



Modeling Mass Customization Level in Apparel and Textile Design Field

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Mass customization is a new approach to manufacturing and providing services that is revolutionizing business and mainly in textile and apparel field.

How can we model the mass customization level? In this study we will present a review of the mass customization concept in textile and apparel field, and some key success factors such as modular product design.

It presents also a framework, aiming to develop the mass customization for textile and apparel industries, by reviewing and modeling the mass customization strategy by assessing the mass production level and the co-design experience level and by presenting some scales to classify the mass customization level.

Keywords: Modeling; mass customization; textile; modular design; sustainability.

1. INTRODUCTION

Mass customization is the process of delivering market goods and services that are modified to

satisfy a specific customer's needs [1-3]. Mass customization is a marketing and manufacturing technique that combines the flexibility and personalization of custom-made products with

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the low unit costs associated with mass production. Other names for mass customization include made-to-order or built-to-order [4,5].

To simultaneously achieve customisation and efficiency, mass customisation requires collaborative engineering efforts between customers and manufacturers.

Emerging research in collaborative engineering, particularly the emerging Engineering Collaboration via Negotiation (ECN) as proposed by Lu [6], promises great potential to tame many of the challenges that are currently constraining many mass customisation programmes.

Conceptually, mass customisation can be taken as a collaborative engineering activity, where customers and manufacturers with asymmetric information and different preferences engage in interactive and joint conflict resolutions to co-create an artifact [7-9].

In general, there are synergies between these two fields of study. On the one hand, collaborative engineering research results can be applied to address various collaboration issues in mass customisation; on the other hand, mass customisation offers a fertile test bed to develop new collaborative engineering theories, techniques, and tools [9].

Our study on the development of mass customization in apparel industries will be done

in different part. The first part is devoted to the study of mass customization concept, we have presented some factor affecting mass customization level like mass production level and co-design experience level. We proposed some scale related to the assessment of mass customization.

2. MATERIALS

2.1 Review of Mass Customization's Concept

Pine introduces a model called "Feedback Loop" [10] In effect the chain bends around to become a loop with customers as integral part of it, creating and becoming prosumers, producers and consumers at the same time. Within this loop manufacturers and prosumers communicate interactively.

Kumar in 2004, presents the mass customization process in different steps as follow [11] in Fig. 1.

2.2 Mass Customisation in Textile and Apparel Industries

Mass customisation can be seen as a hybrid of mass production and customisation [12]. This system, like mass production, serves a large market with low cost products. By applying additional technology, the manufacturer is able to respond to consumer drives for custom garments.

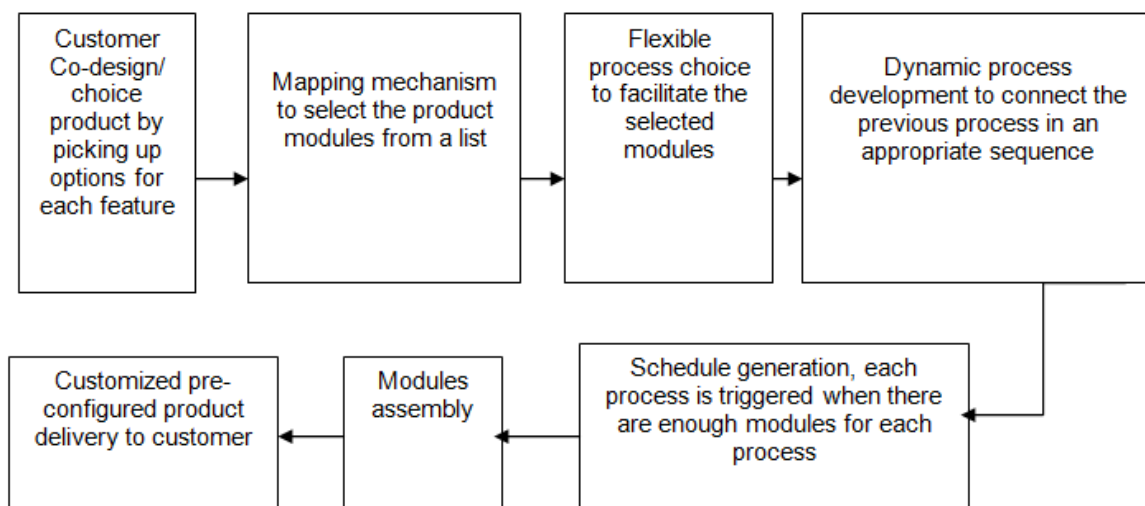


Fig. 1. Process for mass customization starting from customer co-design until the delivery of the customized product works [11]

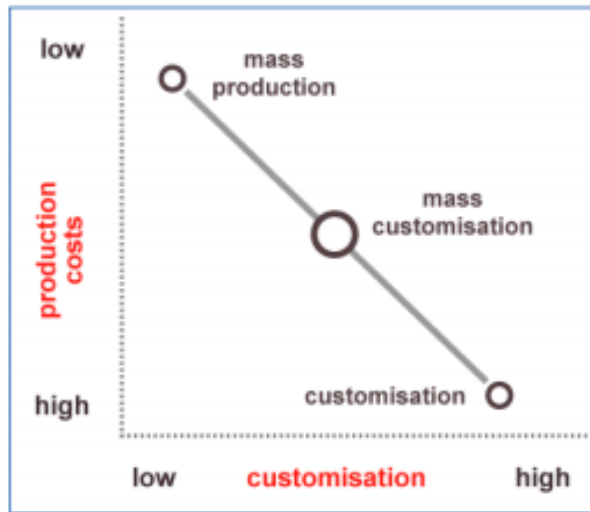


Fig. 2. Mass customization: a hybrid of mass production and customisation [13]

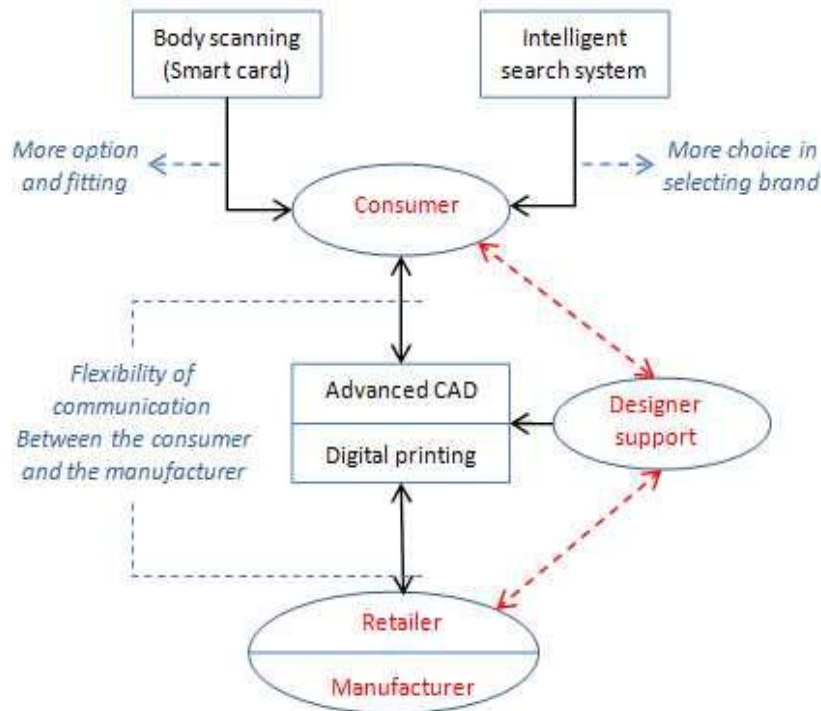


Fig. 3. Possible effects of mass customisation in the apparel industry Anderson et al. [13]

Anderson et al. [13] present a model of the effects of mass customisation in the apparel industry, they indicated that digital information and new technology in the process of manufacturing will develop customised apparel with the four previous options.

In the production process of apparel industries, mass customization strategies can be used at any of the six following stages.

Mass customization allows the consumer to modify a company product line to meet individualized design tastes or fit requirements.

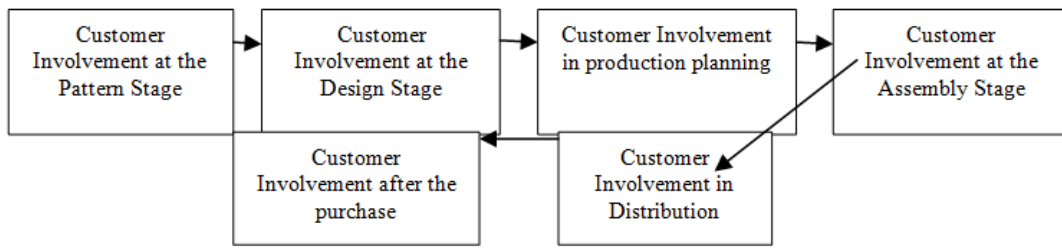


Fig. 4. Customer involvement in the stage of the apparel production process

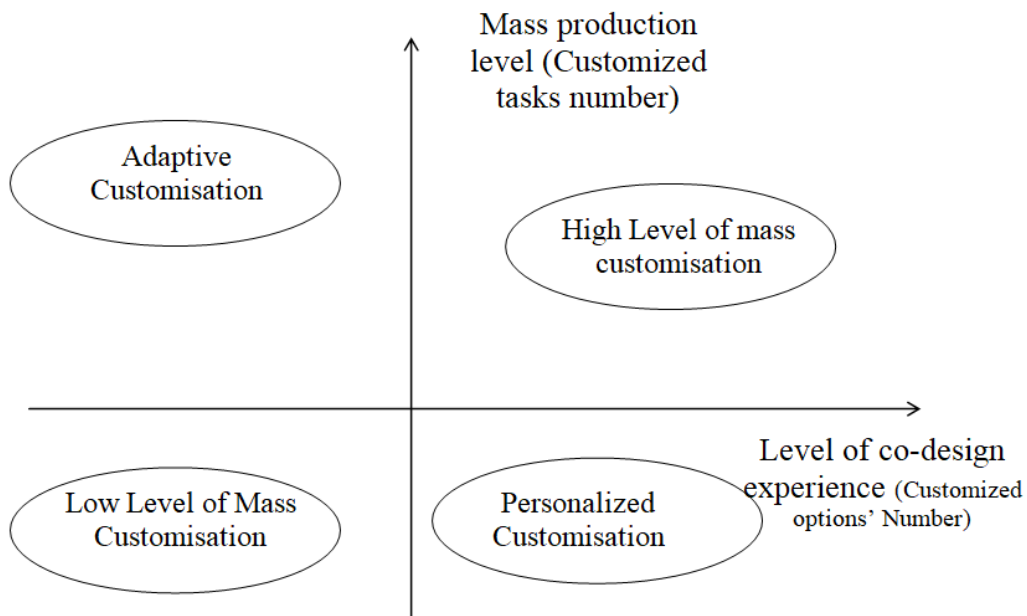


Fig. 5. The level of mass customization

2.3 Assessment of the Level of Mass Customization

Having defined a scale of the mass production level and an assessment of the level of co-design experience, we then deduce an overview of the level of mass customization, shown in the following Fig. 5, combining the two following variables: the level of co-design experience (x-axis) and the level of mass production (y-axis).

involved in the design process. Cari translates this idea into her graduation project called Utopia connect, by including the consumer in the co-design experience. This project was subsequently sold to the Givenchy brand in 2010.

The kit dress is composed of a basic mesh underlayer, a white cover dress, eyelets and jersey threads (Figs. 6 and 7).

3. EXAMPLE OF CUSTOMIZED PRODUCT

3.1 Dress Kit: Utopia Connect by Givenchy

The Givenchy kit dress from the Utopia connect collection, was created by Cari Marsden. Cari is a British designer, graduated from London College of Fashion, University of Leeds. This designer explains that: "The role of the designer is changing. The consumer is increasingly

The name kit corresponds to the way of selling this dress. Indeed the set: base mesh underlay, cover dress, eyelets and jersey yarns are sold in a kit.

The user will design her dress from these elements without however making the slightest seam on this dress. Thus, she brings the jersey threads into the base mesh underlayer and brings them out by creating trajectories with these threads. These trajectories can be in

crossed, parallel, vertical, horizontal or oblique forms, depending on the conception of the user. The cover dress will then be trimmed with eyelets

whose role is to reinforce the fixing of the jersey threads and make them come out from this eyelet (Fig. 8).

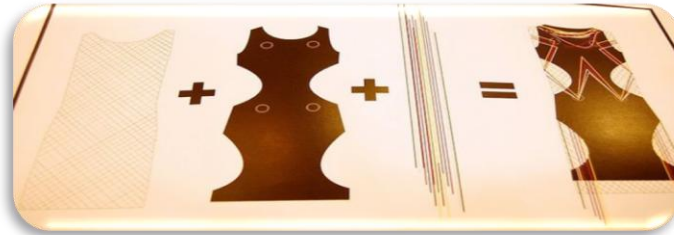


Fig. 6. Givenchy kit dress [14]



Fig. 7. Components of the kit dress [14]



Fig. 8. Jersey threads of the kit dress [14]



Fig. 9. Final kit of the Givenchy dress [14]



Fig. 10. Proposed customized dress models [14]

Cari also thought of adding beads and other embellishments to the kits so that the wearer has even more customization options (Fig. 9).

Cari Marsden offered brochures containing proposals for different designs to help customers and explain the principle of the kit dress to them (Fig. 10).

The materials are the same: base mesh underlay, cover dress, eyelets and jersey yarns. But the way of weaving the threads varies so as to result in different looks and designs.

Indeed, the customization is done by acting on the following parameters:

- Weaving lines
- Eyelets
- Jersey yarn

The factors allowing to act on the weaving lines are the direction, starting point, end point and their numbers.

For carnations, we can act on the factors of number and location.

Finally, for jersey yarns, we can act on their numbers and fallout.

The kit dress features four basic elements which are base mesh underlay, white overlay dress, eyelets and jersey yarns. The combination of

these elements will result in very diverse and different products. Indeed, by acting on the parameters described previously during the execution of the kit dresses, this would allow us to have an infinity of copies, and therefore it is impossible to have two identical designs of the kit dress [15,16,17,18].

The experience of co-designing the kit dress is a delicate task. From the start, the client could unintentionally reverse the role of the two dresses by considering the cover dress as the bottom of the dress and the base mesh underlay as the main dress. It is for this reason that Cari Marsden offered a brochure with the kit in order to help the client understand the practice of customizing this dress (Fig. 10). The customer can never exactly reproduce the designs proposed by Cari because it is difficult to imitate the way in which the jersey threads pass through the meshes of the underlay. This would give the assurance to any wearer of the kit dress of being the owner of an exceptionally unique model through her experience of co-designing her dress.

The box accompanied by the kit (Fig. 9) containing beads and accessories, helps the customer to embellish her dress and continue her co-design experience. The designer Cari did not propose dresses with accessories, since this step comes down to the taste and choice of each woman.

3.2 Customized Nike Sneakers

In 1950, a former track and field coach at the University of Oregon, Bill Bowerman, and Philip Knight, an accounting student and middle-distance runner, began selling shoes from the Japanese brand Onitsuka Tiger. In 1973, Bowerman and Knight launched their famous pair of basketball shoes. The pair of sneakers was revolutionary because it had a sole capable of absorbing shocks and helping to rebound. Bowerman and Knight's company is named after the Greek goddess of victory Nike with an upside-down comma logo, created by graphic design student Carolyn Davidson.

In 1999, Nike, a pioneer in the customization experience, launched a new program called Nike iD to customize Nike shoes. This can be accessed through the Nike iD website.

This program provided customers with the ability to choose from a predefined range of materials, texture, color and size in order to develop their own style of shoe.

Before starting the customization, the Nike iD program asks you to select the type of sport from 6 choices: football, basketball, skateboarding, running, tennis and training. This choice makes it possible to define the basketball model based on the nature of the sport.

Depending on the nature of the selected sport, the program offers examples of sneakers from a library of reference models with different colors,

textures and designs. The user chooses among these models, one which seems to him the closest.

After selecting a model from the list of examples of customized shoes and entering the shoe size, the co-design experience begins.

The user proceeds to click on the part of the sneaker with which he will start the customization: midsole and vamp, heel edging, lining, tongue ID, lace loops, lace, swoosh, mesh upper, upper line of the midsole, outsole and heel trim, midsole and vamp (Fig. 11).

The Nike iD program does not present customization steps. By clicking on the part to customize, a list on the left appears, presenting the customization parameters. These parameters vary depending on the part of the shoe. Indeed, for each of the parts: swoosh, lining, lace, and lace loops, 14 different colors are available.

The mode of customization of the mesh upper part does not only present color choices, but also texture choices:

United and camouflaged. The plain texture has 14 different colors while the camouflaged texture has four.

For the midsole and upper part, the customization is not limited only to the choice of color. Indeed, the Nike iD program gives the possibility of making a shade of color on this part.

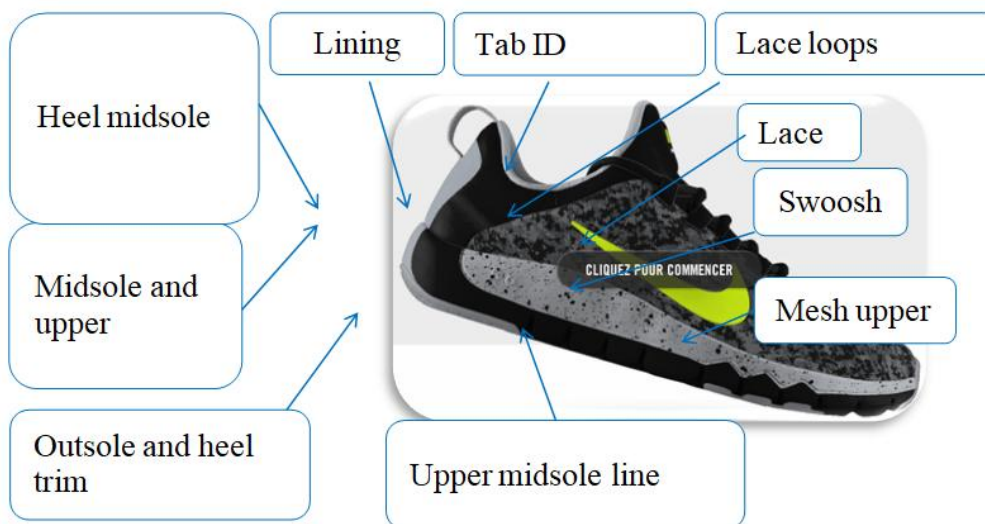


Fig. 11. Example of customized shoes offered by Nike iD [19]

After choosing the color of the upper line of the midsole, the program gives you the option of adding a splash to this part, that is, small dots whose color you can assign favourite.

Finally, the consumer has to customize tab iD. The Nike iD program offers either to leave the word Nike and define its color, or to type a set of words on each of the two pairs.

The customization of Nike shoes on the Nike id site is based on the type of sport performed and a model of shoe already customized. Indeed, the customization steps that we have already presented vary depending on the type of sport and the model chosen.

The choice of an already customized model, from the reference library, as a support gives the user an idea of the customization. The latter is based on the one hand on the choice of texture and on the other hand on the choice of the color of which one can play on the contrast, the harmony and the gradient.

Although the execution of customization through the Nike iD program is painstaking. Indeed, the breakdown of the shoe into small parts, makes it possible to offer the consumer the wide choice of properly carrying out the co-design stages. But also, these multitudes decompositions of the shoe make the question of customization tedious.

Also, the lack of numbering of customization steps makes co-design execution messy. Indeed, the user tends to forget the parts and tasks already done.

3.3 Monster High Purse

In 1945, Harold Matson and Elliot Handler started a company that made toys under the name Mattel. This nomination is made up of "Mat", nickname of Harold Matson, and "El" of Elliot Handler.

Mattel, which owns the Barbie brand, launched a range of fashion dolls called Monster High in July 2010. The Monster High franchise is not limited to the production of dolls only, spreads over a large number of products such as clothing, jewelry and handbags.

In 2012, the company Mattel launched a Monster High handbag kit for girls from 5 years old. This

kit contains a purse, felt pens and rhinestones (Fig. 12).



Fig. 12. Customised monster high handbag kit

The handbag is made of canvas, trapezoidal in shape, zipped on the top. It is composed of two shoulder straps and the main part which has a print of a Monster High doll in black and white (Fig. 13).



Fig. 13. Proposed customised monster high handbag

The kit also contains rhinestones and felt pens in five colors: mauve, hot pink, grey, baby pink and blue.

The principle of customization of Monster High handbags is as follows: the customer (the girl) colors the design printed in black and white by the felt pens already existing in the kit. Indeed, this girl will give a personal look to her Monster High doll by choosing hair colors, eyes, skin, clothes, accessories and of course the color of the background.

Then, the girl will stick the beads of rhinestones on the different elements existing on her bag according to her taste and her preferences. Indeed, there are about twenty rhinestones of different shapes, with different sizes and colors.

Monster High's handbag customization experience lets little girls not only color and decorate their handbags, but also develop their performance personalities as they participate in creating her handbags. hands; thus they live an experience of co-design.

4. ASSESSING THE LEVEL OF MASS CUSTOMIZATION

Having defined an evaluation of the level of mass production and an evaluation of the level of co-design experience, we then deduce an overview on the level of mass customization, presented in Fig. 5, combining the two variables levels: level of co-design experience (X-axis) and level of mass production (Y-axis).

We deduce from Fig. 14, three different customization situations depending on the level of mass production and the level of co-design experience. From where we distinguish: personalized customization, adapted customization and customization tending towards a high level.

First of all we start with the first case: As the level of co-design experience increases and the level of mass production decreases, in this case we

are talking about personalized customization. This situation coincides with online customization by website such is the case of Nike sneakers. Indeed, the increase in customization options, such as the insertion of images and texts, allows mass production to converge towards tailor-made.

Then, we differentiate the adapted customization (Case 1). This situation is obtained when the level of mass production increases at the same time as the number of customization options decreases. This reminds us of the case of Monster High's purse. Within this situation, adapted customization, the co-design experience is limited by the combination of the different elements that make up the product.

Finally, we distinguish a customization which tends towards a high level (Case 2). Thus, in order to converge towards a high level of mass customization, it is necessary to evolve both the level of mass production and the level of the co-design experience.

The increase in the level of mass production is achievable, thanks to the restriction of the tasks carried out to measure, in order to take advantage of a completely mass production. Thus, the increase in the level of the co-design experience translates into the increase in customization options. However, our goal in this study is to have a large enough customization space to excite the consumer and trigger their creativity in a mass production setting.

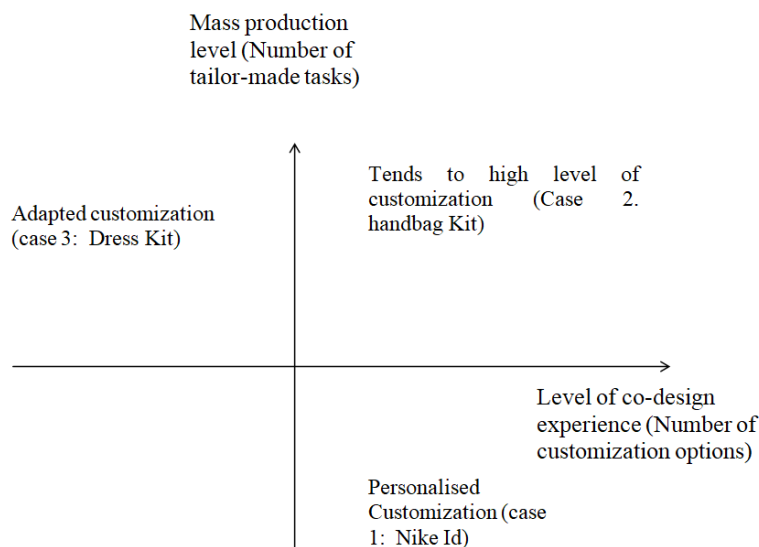


Fig. 14. The level of mass customization

Finally, our work on the development of the role of mass customization in design, between mass production and the co-design experience, will be carried out in parallel on the following two axes of reflection:

- First axis: Development of marketing work.
- Second axis: Organization of a structure allowing the development of mass customization and the enhancement of the customized product.

4.1 Development of Marketing Work

In order to develop marketing and commercialization work, it is essential to carry out a study for each customized product according to different strategies.

First of all, it is necessary to choose the target customer. Indeed, the requirements of the co-design experience as well as the means of customization followed, vary from one client to another. We have noticed from the questionnaire carried out in the first part of this chapter that adolescents show a different attitude compared to other age categories. Therefore, a segmentation of the market according to age is necessary to develop the commercial side of a customized product.

Next, we quote the packaging. The latter must have an adequate design to enhance the customized product, highlighting the different elements that make up the kit. Thus, a packaging which has transparent parts showing the customized product with the various elements constituting the product, is necessary to present a customized product. In addition, application examples illustrated on the packaging help to initialize customers on the use of mass customization.

On the other hand, the cost price of a customized product must obey a compromise between mass production and the co-design experience in order to minimize the price of the customized product.

Finally, we mention advertising. This ad will raise consumer awareness of the importance of the mass customization experience, and trigger the spirit of creativity and innovation for more distinction and personalization.

4.2 Organization of a Structure to Develop Mass Customization and Enhance the Customized Product

We propose to organize a design office specializing in the development of mass

customization, with the aim of developing the customization options of a product, while avoiding the introduction of made-to-order tasks in production by series.

For this, we propose to transfer customization options from tailor-made to the consumer in order to enrich the co-design experience, while increasing the level of mass production. Indeed, the company can offer tools to engrave, print or stick a text or an image on a product to customize.

Then, we propose to break down the product into elementary modules, resulting in different designs. The advantage of this decomposition operation is beneficial for both the company and the customer. Indeed, on the one hand it allows the company to get rid of certain manufacturing phases such as the assembly of the different elements of the product. On the other side and parallel to this idea, the customer will feel by this option, both freer and more creative: first more free by choosing himself and according to his preferences the assembly that suits him. Equally more creative, by juggling the multitude of combinations leading to a suitable, unique and satisfying product.

However, and with the aim of satisfying a wide social spectrum, we propose to combine customization via the internet (a choice of particular interest to teenagers) whose choice offers us several customization options with manual customization (choice concerning the rest of the category social). In this approach, we will propose to divide the co-design experience into two parts: the first part is the one that presents a mass production, from where the choices of color, texture, function and design will be made by website. The second part, presenting tailor-made tasks, we propose to perform them manually by offering the necessary tools to perform these tasks.

5. CONCLUSION

Our work on the development of mass customization was carried out in three parts. The first part was devoted to the study of mass customization. As for the second part, we analysed examples of customized products. In the third and last one, composed of two parts, we presented an assessment of the level of mass customization. Finally, we proposed solutions for the development of mass customization.

Through this survey, we can deduce that mass customization is not necessarily an indicator of the economic development of a society. However, this concept can attribute a certain taste and dynamism to life, by breaking with the routine of buying ready-made products, but by participating oneself, either in the decoration or even in the design of the product. The culture of mass customization, well known and widespread in European and especially American societies, is almost ignored in our society.

So, in order to succeed and promote the mass customization experience in our society, it is necessary to follow suitable strategies for each product for the development of this concept. These strategies can be summed up, on the one hand, at the scale of marketing development, and on the other hand, in the creation of a design office specializing in the development of mass customization. All this must happen while maintaining mass production, in order to minimize the cost of a customized product so that it can be competitive in the market.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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