass customizing shirts at Bivolino and pellets at M&M's was not available. For M&M's this did not represent a problem as the company already knew how to work with consumable ink. The company only needed to test how to print other letters and figures besides the 'm' (Meyer & Luecke, 2011). The implementation of the technology was neither complex nor costly (V. Struye, personal communication, June 12th, 2015).

The same cannot be said for Bivolino. In addition to the unavailability of the technology, it also took the company two years and several millions of Euros to implement it (M. Byvoet, personal communication, June 3rd, 2015). The cost and complexity of the technology can be justified by advantages for both the company and its customers. Indeed, the technology enables customers to easily configure a shirt on the website. They only need to give four pieces of information to have a shirt that fits. This easy configuration also results in benefits for the company. It enables the company to easily re-task the machine from one customer's order to the other. Another benefit for the company is the patent they have on the technology. (Bivolino, 2014d and M. Byvoet, personal communication, June 3rd, 2015)

Solution space development based on customers' needs

This success factor relates to the sacrifice gap. Bivolino defined the features it wanted to customize and which options it would offer for those features based on what it learned about its customers before the company started mass customizing shirts (M. Byvoet, personal communication, June 3rd, 2015). M&M's on the other hand, defined the solution space based on the message it wants to convey – colorful fun – and on its existing capabilities – printing consumable ink on pellets (V. Struye, personal communication, June 12th, 2015). The company did thus not develop its solution space based on its customers' needs. What the company did do, is allowing customers to print anything they want on the

chocolate candies – provided that it does not exceed a certain amount of characters – which is a way to build a closer relationships with them. (V. Struye, personal communication, June 12th, 2015)

Variety

My M&M's offers enough variants to its customers, without offering to many which could lead to mass confusion (My M&M's, 2015). The same cannot be said for Bivolino. The company offers over a billion unique variants to its customers. In order to avoid customers being deterred from buying the company's product due to mass confusion, Bivolino reduces this confusion by means of choice navigation. The company does this by offering its customers the possibility to chat with an employee of the company while configuring, by implementing filters that reduces the number of choices, and by showing an image of the shirt while the customer is configuring. (Bivolino, 2014f)

From the analysis it can be concluded that most success factors of mass customization have been fulfilled by both companies. Those that were not, were usually fulfilled by one of both companies. Only two success factors were fulfilled by neither of them, namely operating in a turbulent business environment and available technology. Both companies made up for the lack of some success factors by benefiting from other aspects or even from other success factors. There is thus no need to fulfill all success factors in order to be successful. The case study of Bivolino and My M&M's show that there are solutions to tackle the lack of some of these factors.

3.5 Limitations of the study

As with any research, some conditions influence the outcome. First is that there has been done limited to no research on the topic of how to manage mass customization in imperfect conditions. There is thus close to no information on this topic. Indeed, the only aspect that has been discussed in the literature is how to reduce mass confusion (Salvador *et al*., 2009).

A second limitation is the limited information available about success factors of mass customization in recent years. No research has been done about the topic after 2009. However this does not imply that, in reality, these factors have not changed.

A third and last limitation was the difficulty to contact the companies. Getting a positive answer from companies seemed impossible without knowing someone working for the company, except for the CEO of Bivolino. This results in the analysis of only two companies and only one interview per company.

3.6 Areas for further research

It would be interesting to analyze under which conditions it is possible for companies to create a need for personalized goods. For instance, is it only possible for multinational companies like Mars with high brand recognition, or can it also be done by small or medium-sized businesses?

All the literature argues that mass customized products should be sold at prices comparable to similar standard products (Davis, 1987; Pine, 1993; Hart, 1995 and Piller, 2005). Piller even adds that mass customized product should be sold at a "*price level that does not imply a switch in an upper market segment*" (Piller, 2005, p. 315). However, mass customized M&M's are sold at much higher prices than standard M&M's and even higher prices than most comparable standard products in the gifting industry, which implies a switch to a higher market segment. Therefore, further research about the conditions under which prices do not need to be similar to standard products in order to be successful in mass customization should be done.

The example of Bivolino shows that, when having many variants, mass confusion can be reduced through choice navigation. This has also been said by Salvador *et al*. in 2009. However the literature does not say how much a company needs to guide its customers to avoid this confusion. Therefore it would be interesting to test the link between the number of variants offered and the level of guidance, or choice navigation, offered by the company.

4 CONCLUSION

The purpose of this thesis is twofold: to find out if companies can be successful in mass customization in imperfect conditions and, if so, how to manage these. In other words, to provide a solution to companies as to what they can do to tackle the lack of success factors for a mass customization strategy.

Extensive literature review enabled the identification of all success factors of mass customization. This list of success factors was further used in a case study research of two successful mass customizers to determine whether all of them need to be met in order to be successful, and, if not, to explain how to manage those that are not fulfilled. The case study research led to the following conclusions.

Firstly, not all success factors need to be fulfilled in order to be successful. It is therefore possible to be fruitful in imperfect conditions.

Secondly, solutions were found to tackle the absence of seven success factors, namely the sacrifice gap, technical knowledge of customers, prices comparable to similar standard goods, a turbulent business environment, technology to produce mass customized products, solution space development based on customers' needs, and enough variety to answer all customers' needs but not too much to avoid mass confusion. These solutions are the following:

When customers do not have a sacrifice gap for the product, meaning that they do not have differing needs for certain aspects of the product, a company can create a need for the product by playing on its brand attractiveness (V. Struye, personal communication, June 12th, 2015). This will create a demand even though initially there is no need for customization;

A lack of technical knowledge among customers about the product or an aspect of it, can be solved by explaining its purpose on the company website (Bivolino, 2014f);

Regarding the price factor, a company can afford to sell its mass customized products at much higher prices than similar standard products by entering another industry, such as the gifting industry (V. Struye, personal communication, June 12th, 2015). It can also afford it when its standard product is sold in very large quantities. Indeed, even though the similar mass customized good is sold in quantities that only represent a small percentage of the standard product, this number of products sold, still represents mass quantities (V. Struye, personal communication, June 12th, 2015);

The case study research has also shown that a mass customizer does not necessarily need to operate in a turbulent business environment in order to be successful. Even though demand is stable, product life cycles are short and needs are relatively homogeneous, the mass customizer can decide to customize other aspects of the product for which customers do have differing needs. A good example is the apparel industry. Suppose customers have a similar taste concerning fabric and print, and that this taste does not change over the years. For companies operating in the apparel industry it would still make sense, despite everything, to offer mass customized products, as they can customize based on size and fit. (M. Byvoet, personal communication, June 3rd, 2015);

When the technology to produce mass customized good is not available, and that it is costly and complex to implement, companies that decide to create the technology themselves can rely on better customer service, enhanced flexibility, and patents on the developed technology to make up for this lack (Bivolino, 2014d and M. Byvoet, personal communication, June 3rd, 2015);

Concerning the solution space, the literature argues that it should be developed based on customers' needs (Salvador *et al*., 2009). In other words, a mass customizer should choose what to offer based on what its customers require. However, when a company decides to

develop its solution space based on other factors – such as the message it wants to convey or its capabilities – it should ensure that this leads to a closer relationship with its customers;

Offering too much variety could result into mass confusion (Blecker and Friedrich, 2007). However, when a company wishes to offer many different options to ensure all customers' needs are fulfilled, this confusion can nonetheless be avoided through choice navigation (Salvador *et al*., 2009).

The knowledge that mass customizers can be successful in imperfect conditions and that there are solutions to tackle these, could lead to an increased number of mass customizers who previously were deterred of engaging in such a strategy.

Apart from the research question that was answered, an additional finding was to see how some factors, described as crucial for successful mass customization by the literature, proved to be unnecessary after having conducted case study research. The unfulfilled factors that are most surprising are the need for a mass customized product and its price. The need factor is seen as the ultimate reason for any company to exist (Tedesco, 2013). However, in this research it is shown that this need for customized products can simply be created by the company based on brand attractiveness. Regarding the price factor, it is even part of the definition of mass customization. Indeed, Davis (1987), Pine (1993), Hart (1995) and Piller (2005), argue that the price of mass customized products should be comparable to similar standard goods. Nevertheless, this research showed that this success factor is not mandatory. The absence of these two factors, that seemed indispensable, could change the current view on mass customization and could lead to new types of mass customization.

Less companies could be deterred of engaging in a mass customization strategy and new types of mass customization could emerge, however only time can tell whether this will indeed happen and if this could lead to mass customization becoming the future of retail as previously anticipated by the literature (Gilmore & Pine, 1997 and Weintraub, 2013).

5 REFERENCES

anonymous. (2013). *MY M&M'S boosts ROI by 15% after upgrading to enhanced campaigns*. http://www.ittechnology.us/wp-content/uploads/2013/10/case-study/my-mms.pdf (Retrieved on June 19, 2015).

Baldwin, C. Y., & Clark, K. B. (1994). *Modularity-in-Design: An Analysis Based on the Theory of Real Options.* Working Paper, Harvard Business School, Boston, MA.

Bivolino. (2014a). *Bivolino brand story*. http://www.bivolino.com/nl/bivolino-brand-story.html (Retrieved on June 9, 2015).

Bivolino. (2014b). *Bivolino* eekhoorn. http://www.bivolino.com/nl/bivolino-eekhoorn.html (Retrieved on June 9, 2015).

Bivolino. (2014c). *Accessories*. http://www.bivolino.com/en/accessories.html (Retrieved on June 9, 2015).

Bivolino. (2014d). *Customer service*. http://www.bivolino.com/en/customerservice.html (Retrieved on June 9, 2015).

Bivolino. (2014e). *Mannen corporate hemden*. http://www.bivolino.com/confpage.aspx?CID=119 (Retrieved on June 9, 2015).

Bivolino.(2014f). *Overhemden*. http://www.bivolino.com/confpage.aspx?CID=21 (Retrieved on June 9, 2015).

Bivolino. (2015). *Bivolino's patented biometric sizing technology*. http://cadans.uantwerpen.be/sites/default/files/Bivolino_UANTWERPEN_V2.pdf (Retrieved on June 17, 2015).

Blecker, T., & Friedrich, G. (2007, February). Guest editorial: Mass customization manufacturing systems. *IEEE Transactions on Engineering Management, 54*(1), 4-11.

Broekhuizen, T. L., & Alsem, K. J. (2002). Success factors for mass customization: A conceptual model. *Journal of Market-Focused Management*, *5*, 309-330.

Carrefour. (2015). *Carrefour*. http://www.carrefour.eu/ (Retrieved on June 14, 2015).

Centexbel. (2015a). *Mission statement*. http://www.centexbel.be/mission-statement (Retrieved on June 29, 2015).

Centexbel. (2015b). *People*. http://www.centexbel.be/people/sander-de-vrieze (Retrieved on June 29, 2015).

Charles, M. (2014). *What is flexible automation?* http://cross-automation.com/blog/what-flexible-automation (Retrieved on May 5, 2015).

da Silveira, G., Borenstein, D., & Flogliatto, F. (2001). Mass Customization: Literature review and research directions. *International Journal of Production Economics*, *72*(1), 1-13.

Davis, S. M. (1987). *Future Perfect.* Boston: Addison-Wesley.

De Bijenkorf. (2015). *De Bijenkorf Corporate*. http://www.debijenkorf.nl/debijenkorf-corporate (Retrieved on June 12, 2015).

Duray, R. (2002). Mass Customization origins: mass or custom manufacturing? *International Journal of Operations and Production Management*, *22*(3), 314-328.

Duray, R., Ward, P. T., Milligan, G. W., & Berry, W. L. (2000). Approaches to Mass Customization: configurations and empirical validation. *Journal of Operations Management*, *18*(6), 605-625.

e5 mode. (2015). *e5 mode*. http://www.e5mode.be/fr/ (Retrieved on June 12, 2015).

Feitzinger, E., & Lee, H. L. (1997). Mass customization at Hewlett-Packard: The power of postponement. *Harvard Business Review*, *75*(1), 116-121.

Franke, N., & Piller, F. (2004). Value Creation by Toolkits for User Innovation and Design: The Case of the Watch Market. *The Journal of Product Innovation Management*, *21*, 401-415.

Gilmore, J. H., & Pine, J. B. (1997). The Four Faces of Mass Customization. *Operations Management. Harvard Business Review*, *75*(January-February), 91-101.

Godiva. (2015). *Assortiment de chocolat*. http://www.godivachocolates.eu/fr/boutique/assortiment-de-chocolats/chocolat-belge-fr.htm (Retrieved on June 14, 2015).

Hart, C. W. (1995). Mass Customization: Conceptual Underpinnings, Opportunities and Limits. *International Journal of Service Industry Management*, *6*(2), 36-45.

Haug, A., Ladeby, K., & Edwards, K. (2009). From engineer-to-order to mass customization. *Management Research News*, *32*(7), 633-644.

Hedenstierna, P., & Ng, A. H. (2011). Dynamic implications of customer order decoupling point positioning. *Journal of Manufacturing Technology Management*, *22*(8), 1032-1042.

Huffman, C., & Kahn, B. E. (1998). Variety for sale: Mass customization or mass confusion? *Journal of Retailing*, *74*(4), 491-513.

Janssen, C. (2015). *Computer-Aided Manufacturing (CAM)*. http://www.techopedia.com/definition/4698/computer-aided-manufacturing-cam (Retrieved on June 24, 2015).

Kalmès, F. (2010). *Via het internet*. https://www.uhasselt.be/Documents/EDM/Press/via_het_internet.pdf (Retrieved on June 10, 2015)

Kotha, S. (1995). Mass Customization: Implementing the Emerging Paradigm for Competitive Advantage. *Strategic Management Journal*, *16*(Special issue), 21-42.

Kotler, P. (1989). From Mass Marketing to Mass Customization. *Planning review*, *17*(5), 10-13.

Leonidas, P. (2015). *Bestellen bij Pralines Leonidas Patricia*. http://www.pralines-leonidas.be/nl/bestellen-bij-pralines-leonidas-patricia- (Retrieved on June 14, 2015).

Ma, Y., Wang, N., He, Z., Lu, J., & Liang, H. (2015). Analysis of the bullwhip effect in two parallel supply chains with interacting price-sensitive demands. *European Journal of Operational Research*, *243*, 815-825.

Manktelow, J. (2015). *Lean Manufacturing*. http://www.mindtools.com/pages/article/newSTR_44.htm (Retrieved on June 24, 2015).

Mars. (2015a). *History*. http://www.mars.com/global/about-mars/history.aspx (Retrieved on June 14, 2015).

Mars. (2015b). *Brands*. http://www.mars.com/global/brands.aspx (Retrieved on June 14, 2015).

Mars. (2015c). *Petcare*. http://www.mars.com/global/brands/petcare.aspx (Retrieved on June 14, 2015).

Mars. (2015d). *Food*. http://www.mars.com/global/brands/food.aspx (Retrieved on June 14, 2015).

Mars. (2015e). *Drinks*. http://www.mars.com/global/brands/drinks.aspx (Retrieved on June 14, 2015).

Mars. (2015f). *Wrigley*. http://www.mars.com/global/brands/wrigley.aspx (Retrieved on June 14, 2015).

Mars. (2015g). *Symbioscience*. http://www.mars.com/global/brands/symbioscience.aspx (Retrieved on June 14, 2015).

Mars. (2015h). *Chocolat*. http://www.mars.com/global/brands/chocolate.aspx (Retrieved on June 14, 2015).

Meyer, M. H., & Luecke, R. (2011). *My M&M's*. http://www.sagepub.com/meyer/study/resources/venturecases/mymandms.pdf (Retrieved on June 17, 2015).

Miller, G. A. (1955). The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information. *Psychological Review*, *101*(2), 343-352.

Miseur, R. (2015). *Web-to-print: bedreiging of opportuniteit*. http://www.febelgra.be/upload/editor/docs/Diensten/kennisdatabank/technisch/w2p.pro/verslag_expertennetwerk_27jan2015.pdf (Retrieved on June29, 2015).

My M&M's. (2015a). *Verpakking*. http://www.mymms.be/nl/config/#/packagings (Retrieved on June 14, 2015).

My M&M's. (2015b). *Kleuren*. http://www.mymms.be/nl/config/#/colors/1 (Retrieved on June 14, 2015).

My M&M's. (2015c). *Personalisatie*. http://www.mymms.be/nl/config/#/customization/1 (Retrieved on June 14, 2015).

My M&M's. (2015d). *De populairste*. http://www.mymms.be/config/BE/#/colors/1/inspiration (Retrieved on June 18, 2015).

Neuhaus. (2015). *Chocolat belge*. http://www.neuhaus-online-store.com/fr/pralines-belges-assortiments/chocolat-belge-be.htm (Retrieved on June 14, 2015).

Novak, T. P., Hoffman, D. L., & Yung, Y.-F. (2000). Measuring the customer experience in online environments: a structural modeling approach. *Marketing Science*, *19*(1), 22-42.

Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics*, *85*(3), 319-329.

Oxford dictionaries (2015). *Locus*. http://www.oxforddictionaries.com/definition/english/locus (Retrieved on June 24, 2015).

Pearson Education (2015). *First-Mover Advantage*. http://www.pearsoned.co.uk/bookshop/article.asp?item=312 (Retrieved on June 24, 2015).

Piller, F. T. (2005). Mass Custumization: Reflections on the State of the Concept. *The International Journal of Flexible Manufacturing Systems*, *17*(4), 313-334.

Piller, F. T., Möslein, K., & Stotko, C. M. (2004). Does Mass Customization Pay? An economic approach to evaluate customer integration. *Production Planning & Control*, *15*(4), 435-444.

Pine, J. B. (1993). *Mass Customization: The New Frontier in Business Competition.* Boston: Harvard Business Press.

Rouse, M. (2011). *CAD (computer-aided design)*. http://whatis.techtarget.com/definition/CAD-computer-aided-design (Retrieved on June 24, 2015).

Rouse, M. (2015). *Just-in-time manufacturing (JIT manufacturing)*. http://whatis.techtarget.com/definition/just-in-time-manufacturing-JIT-manufacturing (Retrieved on June 24, 2015).

Salvador, F., de Holan, P. M., & Piller, F. (2009). Cracking the code of mass customization. *MIT Sloan Management Review*, *50*(3), 71-78.

Tedesco, M. (2013). *Why Do Companies Exist?* http://www.wobi.com/blog/companies-purpose/why-do-companies-exist (Retrieved on May 23, 2015).

Ulrich, K. T., & Tung, K. (1991). Fundamentals of Product Modularity. *Proceedings of the 1991 ASME Winter Annual Meeting Symposium, Design and Manufacturing Integration, Atlanta, GA*, 73-79.

von Hippel, E. (1994). Sticky information and the locus of problem solving. *Management Science*, *40*(4), 429-439.

Weintraub, A. (2013). *Is Mass Customization the Future of Retail?* http://www.entrepreneur.com/article/229869 (Retrieved on April 15, 2015).

Yin, R. K. (2014). *Case study research: design and methods (5th ed).* California: SAGE Publications.

Zipkin, P. (2001). The limits of mass customization. *MIT Sloan Management Review*, *42*(3), 81-87.

6 APPENDICES

Appendix 1: Relevant situations for different research methods (Yin, 2014, p. 9)

METHOD	Form of research question	Requires control of behavioral events?	Focuses on contemporary events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, why?	No	No
Case study	How, why?	No	Yes

Appendix 2: Retail price of a standard pack of plain chocolate M&M's of 400 gram (Picture taken on the 13th of June 2015 in Carrefour Market Wetteren)

Appendix 3: Questionnaire sent to Bivolino and M&M's

The product

1) To what industry do(es) the product(s) your company mass customizes belong?

2) What type of product(s) does your company mass customize?

3) Which features of the product are customizable? If your company mass customizes more than one product, please detail for all products.

4) Out of how many options can the customer choose for each feature that is customizable?
5) Are all customers' needs fulfilled with the number of variants offered by your company or are there still customers that would require a bigger offer of different options?
6) Do your customers sometimes get confused because there is too much choice to such an extent that they cannot make a choice?

The company

7) What type of mass customizer do you think your company is? Collaborative, adaptive, cosmetic, or transparent? Please explain why your company belongs to one type. If you are not familiar with these types of mass customizers, please check appendix 1 for more explanation.

The customers

8) Who are your customers? Companies, people,...?
9) How did you find you out about the demand for mass customized products in your industry?
10) Do your customers have very different needs for the features that are customized? Or do they often have similar needs?
11) Do(es) your product(s) require technical knowledge? If yes, do your customer have the technical knowledge about the product?
12) Do your customers know their own preferences or do you need to guide them?
13) Do you sell your products at a (slightly) higher price than your competitors that do not mass customize their products?
14) If yes, are there some customers that are not willing to pay for the customized product because of that higher price?
15) How much time and effort do your customers put into the mass customization process? In other words, how long does it take them to indicate their preference and how long do they have to wait for the product?

16) Is this considered as a long time by your customers? Meaning, are some customers dissuaded of buying the product because of this?

Market conditions

17) Would you consider the business environment in which your company operates as turbulent? In other words, are the needs of customers heterogeneous, is the demand unstable, and are the product life cycles short?

Technology

18) When your company started mass customizing, was the technology available in your industry to implement such a strategy?
19) If yes, what technology was this?
20) If yes (to question 18), do you think you would have been successful if it did not exist?
21) If not (to question 18), what kind of technology did you implement?
22) Was it complex to implement?
23) Was it costly to implement?

Organizational factors

Solution space development
24) Before you started offering mass customized products, how did you define which features of the product you were going to customize and how many options you were going to offer?
25) Did this offer evolve over time? If yes, what made you decide to change your offer?
26) Does your company use virtual concept testing to help determine what to offer? Virtual concept testing is the following: Instead of making physical prototypes, companies make virtual prototypes for customers to efficiently give scores and evaluate the prototype.

Process design

27) Does your company reuse or recombine existing organizational and value-chain resources to deliver customized products?

-a) Does your company use flexible automation? (Which is the ability for a robot or system to be quickly and easily re-tasked to change product design?)

-b) Does your company use modularity? (you can find an explanation about modularity in Appendix 2)

-c) If yes (to question 27c), in which stage of the production process is modularity implemented? Design, fabrication, assembly, additional services (for example packaging), or use stage?

-d) If yes (to question 27c), could you describe the modules you use?

-e) Are all employees and managers able to deal with new and ambiguous tasks?

Choice navigation

28) Does your company help customers identify their preferences while minimizing complexity and the burden of choice?

29) If yes, how? Through which mechanisms?

First-mover

30) Was your company the first one to implement mass customization in your sector?

31) If yes, could you identify the advantages you had from this?

32) If not, has the first mover kept its advantages and do you still feel the consequences of this?

Postponement

33) Does your company delay/postpone the task in which you differentiate the product for one specific customer? This means that before that point some aspects of the product are standardized for all customers.

34) If yes, at what stage of the production process do you differentiate the product? Design, fabrication, assembly, additional services (for example packaging), or use stage?

Customer order decoupling point (CODP)

The CODP defines the stage in the manufacturing value chain/production process, where a particular product is linked to a specific customer order.

35) In which stage of the production process is the CODP in your company? Design, fabrication, assembly, additional services (for example packaging), or use stage?

Marketing department

36) Do you have a marketing department that knows how to excite customers for customized products? If yes, how do they do that?

Appendix to the questionnaire

Appendix 1 to questionnaire: Types of mass customizers

When applying collaborative customization it is all about directly dialoguing with each individual customer in order to help them define their needs, especially when they have a hard time defining those themselves. It is a strategy often used in industries such "as apparel, windows, news services, and industrial valves" (Gilmore & Pine, 1997, p. 9). The reason for this is that all these industries' customers have to make onetime decisions based on an "either/or sacrifice gap", meaning that they have to make a choice between either one option or the other at one specific moment. A good example of this is Custom Foot, a shoe manufacturer. They enter in direct dialogue with their customers by making a digital image of their feet and through one-to-one conversation in order to make a shoe that exactly fits the customers' feet. By doing so, the company eliminates this either/or sacrifice gap customers have when choosing between, for instance, perfect fit for one foot but tightness or looseness for looseness the other. (Gilmore & Pine, 1997)

The second type of mass customization according to Gilmore & Pine (1997) is adaptive customization. This type of mass customizer offers one standard product that is easily customizable once the customer already pursued the product. It is the perfect type of mass customization for clients that would like to use the product differently at different occasions. Davis (1987) and Pine (1993) refer to this as “point of sale customization. Lutron Electronics Company is a good example of adaptive customization. The company offers lighting systems that are customizable by the user depending on, for instance, the mood they want to create in a certain room or the color of the walls. That way the lighting could be adapted to the atmosphere you want to create for certain occasion, such as a party or a romantic evening. (Gilmore & Pine, 1997)

The third type is cosmetic customization. Cosmetic customizers offer the same product to all clients with the only difference being the presentation of this product. This type is useful when all customers’ sacrifice gap is only about how they want the product to be presented. So they do not differ in the way they use the product. Consider the Planters Company, which sells peanuts and mixed nuts. They used to do this in either small, medium or large batches. When realizing its clients don’t all require the same packaging as they display products differently and don’t all use the same amount of shelf space, Planters chose cosmetic customization to offer any size to its customers. (Gilmore & Pine, 1997)

The fourth and last type of mass customization according to Gilmore & Pine (1997) is transparent customization. When applying transparent customization, a company offers customized goods without its customers’ explicit knowledge of it. This type of mass customization is used when a company has sufficient information about its customers to offer a product that responds exactly to their individual needs and when the customers don’t want to be bothered with specifying their preferences. ChemStation, a company that mass customizes industrial soap, observed its customers to learn about their usage pattern and about the right mixture of soap required. This company shows how you can customize a product to your customers’ specific needs with the need of direct collaboration. (Gilmore & Pine, 1997)

Appendix 2 to questionnaire: Modularity

Companies use modularity when they work with modules. Modules are standard pieces that can be combined - with components or other modules - or (slightly) adapted - before combining - for one customer. This allows for a certain amount of standardization which allows for economies of scale and thus lower costs. Modules in the design and fabrication stage enable the modification of components whereas modules in the assembly, additional services, and use stage are just added or interchanged, but not modified. (Duray *et al*., 2000)

Appendix 4: Skype interview with M. Byvoet, CEO of Bivolino – June 3rd 2015

Me: Heeft u de vragenlijst voor u?
Mr Byvoet: Ja.
Me: OK dan kunnen we beginnen. To what industry does the product your company mass customizes belong? Ik neem aan dat dat textiel is?
Mr Byvoet: Ja fashion.
Me: What type of products? Dat zijn dus de hemden.
Mr Byvoet: Ja.
Me: zijn er nog andere producten die u mass customized?
Mr Byvoet: Nee mainly women and men shirts 95%
Me: En ook hemden voor kinderen?
Mr Byvoet: Ja ook inderdaad.
Me: ok. Which features of the product are customizable? Wat kun je allemaal aanpassen naar eigen keuze?
Mr Byvoet: Size and style options
Me: Mag je als klant zelf een print kiezen of moet je kiezen tussen de gegeven prints?
Mr Byvoet: Nee je kan ook een print zelf voorstellen. Dat doen we met de artirange. Dus artiesten kunnen dessins uploaden. Dus voor de artirange is ook de fabric customizable.
Me: De fabric zelf kun je dus ook kiezen? Of enkel de print?
Mr Byvoet: Ja, ze kunnen ook kiezen op wat ze het printen. Dus op katoen of op katoen viscose of… De support kan ook gekozen worden ja.
Me: Out of how many options can the customer choose?
Mr Byvoet: Voor de maat op zich hebben we voor de heren 19 boordmaten, 4 fits, 100 leefdtijden, 100 kilos. 100 centimeters in lengte. Dus dat komt op 76 miljoen varianten voor de maat alleen. Dus als je de opties voor de prints bekijkt kom je op een miljard mogelijkheden ofzo.
Me: Uit hoeveel keuzes kunnen klanten kiezen bij de fabric?

Mr Byvoet: Katoen, katoen polyester,… Euhm ik denk een tiental
Me: ok, Over het algemeen heeft u het gevoel dat u klanten wel blij zijn met het aantal verschillende variants dat u aanbiedt?
Mr Byvoet: Ja dus als ze voor de eerste keer komen is het een beetje overweldigend. En nadien als ze één keer het systeem kennen dan zijn ze blij date er zoveel opties zijn. Dus je hebt een beetje een dualiteit daar. Too much, too less confused, not confused.
Me: Ja, ok. Das een vraag die ik later ook nog ga vragen maar: doet u iets om u klanten daarbij te helpen?
Mr Byvoet: Ja bijvoorbeeld de mobile, de klanten die op mobile komen, die switchen naar een mobile site en daar zijn de aantal opties beperkt. Dus veel nieuwe klanten die via tablet of smartphone bestellen die springen naar bivolino.com/mobile en dat is een site die beperkter is in opties.
Me: Ok. Volgende vraag dan, meer over het bedrijf, what type of mass customizer do you think your company is? Collaborative, adaptive, cosmetic, or transparent? Ik zou dat zelf kunnen afleiden maar ik vraag het toch om zeker te zijn dat mijn analyse juist en volledig is. Kent u deze types?
Mr Byvoet: Ik heb daar wel al van gehoord. Waar we juist inzitten dat weet ik niet.
Me: (Explanation of the different types of mass customization based on what is explained in the questionnaire.)
Mr Byvoet: Dus het eerste zou ik zeggen.
Me: sommige doen een combinatie, ik weet niet of u daar aan denkt?
Mr Byvoet: Die adaptive dat is het effectief niet. (while he is looking again at the explanation of the four types) Euhm neen, het is enkel de eerste, collaborative.
Me: OK. Who are your customers? Een vrij straightforward question. Dus dat zijn eigenlijk iedereen? Niet bepaald bedrijven? Bedrijven vragen nooit voor mass customized shirts voor hun werknemers?
Mr Byvoet: Jawel jawel, das de corporate applicatie van Bivolino. Daar verkopen we ook aan bedrijven met logo's en voor groepen van mensen.
Me: Ok, dus alle twee doen jullie?
Mr Byvoet: Ja, B2B en B2C.
Me: OK. How did you find out about the demand for mass customized products in your industry?
Mr Byvoet: Wat bedoelt ge daarmee?
Me: Dus, Hoe bent u op het idee gekomen om shirts te gaan mass customizen? Had u het gevoel dat er een nood was aan?
Mr Byvoet: Ja, op maat heeft altijd bestaan. Vroeger was het altijd op maat. De tailor om de hoek die deed niets anders als maatwerk. Wat wij willen doen is het maatwerk wat industrializeren en dus verlinken via het internet om het toeganklijk te maken voor iedereen.
Me: Do your customers have very different needs for the features that are customized? Or do they often have similar needs? Weeral, zoals u zei, dat is natuurlijk omdat ze allemaal

verschillende maten hebben en allemaal verschillende smaken, zal het daarom het antwoord ja zijn op die vraag neem ik aan?
Mr Byvoet: Ja.
Me: OK, Does your products require technical knowledge? If yes, do your customer have the technical knowledge about the product?
Mr Byvoet: Euhm wat dikwijls de klanten niet verstaan is als je spreekt over two-fold, zo'n technische features van hemden. Dat interesseert hen meestal wel maar ze kennen het verschil meestal niet. Single apply of two-fold of Egyptian cotton, zo'n dingen.
Me: Doet u iets om hen te helpen deze termen te begrijpen?
Mr Byvoet: Nee onvoldoende (laughing). We zullen proberen om inderdaad op de website technische te kunnen geven over de stoffen etc. Dat zou een verbeteringspunt kunnen zijn.
Me: OK. Do your customers know their own preferences? Or do you need to guide them?
Mr Byvoet: We hebben een chat, tijdens het configuratieprocess kunnen ze chatten maar we merken dat het toch niet te veel gebruikt word dus de meeste klanten weten toch wel wat ze willen.
Me: ondanks het feit dat er zoveel keuze is.
Mr Byvoet: Ja maar ze kunnen gemakkelijk filteren ook naar prijs, naar collectie, naar type. Als ze zoeken voor business, dan hebben we daar een speciale collectie voor.
Me: Ok dus u heeft wel zo'n filter die dan de keuzes reduceert en het makkelijker maakt om voor hen een keuze te maken. OK, Do you sell your products at a (slightly) higher price than your competitors that do not mass customize their products? Met competitors bedoel ik dan diegene die ongeveer in dezelfde pricerange zitten, dus niet de super luxe merken ofzo waar je super veel moet betalen voor een shirt.
Mr Byvoet: We worden vaak vergeleken met de prijzen van Hugo Boss of Tommy Hilfiger, rond de €80-90-100.
Me: Dus toch gezien als een luxemerk.
Mr Byvoet: Ja het betere merk maar geen hemden van €200 ook niet.
Me: Ja, neen, ok. Heeft u het gevoel dat u toch hogere prijzen moet vragen omdat de hemden zijn customized?
Mr Byvoet: Dat kan tot 15% gaan ja. Dat accepteren ze volledig.
Me: How much time and effort do your customers put in the mass customization process? Dus hoelang ongeveer duurt het voor hen om hun hemd te configureren, ik wil met deze maat, met deze fabric, deze print. En daarna hoelang moeten ze erop wachten om het product dan thuis te krijgen?
Mr Byvoet: Het configuratie bij ons is relatief eenvoudig omdat ze geen maat moeten opnemen met de lintmeter. We hebben een biometrisch matensysteem lengte-leeftijd-gewicht-boordmaat waardoor ze uiteindelijk op 5 minuten tijd het volledig process online kunnen doen.
Me: En hoe werkt dat?

Mr Byvoet: We hebben een complain rate van 5%. Dus het werkt voor het gross van het publiek. Als er iets niet klopt dan hebben we een fit garantie zodat we dan enkele extra maten vragen aan de klant en dan die fixeren in de back office voor die 5% complaints zodat ze bij repeat orders dan de goeie maat hebben. Maar voor 95% worden geen maat gevraagd zodat ge op 5 minuten kunt bestellen en het wordt gelevert op 10 dagen.
Me: Dus je moet je maten niet ingeven maar wat geef je dan wel in?
Mr Byvoet: lengte-leeftijd-gewicht-boordmaat. En voor dames: lengte-leeftijd-gewicht-cupmaat. Das een biometrische gepatenteerde technologie, dat staat ook op de website.
Me: Ja daar zal ik zeker naar kijken. Is 10 dagen gezien als lang?
Mr Byvoet: We zijn één van de snelste op de markt. We maken in Roemenië en Tunesië en onze concurrenten maken meestal in het verre oosten.
Me: Ok dus daarom is het ook sneller. Dus u heeft niet het gevoel dat sommige klanten niet gaan bestellen omdat ze 10 dagen moeten wachten?
Mr Byvoet: Ja dat gebeurt wel omdat ze tijdens het configureren niet echt beseffen, en dan ze ineens 10 dagen en dan 'wow tjein'. En valt hun frank dat het op maat is en dan 'neen dat is voor mij te moeilijk, dat doe ik niet' en ze zijn dan weg. Dat gebeurt absoluut.
Me: OK, volgende, market conditions, Would you consider the business environment in which your company operates as turbulent? In other words, are the needs of customers heterogeneous,? Dat is dus ja zoals al gezegd. Is the demand unstable, and are the product life cycles short?
Mr Byvoet: Demand is unstable, nee, ik zou zeggen we zijn al 10 jaar bezig en we zien klanten die jaar in jaar uit dezelfde stiffen bestellen.
Me: Dus toch dezelfde stoffen, niet: ze willen een andere stof omdat het nu meer in de mode is ofzoiets?
Mr Byvoet: Basic garderobe is toch wit blauw en een vichy met blauwe streepke. Das 80% van onze business. En de mensen kennen de naam van de stoffen en ze kopen die stoffen opnieuw. We hebben een pronto die een selectie is van 100 core stoffen die we al 10 jaar volgen en daar zijn eigenlijk echt heel blij mee. Dus het is eerder voor maathemden een stabiel demand en de product life cycle is eigenlijk, ja ze kopen om de 6 maanden opnieuw, een basis outfir voor business. Tis dus korte cyclussen maar uiteindelijk lange cyclus tegelijker tijd.
Me: Ja omdat het toch dezelfde producten blijven.
Mr Byvoet: Ja. Omdat het op maat is. Het verschil met een standaard product is het maatwerk maar het stoffen aanbod kan heel stabiel zijn.
Me: Ja dus in verband met technologie, u heeft er al over gesproken. When your company started mass customizing, was the technology available in your industry to implement such a strategy?
Mr Byvoet: Nee die hebben we zelf moeten bouwen. De configuratie technologie hebben we zelf gebouwd. En dus de fit technologie, het biometrische fittechnologie ook. Je kunt informatie over onze technologie vinden op de website bivolinoservices.com, daar heb je de

verschillende componenten, bivosoft bijvoorbeeld is een software voor het 3D configuratie. Linosoft is een software voor het biometrische.
Me: ok dankuwel. Ja, was het complex to implement it?
Mr Byvoet: Ja vandaag kunt ge gewoon websites bouwen voor €5000, €20000, maar hier was het meer een paar miljoen euro omdat het een complex systeem is en die configuraties bestonden niet, dat hebben we allemaal moeten bouwen. Die konden niet werken op Flash omdat ios devices van Apple flash niet ondersteunden dus hier spreken we toch over een heel andere dimensie van IT ontwikkeling dan standaard producten.
Me: Dus toch heel complex en heel duur?
Mr Byvoet: Ja ja toch een paar mijoen euro en tis inderdaad complex en duur.
Me: En hebben sommige concurrenten jullie technologie overgenomen?
Mr Byvoet: Ja de 3D technologie, het visualisatietechnologie dat is niet beschermt, das open source dus anderen concurrenten doen dat vandaag ook, op z'n eigen manier. Maar we hebben wel uniciteit voor het biometrische systeem. Dat hebben we gepatenteerd, dat noemen we Linosoft. Als je zoekt onder M. Byvoet patent gaat ge ook informatie vinden over het patent.
Me: OK, super. Nu gaan we naar de organizational factors. Before you started offering mass customized products, how did you define which features of the product you were going to customize and how many options you were going to offer?
Mr Byvoet: Ja we zijn hemdenmakers sinds een paar generaties dus we weten alles over hemden dus het was dan niet moeilijk om dan kragen en manchetten aan te bieden en door consumenten te laten kiezen.
Me: Dat was dan gebaseerd op wat u al aanvoelde wat klanten wouden?
Mr Byvoet: Ja dat is gewoon standaard klassieke kragen, italiaanse kragen,… De monogram borduren, initialen
Me: U heeft dat dan gebaseerd op wat u daarvoor al deed, over wat de vraag van de klant daarvoor.
Mr Byvoet: Ja. Dus voor dat we met mass customized products gestart zijn 10 jaar geleden deden we standaard hemden. Standaard en ook wat maatwerk maar dan offline, niet via het internet natuurlijk.
Me: Ja, ok. Did this offer evolve over time? If yes, what made you decide to change your offer?
Mr Byvoet: Weinig, behalve het feit dat ze kunnen met die artirange zelf designs uploaden. Das eigenlijk het echte verschil met in het begin.
Me: Does your company use virtual concept testing to help determine what to offer? + explanation about the term.
Mr Byvoet: Nee. We hebben een configureerder en de klant configureerd wat hij wil, tis niet dat wij zelf met een configureerder gaan configureren en dan gaan vragen 'wat vind ge van die configuratie?' Neen dat doen we niet neen.

Me: Volgende. Does your company reuse or recombine existing organizational and value-chain resources to deliver customized products? Deze vraag is in onderdelen gesplitst. Dus, does your company use flexible automation? (+ explanation of the term flexible automation.)
Mr Byvoet: Euhm ik kijk ook naar die tweede vraag.. Modularity… (Reading questions below) Ja bij ons is het proces gedigitaliseerd tot en met het snijproces. Dus stoffen worden op een snijtafel gelegd en automatisch via cutters gesneden. Dus wij generen hier cad cam files, maatpatronen, automatisch worden die in cutters opgeladen en dan versneden in onderdelen. Dus er zit een modulariteit in. Maar omdat al die onderdelen van een hemd, een hemd heeft 14 onderdelen, met de tripluur, de stof, de kraag en de manchette, en dan begint het stikwerk. Dus dat is het proces. Het is geautomatiseerd tot na, euhm ja het aan elkaar stikken is nog een manueel proces met stikmachines maar alles daarvoor is volledig gedigitaliseerd. En dus ook heel flexibel en automatisch en modulair. Maar één keer dat alle stukken daar zijn dan wordt dat in elkaar gebracht voor die unieke consument.
Me: Dus het gesneden worden dat is dan ook allemaal anders voor elke klant?
Mr Byvoet: Ja ook.
Me: Dus de machine kan zich dan gemakkelijk aanpassen aan de vraag van de klant?
Mr Byvoet: Ja.
Me: dus dat is eigenlijk daarvoor ook al dan?
Mr Byvoet: Dus ja het is heel flexibel en automatisch en uniek tot en met het snijproces volledig. Elk order heeft een ander patroon want iedereen heeft een andere lengte, leeftijd, gewicht dus elk hemd is echt uniek en op maat. Het patroon wordt individueel versneden maar dat is volledig automatisch, daar komt geen manuele complexiteit van de persoon daar tussen. Dus we zijn volledig , wij noemen dat ‘consumer driven customized digitilized supply chain’ met volledig modulair en automatisch of agile facturing maar daar zitten geen robots in. Ja de snijmachine is een soort robot. Maar het stikken niet.
Me: Modularity dat is eigenlijk dat u bepaalde modules hebt en dat zijn delen die u gaat recombinen met andere modules of echt componenten van het product of nog een beetje aanpassen voor de klant zelf. Gebruikt u dit?
Mr Byvoet: Ja bijvoorbeeld kragen en manchetten die worden op voorhand gemaakt, want een boordmaat dat is 36-37-38cm. We hebben de topkragen en de tripleuren en die worden al op voorhand klaargemaakt. Dus die kunnen inderdaad gebruikt worden voor klant A, voor klant B. Dus dat zijn onderdelen die klaar liggen bij wijze van spreken en die dan op het laatste ogenblik in het hemd gebracht worden van die individuele consument.
Me: Ok, en die modules,die wordt dan op voorhand gemaakt en die wordt dan bij de assembly gebruikt?
Mr Byvoet: Ja klopt.
Me: OK. Heeft u ook andere modules ook die u nog gebruikt en die misschien in een andere stage van de productionproces gebruikt worden.
Mr Byvoet: Dus kragen, manchetten en zakken.

Me: Ja. Dan nog een vraag 27 e), Are all employees and managers able to deal with new and ambiguous tasks? Ja ik neem aan dat voor u bedrijf niet zoveel nieuwe dingen aankomen omdat het eigenlijk altijd hetzelfde is. Maar had u in het begin het gevoel dat uzelf en andere managers en employees echt moeten veranderen van mentaliteit om naar mass customization?
Mr Byvoet: Zowel de custom service als het patroon is uniek voor een individuele klant dus das een hele mentaliteitswijziging maar ook in de productie, het is geen bandwerk meer, het is een individueel man of vrouw die het hemd voor één individu in mekaar steekt. Één persoon kan 12 hemden in elkaar steken per dag en die doet het volledig hemd zelf. En dat gebeurde vroeger niet. Iedereen zat in de band en dat was: één persoon zet de kraag erop, één de boord, één de manchette, één de zak en die waren achter elkaar in de file. Dus het is een heel andere productie instelling maar ook een heel andere customer service.
Me: Heeft u veel moeten doen om die mentaliteit te veranderen? Heeft u daar problemen mee ondervonden?
Mr Byvoet: Nee nee, das een proces natuurlijk maar dat viel goed mee.
Me: De mensen die dat maken, hebben ze dat dan gewoon moeten leren hoe ze de rest van het hemd ook kunnen maken?
Mr Byvoet: Die waren natuurlijk al ervaren met hemden van aan de bandwerk.
Me: Vraag 28 hebben we ongeveer al gehad. Does your company help customers identify their preferences while minimizing complexity and the burden of choice? U zei dat u met de price range en andere…
Mr Byvoet: Ja en ook met de mobile site en de chat support.
Me: En dus ook met het filtersysteem?
Mr Byvoet: Ja inderdaad.
Me: Was your company the first one to implement mass customization in your sector?
Mr Byvoet: Ja dat klopt.
Me: OK. Could you identify the advantages you had from this?
Mr Byvoet: Ja als je de eerste zijt dan heb je altijd natuurlijk dat branding voordeel. En je hebt soms het nadeel dat je soms wat de vroeg zijt maar toch het voordeel dat je de eerste bent en dat weet men.
Me: U heft daar klanten aan overgehouden die bijvoorbeel niet naar andere mass customizers gaan daarna? Die hebben het brand image en trust opgebouwd? Heeft u dat gevoel?
Mr Byvoet: Jaja inderdaad.
Me: Does your company delay/postpone the task in which you differentiate the product for one specific customer? This means that before that point some aspects of the product are standardized for all customers. Er zijn inderdaad zoals u al zei, dingen die u op voorhand maakt. Voor dat de customer zijn order maakt.

Mr Byvoet: Ja inderdaad, de stoffen liggen daar, die kragen, die manchetten etc liggen klaar. De manuele differentiatie begint pas bij het samenbrengen van de onderdelen en dat is na het snijproces in de supply chain.
Me: OK, ja. Maar op zich is het snijproces ook al specifiek voor de klant?
Mr Byvoet: Ja dat klopt omdat het volledig op maat is.
Me: Dat wordt dan geconfigureerd in de machine en de machine weet hoe die moet snijden?
Mr Byvoet: Ja dat klopt inderdaad.
Me: OK dus eigenlijk voor de vraag 'at what stage of the production process do you differentiate the product? Design, fabrication, assembly, additional services (for example packaging), or use stage?' Dat is dan eigenlijk al bij het design?
Mr Byvoet: Ja het is inderdaad al als de consument begint de configureren.
Me: Ja. Ok. Het volgende is een redelijk similaire vraag. In which stage of the production process is the CODP in your company? Design, fabrication, assembly, additional services (for example packaging), or use stage?
Mr Byvoet: De customer is in het proces vanaf het design van het product.
Me: En dan de allerlaatste vraag: Do you have a marketing department that knows how to excite customers for customized products? If yes, how do they do that?
Mr Byvoet: Ja we hebben een e-marketing afdeling. Wat we hier veel doen is affiliate programs, wat wij bijvoorbeeld fashion rooms noemen. In België doen we dat met Inno of met E5. Dus je hebt E5.bivolino.com, dat zijn fashionroom shops, digitale shops in de shops. We hebben bij grote partels, Marks&Spencers, WE fashion, de Bijenkorf etc. Zo proberen we zoveel mogelijk het custom concept via de grote partels of Amazon Bivolino shirts aan te bieden.
Me: Dus alleen maar digitaal dan?
Mr Byvoet: Ja. Inderdaad we doen geen offline.
Me: Dat was het, wilt u misschien nog iets toevoegen?
Mr Byvoet: Ja neen, ik zou zeggen, kijk goed op de footer links op bivolino.com en naar bivolinoservices.com. Bivolino is meer als een website, het is een platform. We verkopen dus op bivolino.com maar ook via E5.bivolino.com, daar hebben we veel fashion rooms. Je ziet die klanten dan ook op de pagina bivolinoservices customers. Waar je ook wat links hebt. We zijn ook een software bedrijf die oplossingen biedt aan klanten in customization. We proberen zowel rechtstreeks, B2C als B2B oplossingen voor mass customization aan te bieden.
Me: OK. Ja dat was het.
Mr Byvoet: Vriendelijk bedankt, en succes verder en hou me op de hoogte als er problemen zijn.
Me: U bent bedankt voor u tijd. Ik zal er zeker heel veel mee kunnen doen. Dus dankuwel.
Mr Byvoet: Perfect, als er nog iets is, mail me dan maar.
Me: Bedankt, daag.

Appendix 5: Interview with V. Struye, Category Development & Strategy Deployment Director at Mars Food Europe – June 3rd 2015

Me: To what industry do(es) the product(s) your company mass customizes belong?
Ms Struye: Food industry, en gros on est dans l'industrie de l'alimentaire, et dans le FMCG.
Me: oui. What type of product(s) does your company mass customize?
Ms Struye: Ce qu'on customize ce sont les M&M's, donc du chocolat. Ceux sans la cacahouète. Les M&M's choco ou plain comme nous on les appelle.
Me: Which features of the product are customizable? J'ai déjà regardé sur le site, donc c'est la couleur,…
Ms Struye: La couleur, texte ou photo, l'emballage et c'est tout
Me: Il y a le site pour tout le monde, et le site pour B2B.
Ms Struye: Oui en effet on fait du B2C et du B2B. On a démarré en B2C, mais trèes vite on s'est rendu compte que c'était une occasion de faire du B2B. Beaucoup d'entreprises ont des couleurs spécifiques, ils peuvent mettre un message et ça peut être utilisé pour pas mal d'occasions.
Me: Oui tout a fait. Out of how many options can the customer choose for each feature that is customizable? J'ai déjà un peu regarder et j'ai vu qu'on peut choisir entre 10-15 couleurs.
Ms Struye: puis il y a une limite sur le nombre de lettres que tu peux mettre dessus, 2 lignes de 8 caractères ou sinon tu peux mettre une photo.
Me: Are all customers' needs fulfilled with the number of variants offered by your company or are there still customers that would require a bigger offer of different options?
Ms Struye: Il y a toujours moyen de faire plus. On pourrait offrir 50 couleurs, par contre on peut difficilement offrir plus de texte mais je crois que ça ça convient. Après ça évolue. Il y a déjà plus de couleurs qu'au départ, on ne pouvait pas mettre de photos, maintenant oui. Tout dépend de ce que nous sommes capables de produire. On regarde aussi en fonction des couleurs le plus souvent choisie. En fonction des logos des entreprises ou de la période de l'année.
Me: C'est depuis quand que M&M's fait MyM&M's ?
Ms Struye: On a commencé aux USA disons une quinzaine d'années. Et puis on l'a lancé en France car l'usine est en France, donc en Europe depuis une dizaine d'années.
Me: Do your customers sometimes get confused because there is too much choice to such an extent that they cannot make a choice?
Ms Struye: Je ne pense pas mais je pense que c'est une bonne question car pour que ça marche il faut que ce soit facile, intuitif, et il faut une bonne logistique. Il faut leur laisser suffisamment de choix pour leur donner le sentiment de customiser. Mais après il ne faut pas exagérer parce qu'après ils sont perdus. Et aussi pour nous, dans la fabrication ça doit rester faisable.

Me: Oui. What type of mass customizer do you think your company is? Collaborative, adaptive, cosmetic, or transparent? (+ explanation of the four types)
Ms Struye: Cosmetic ça ce n'est pas parce qu'on fait plus que ça. Alors c'est le premier, collaborative.
Me: ça j'avais déjà demandé : who are your customers ? Donc c'est B2C et B2B
Ms Struye: Oui ça peut être n'importe qui.
Me: Ok. How did you find you out about the demand for mass customized products in your industry? Est-ce qu'il y avait vraiment un besoin de M&M's personnalisés ?
Ms Struye: Ca fait plutôt partie de comment évolue le marché, comment on fait du marketing. Les gens maintenant sont un peu plus à la recherche de pouvoir influencer. Ils beaucoup plus intéressés à savoir qui est derrière les marques, est-ce que c'est du sustainable business etc. Don il y a beaucoup plus d'intérêt de se côté-là. On aime influencer les marques. Je pense que ça rentre dans un trend. Pour M&M's spécifiquement, on savait que c'est une marque qui attire beaucoup par tous les marketing qu'on crée autour avec les personnages etc. On vendait déjà pas mal de merchandized M&M's donc les t-shirts… Dans mêmes des magasins M&M's. Donc on sait qu'il y a une demande assez forte pour se genre de chose, il y a un intérêt. La marque c'est colorful fun. Pour se rapprocher de ses consommateurs. Et vu que depuis le départ déjà on imprime le M sur chacune des pastilles, le passage à l'acte a été plus facile. Après, est-ce que c'est venu d'un manifestement du consommateur, pas vraiment.
Me: Si j'ai bien compris, c'est plutôt M&M's qui a crée le besoin ?
Ms Struye: Oui. Mais on savait qu'il y avait un lien fort, qu'on pouvait créer un lien fort grâce à la marque.
Me: Oui.
Ms Struye: Il faut savoir que M&M's est la plus grosse marque de chocolat au monde. On a réussie à créer avec cette marque quelque chose d'assez fort. Donc tu ne peux pas faire ça avec une marque qui n'a pas ça. On peut que faire ça quand on a un produit que les gens aiment. Ici il n'y avait pas un réel besoin du consommateur. Par contre ce que c'est c'est 'je veux fêter des moments spéciaux avec les gens que j'aime en leur offrant un cadeau un peu spécial et personnel'. Donc ça c'est le besoin du consommateur et derrière ça il y a une marque forte qui peut l'offrir.
Me: Ok, parfait. Do your customers have very different needs for the features that are customized? Or do they often have similar needs?
Ms Struye: Je ne pense pas. A part le texte dessus. Le need c'est 'je veux offir quelque chose de spécial'. Ca c'est un besoin universel, derrière chaque consommateur a envie de mettre une certaine couleur et un certain texte. Et le fait chacun pour une raison différente. Pour une surprise, un anniversaire, une naissance,…
Me: Does your product require technical knowledge?
Ms Struye: Pour le consommateur il y a rien de technique à comprendre, juste lire les instructions. Par exemple si tu veux mettre un texte tu peux pas mettre plus de 8 caractères.

Par contre on a eu beaucoup de débats, et je ne crois pas que ça rentre vraiment dans la question mais, sur ce que les gens écrivaient sur leurs M&M's. Si quelqu'un veut mettre 'fuck you' ou 'je déteste les noirs' ou… ça ne va pas avec les valeurs de l'entreprises et on a une image de marque importante et on accepte pas le dénigrement. Donc on accepte pas de mettre n'importe quoi sur les M&M's.
Me: Do your customers know their own preferences or do you need to guide them?
Ms Struye: On les guide d'une manière indirecte. Quand tu vas sur le site, tu vois des idées. Ou quand on arrive dans une période spécifique les couleurs sur le site changent. Donc on les guide par l'ambiance générale du site. Mais après est-ce que les gens ont besoin de guidance ? Non je ne pense pas.
Me: OK. Do you sell your products at a (slightly) higher price than your competitors that do not mass customize their products? Ou par rapport aux M&M's normaux ?
Ms Struye: Oui bien sûr. Quand tu compares les paquets de M&M's dans le supermarché qui pèse X grammes, les M&M's customisés sont plus chers pour le même volume. Le packaging est plus cher car tu produis en de quantités beaucoup moins grandes et que les économies d'échelle se font quand tu fais de grandes quantités. On a commencé ça car ça pouvait être un domaine qui pouvait répondre à un certain besoin et en même nous permettre de premiumiser notre offre.
Me: Oui, ok. Are there some customers that are not willing to pay for the customized product because of that higher price?
Ms Struye: Yes. S'ils ne veulent pas payer le prix, ils n'achètent pas. Donc oui actuellement il y a des gens qui n'achètent pas de M&M's personnalisées parce qu'ils trouvent que c'est trop cher. C'est la seule chose qui va les arrêter à les acheter.
Me: Ok. Donc au fait je demande ça car en théorie on dit qu'il faut offrir le produit à un prix comparable pour pouvoir l'offrir en masse.
Ms Struye: Le truc qu'il y a c'est que nous sommes déjà un produit de masse. 98% des Belges achètent au moins une fois par an du chocolat. Dans des marché comme ça il y a une grande masse de consommation, après tu sais que tu vas démarrer en customisation, tu pourras toujours l'appeler de masse car c'est quand même un produit de masse en c'est commandé. Pour nous , la customisation de masse, c'est une niche. C'est beaucoup plus petit. La manière dont nous utilisons la customisation de masse, on le fait plus pour satisfaire un client, pour continuer à construire la marque. Ce n'est pas qu'une action de marketing, c'est aussi pour faire du profit. Càd que offrir des M&M's store et ce genre de choses ça nous permet de premiumiser, on touche moins de gens que quand on vend des paquets de M&M's dans les rayons, mais on continue à construire la marque, d'une manière originale. Donc il n'y a pas d'objectif pour nous d'offrir un produit qu'on puisse vendre en supermarché. Par contre si on pouvait le faire pour moins cher, à des prix plus compétitif, peut-être qu'on le ferait pour toucher plus de gens.

Me: Oui ok. How much time and effort do your customers put into the mass customization process? In other words, how long does it take them to indicate their preference and how long do they have to wait for the product?
Ms Struye: I would say limited. Tu montes sur le site, tu fais ton truc, je veux payer et c'est fait. Et la livraison se fait dans les 10 jours +/-.
Me: Est-ce qu'il y a qui trouve ça trop long ?
Ms Struye: Oui c'est possible. Mais après, pour prendre l'exemple des dragées au baptême, tu peux juste choisir la couleur mais tu ne peux rien marquer dessus.
Me: Oui, ok. Is this considered as a long time by your customers? Meaning, are some customers dissuaded of buying the product because of this?
Ms Struye: Oui bien sûr. C'est comme le prix sauf que ce dernier est encore plus important.
Me: Would you consider the business environment in which your company operates as turbulent? In other words, are the needs of customers heterogeneous, is the demand unstable, and are the product life cycles short?
Ms Struye: Non, non et non mais c'est un environnement compétitif. Il y a plein de producteurs de chocolat. Et pourrais rentrer en concurrence avec d'autres type de cadeaux. Il y a des périodes de pique en fonction des fêtes mais des naissances, des mariages et autres, il y en a toute l'année.
Me: Pourquoi je demande ça, c'est parce qu'on dit que la customisation de masse a commencé parce que la demande is unstable et que le product life cycle est short parce que des customisateurs de masse pourrais vite répondre à ces changements.
Ms Struye: Nous on est pas dans ce modèle. Si on avait un problème dans l'industrie, ça nous permettrait pas de nous adapter plus vite ou moins vite. Parce qu'on reste sur une production à petite échelle comparé au M&M's qu'on vend au supermarché.
Me: Ok, alors, When your company started mass customizing, was the technology available in your industry to implement such a strategy?
Ms Struye: Quand tu veux imprimer quelque chose sur une pastille, il faut de l'encre qui est consommable. Et ça on avait. Et après il faut les machines pour le faire qui ont été faites pour nous.
Me: Ce n'est pas comme si vous avez du inventer une toute nouvelle technologie pour pouvoir le faire ?
Ms Struye: Non. Ce qui change surtout c'est le supply chain autour, le process, que la machine elle-même. Pour le packaging c'est beaucoup plus manuel que nos autres M&M's ce qui se fait a la machine. Les pastilles sont faites de la même manières que les M&M's normaux. On sait qu'il y a certaines couleurs qui sont plus souvent utilisées et on apprend ceci au fur et au mesure. La production de la pastille de chocolat est standardisée. Ce qui est customisé c'est la couleur qu'il y a autour. C'est possible que la couleur soit déjà mise avant la commande. Et ce qui est réellement rajouter après c'est le texte ou la photo et le packaging.
Me: Ok.

Ms Struye: Le packaging est également quelque chose qui est définie et qui existe. Ça a évolué, on a différents packaging.
Me: Donc pour en revenir à la technologie, vous n'avez pas du réinventer le fil à couper le beurre.
Ms Struye: Non mais, ce qui a été le grand changement pour nous c'est qu'on avait l'habitude de produire à très grande échelle et que en customisation de masse c'est à plus petite échelle, donc à chaque fois de petites commandes vs des gros batch. Ca c'était le plus gros changement. Après au niveau de la technologie oui on a du travailler dessus, comme le fait de pouvoir imprimer des photos. Mais a part imprimer et de faire passer les pastilles au bonne endroit on a pas du faire grand-chose.
Me: Was it complex to implement? Was it costly to implement?
Ms Struye: A l'échelle de Mars inc c'était pas un coût énorme. L'opération est plus couteuse. Une fois que t'as acheté la machine, tu as acheté la machine, c'est l'opération-même qui est coûteuse. De la aussi le prix plus élevé.
Me: Before you started offering mass customized products, how did you define which features of the product you were going to customize and how many options you were going to offer?
Ms Struye: Une chose qui était très importante c'est, comme dans la marque les couleurs jouent un rôle très important, le fait de customiser les couleurs c'était d'office. C'est au cœur de la marque. Et après les autres features étaient lié au fait qu'on voulait entrer dans un marché qui était le marché du gifting. De là sont dérivés les options. En fonction des possibilités qu'il y a .
Me: Did this offer evolve over time? Ca tu avais déjà un peu expliqué.
Ms Struye: Oui donc on a commencé avec un peu moins de couleurs, moins de possibilités d'emballage et y avait juste de l'impression de texte. Et ça évolue parce qu'on a d'autres demandes.
Me: Does your company reuse or recombine existing organizational and value-chain resources to deliver customized products?
Ms Struye: La société fait déjà le chocolat, colourcoated. On fait donc les mêmes M&M's au chocolat. On fait donc un mélange de la technologie existante et de la nouvelle technologie. On le produit sur une ligne séparée. Là où les opérations des M&M's standards sont beaucoup plus automatisées, là il y a beaucoup plus de main d'œuvre humaine ne serais-ce que pour la partie emballage. Et aussi pour a chaque fois introduire dans la machine ce qu'elle va a chaque fois devoir produire. Parce que t'as des batch qui viennent l'un après l'autre.
Me: Oui.
Ms Struye: Et oui (looking at question 27e) certaines personnes ont du s'adapter. Est-ce que c'était très compliqué ? Je ne pourrais pas te le dire.
Me: Ok, non.
Ms Struye: (looking at question 27a) D'office tu es obligé de retask très vite ta machine.

Me: Donc il y moyen de vite passer d'un consommateur à un autre ? Il ne faut pas une heure pour adapter la machine à chaque fois ?
Ms Struye: Nonnon. Au fait c'est une machine ou tu introduis les caractéristiques qu'il faut.
Me: Au niveau de modularity (explanation of the term). Ca vous le faite vu que les pastilles-même ne changent pas.
Ms Struye: Oui.
Me: Et les emballages sont prêts. Il ne faut pas l'adapter. Il y a un nombre d'options fixe.
Ms Struye: Mise à part éventuellement une étiquette sur l'emballage, non en effet il ne faut pas l'adapter.
Me: Et alors c'est plutôt dans la fabrication ou dans l'assemblage qu'on utilise les modules.
Ms Struye: C'est plutôt dans l'assemblage. Tu prends une pastille existante, tu mets éventuellement la couleur dessus, si ce n'est pas encore le cas, puis le texte ou la photo.
Me: Ok, très bien. Does your company help customers identify their preferences while minimizing complexity and the burden of choice? J'ai vu que sur le site B2B vous utiliser en tous cas des filters qui réduit le nombre de choix. Et puis comme tu avais déjà dit, les exemples sur le site.
Ms Struye: Oui. Et puis le site te prends step by step à travers le process.
Me: First mover.
Ms Struye: Oui ça c'est une question compliquée. Je dirais probablement oui. Alors ça dépend dans quel secteur. Dans le food je ne pourrais pas te dire. Dans le chocolat, les seuls qui en faisait peut-être un peu c'est les pralines et encore. Pas au même point que M&M's. Un peu au niveau de l'emballage.
Me: Oui. Could you identify the advantages you had from this? Prà des concurrents ?
Ms Struye: C'est une manière vraiment de se rapprocher des consommateurs. Ca améliore ton image de marque énormément d'offrir la possibilité de personnaliser. Donc il a un côté vraiment marketing, branding ou tu renforces vraiment ta marque tout en se rapprochant des consommateurs presque en leur donnant 'leurs' M&M's. Et puis ça nous a permis nous de commencer dans le domaine du gifting. Ou on a des concurrents comme par exemple Ferrero qui sont très fort aux saisons spécifiques. Donc l'avantage concurrentielle que tu prends c'est vraiment que tu renforces beaucoup ta marque à travers ça. Et même peut-être plus qu'avec 15000 spots télé. Ca dépend, je pense que tout joue.
Me: Does your company delay/postpone the task in which you differentiate the product for one specific customer? This means that before that point some aspects of the product are standardized for all customers. Ca c'est donc quand le M&M's est déjà fait. Fin, la pastille.
Ms Struye: Oui. Tu peux pas dire 'je veux du chocolat noir, je veux du chocolat au lait…' peut-être que ça va changer. Donc c'est dans le assembly.
Me: In which stage of the production process is the CODP in your company? (+ explanation about the term). D'un côté c'est le assembly mais d'un autre côté, il peut bien créer sa photo ou son texte. Donc dans ce sens là c'est dans le design stage.

Ms Struye: Oui, d'un point de vue production et supply chain etc c'est surtout dans le assembly et puis le consommateur lui il peut vraiment avoir l'impression d'être dans le design.
Me: Do you have a marketing department that knows how to excite customers for customized products? If yes, how do they do that?
Ms Struye: Ils le font avec les techniques habituels de marketing. Comme c'est quelque chose que tu peux vraiment obtenir exclusivement par internet, notre canal communication sera surtout par internet. Après on utilise aussi parfois via nos emballages. On utilise pas forcément les campagnes qu'on utilise pour promouvoir M&M's pour promouvoir My M&M's. Au début on y pensait mais en fait notre message allait devenir très compliqué vis-à-vis du consommateur. Tu dois toujours faire en sorte de ne pas, fin tu ne peux pas mettre 10000 messages. On ne fait pas de communications télévisées parce nous on considère qu'on est plus dans un domaine niche donc on va utiliser la pub télévisée pour promouvoir la marque M&M's. La customisation on la fait connaître par le site d'internet après avoir promue la marque même. On n'a pas envie de mélanger tous les messages. Nous ce qui est important c'est que la marque M&M's reste grande et importante. On touche le maximum de gens c'est avec nos produits standards. Ca reste le 1iere objectif donc on construit cette marque-là. Donc oui on a une équipe marketing qui est là-dessus. L'avantage c'est qu'on doit pas avoir d'équipe pour My M&M's dans chaque pays parce qu'on a un site internet qui fonctionne pour tous les marchés. Et tout se produit en France. (pour l'Europe)
Me: Voilà c'était la dernière question.