

Utilization of Digital Technology in Designing and Producing Zero Waste Clothes with Sustainability Approach

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(Received: 25.05.2020 Accepted: 24.07.2020)

استفاده از فناوری دیجیتال در طراحی و ساخت لباس بدون ضایعات با رویکرد پایداری

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(دریافت: ۱۳۹۹/۰۲/۳۰ پذیرش: ۱۳۹۹/۰۴/۲۶)

Abstract:

Consumerism is a new phenomenon created in the 21st century that can play a substantial role in the destruction of national resources of any country. Nowadays, concerning the ever-increasing improvement of fashion in the world, consumerism in the field of textiles and clothing is raised more than ever. Considering the wasteful consumption of products may bring about remarkable damages to the environment, presently certain methods such as no waste clothes production with a sustainability approach are under attention and survey. Researches accomplished in this regard resulted in the initiation of methods that are used by designers around the world as leading methods. Since this approach is an unprecedented opinion that is still in the route of extension and expansion, just a few studies have been conducted regarding the results obtained so far from designing zero-waste clothes and the experiences of consumers' awareness of this approach. The present research, regarding its objective, is of applied type based on descriptive-analytical method and procedure. Data collection is achieved by library method, relying on documents, written sources, and the internet. It challenges the discovery of the roots in this being formed field using the point of view proposed by Keith Fletcher. By explaining the experiences of this researcher in holding workshops related to this opinion, the out comings are surveyed. The obtained results confirm the application of various techniques such as digital printing patterns and the use of updated universal technology for the elimination of wastes.

Keywords: Clothes, Zero Waste, Digital Technology, Design and Modeling, Consumer.

چکیده:

مصرف گرایی پدیده‌ای نوظهور و متولد شده در قرن بیست و یکم میلادی است که می‌تواند در از بین رفتن منابع ملی هر کشوری، نقش مهمی ایفا کند. امروزه با توجه به پیشرفت روزافزون مدگرایی در جهان، پدیده‌ی مصرف گرایی بیش از پیش در حوزه منسوجات و پوشاک مطرح شده است. بی‌رویه بودن مصرف این گروه از محصولات می‌تواند خسارات زیادی را متوجه محیط زیست کند و امروزه روش‌هایی همچون تولید پوشاک بدون ضایعات با رویکرد پایداری مورد توجه قرار گرفته است. پژوهش‌های انجام گرفته منجر به ایجاد روش‌هایی شده است که در کشورهای مختلف دنیا به عنوان الگوهای پیشنهادی مورد استفاده‌ی طراحان قرار گرفته است. از آنجایی که این رویکرد نظریه جدیدی است که هم‌چنان در مسیر بسط و گسترش قرار دارد، تاکنون مطالعات کمی درباره رابطه‌ی بین نتایج به دست آمده از طراحی پوشاک بدون ضایعات و تجربیات مصرف کننده‌ی آگاه از این شیوه به دست آمده است. این پژوهش بر اساس هدف، از نوع کاربردی و بر مبنای ماهیت و روش توصیفی-تحلیلی است. گردآوری اطلاعات از طریق روش کتابخانه‌ای و با تکیه بر اسناد و منابع مکتوب و اینترنتی انجام شده است و سعی در کشف ریشه‌های این حوزه‌ی در حال شکل گیری با استفاده از نظرات مطرح شده توسط کیت فلچر دارد. این پژوهش با تشریح تجربیات این محقق در برگزاری کارگاه‌های مرتبط با این نظریه، آنرا مورد بررسی قرار داده است. نتایج حاصل بر استفاده از تکنیک‌های مختلف مانند چاپ دیجیتال الگو و استفاده از تکنولوژی‌های روز دنیا در راستای کاهش یا حذف ضایعات پارچه تاکید دارد.

واژه‌های کلیدی: پوشاک، بدون ضایعات، فناوری دیجیتال، طراحی و الگوسازی، مشارکت مصرف کننده.

Introduction

During the last two decades, universal supply chain management has changed many significant sections of industry. This type of management includes a set of all internal and external systematic activities of a company that in a compiled form and with a holistic view organizes and leads all business processes inside the supply chain. Its objective is the promotion of the processes with minimum costs and optimum efficiency (Kord and Jamshidi, 2017). Since the textile industry causes many harms in three fields of air, water, and sound pollution and is considered as the second environmental pollutant industry (Abbasi Birgani et al., 2017) it will be very hazardous for posterity. Nowadays, many researchers are seeking to create diverse strategies to confront this issue. Kate Fletcher¹ introduced to the world her strategies such as designing clothes with a long-term usage attitude, cultural promotion of using used clothes, skills and innovation in cloth modification, cultural expansion of preservation and maximizing cloth life span (Fletcher, 2008).

Since human lifestyle after the industrial revolution and his attitude toward the universe and its resources as profitability devices have encountered him with important difficulties and risks in continuation of life (Farbod, 2014), attention to a sustainable promotion whose major goal is establishing an equilibrium among human, his surrounding, and economy (La Camera, 2013) can be an effective step in direction of environment preservation in clothing production. Regarding the growth of various brands during recent decades and the rapid increase

in the field of clothing production and lack of public familiarity with approach category relevant to this industry, there is need for more extensive researches and for publicizing attitudes of researchers such as Kate Fletcher, especially in the promotion of using in clothing, that she named as the art of using clothes. Achieving this goal requires the presentation and promotion of strategies such as customer login into the cycle of production and also zero- waste production. In this respect, this article aside from the description of this forming field turns to introduce various attitudes and also Fletcher practical strategies as effective patterns; and eventually, proposes strategies for minimizing waste rate in clothing production.

Research Methodology

The present research is based on theoretical research and based on the meta-synthesis method. This proficiency is a technique for examining qualitative research (Jensen & Allen 1996); so it is based on evidence from documentary studies, containing information and outcomes provided by previous authors and pioneers of sustainable approaches in the fashion era. According to the finding, this paper introduces some new ways of developing the main subject.

Research History

So far many articles and research activities in different countries have aimed at no waste clothing production and moved in its direction. Alison Gwilt² in a book entitled “*Global Perspectives on Sustainable Fashion*” (Gwilt, 2019) surveyed the similarities and differences of sustainable design and its effects on the community in eighteen different zones in the world through the presentation of various charts and

¹ Kate Fletcher. English researcher, writer, and activist in the field of fashion and clothing. She has concentrated her activity on the sustainable expansion of fashion and its relation with universal supply chain management during the past 15 years. She is an authorized figure in the field of sustainable products.

² Alison Gwilt. Australian researcher in the fashion industry.

statistical research. Timo Rissanen¹ in a book entitled “*Zero Waste Fashion Design*”(Rissanen, 2016) mentioned the importance of studying fashion history for designing clothes without waste and is challenging to survey the present lack of changes in defined strategies in future clothes designing, through examples of clothes history. McQuillan² and Coworker in an article under the title of "Making Fashion without making waste" (McQuillan et al., 2011) expressed that the application of designing clothes without waste at the macro level will result in providing many approaches in the way of deleting rubbish from human life. She also mentions the aesthetic aspect of clothing designed and produced based on considering this attitude. She believes that these clothes must be designed based on timeless theory and the designer is obliged to design the clothes with a long-term vision and does not pay much attention to fashionable clothes. Based on McQuillan's idea, in this way, the life span of these types of products will be expanded to a large extend. In a general view, the majority of these researches focus on some common items such as the enforcement of material evaluation, risk ability, innovation, and expansion of strategies like using computer software's, that in case of obtaining enough familiarity of activists in this field, can be used efficiently. Regarding the shortage of resources in Iran, this subject has just recently attracted the attention of researchers and thus there are not many studies in this field. Among the most important published work, an article by Farinaz Farbod should be mentioned under the title “The Aesthetic of Eco Sustainable Approaches in Textile Design” (Farbod, 2014) in which the author reviewed the meaning of

aesthetic in textiles of sustainable life and the method of reflection of considered designing style on textiles and fashion. Also, Davari and Coworkers in an article under the title of “Female students’ awareness toward sustainable purchase consumption of clothing (Case study: Art faculty of Alzahra University)” (Davari *et al*, 2016) studied the feedback of considered statistical community is facing with sustainable life clothing. Regarding the mentioned researches in this field, no research has been achieved in the application of digital technology in designing and production of no waste clothing so far.

Research Findings

There are various definitions of the concept of sustainable development, the best of which, as far as is known, is published by the Universal Environment and Promotion Commission in the United Nation in 1987 (Arjmand Siahpush, 2016). As the concept developed, it has shifted its focus more towards economic development, social development, and environmental protection for future generations. It has been suggested that “the term 'sustainability' should be viewed as humanity's target goal of human-ecosystem equilibrium, while 'sustainable development' refers to the holistic approach and temporal processes that lead us to the endpoint of sustainability” (Shaker, 2015).

This definition is in contradiction with the present fashion culture of the world in two aspects. First, mass production of clothes for attaining more profits, which aside from environmental harms, would have a destructive result on the country's economy; and second, a cultural feature that presently lies in human consumerism in the field of clothes use. Kate Fletcher in her book “*Craft of Use*” published in 2014, believes that the volume of fashion production of clothes with a medium degree of damage to the environment may decrease but, in any case,

1 Timo Rissanen. Researcher and professor at Sydney University in the field of sustainable fashion.

2 McQuillan. Polish researcher in textile and sustainable fashion managed and directed.

irregular consumerism remarkably destroys environmental achievements. As per statistic announced by this researcher, in each Christian year, almost 120 billion new clothes are produced and this figure is a warning fact that present societies have urgent needs to modify the consuming behavior (Fletcher & Toth-Fejel, 2014).

Certainly, in this route, we need to plan and produce a textile industry in which by having a sustainable approach, each user contributes to the production of clothes. This category which will be effective in all three sections of sustainable promotion should be created as a modern culture in the whole world. Therefore, people must be able to express their innovation, participate in designing, and spend a part of their time in production. To attain this goal, certainly, the existence of chain supply management is necessary so that the process of production with the presence of users can be effective in this field are under study.

A.) Timeless Design

In seeking samples of the attitude of designing and producing different objects without waste with sustainable promotion, various researchers such as Enzo Manzini¹, Cameron Tonkinwise², Alister Fuad- Luke³, and Liz Sanders⁴ presented strategies based on a free or timeless design. Manzini in 1994 published a call with the name of "Design, Environment and Social Quality: From Existenzminimum to Quality Maximum" (Manzini, 1994). In this call, he turned to the influence of designing in

the 20th-century crisis-stricken world, and by addressing the designers warned them not to seek only a solution to the problem; rather operate in three principals proposed by him. These three principals were from consumption to care, from consumption of products to utilization of service and eventually, the most extreme, from consumption to non-consumption. He believes that when a designer looks through these three filters to his subject of design, unintentionally, his behavior would form based on this goal that his product will add a new strategy or a new attitude to the world (Manzini, 1994). On another side Tonkinwise, in his article under the title of "Is, Design Finished? Dematerialization and Changing Things", expanded theory and suggested that the designers should move toward temporal designing. He believes that designing the temporal objects that can be changed and replaced, objects which do not end and their survival is in mending and changing (Tonkinwise, 2005). Later, the proposal of designing timeless products was offered, explored, and described in more detail by Fuad-Luke in his book "*Design Activism: beautiful strangeness for a sustainable world*" published in 2009. In a section of this article, he proposed suggestions for making methods aimed at confrontation with unusual consumerism. This researcher expressed that semi-finished products are one of the methods of opposition to consumerism. He suggested that products would be semi-finished by producer and then will be completed by the user and therefore the user becomes a part of the production process (Fuad-Luke, 2009). Fuad-Luke investigated this idea of the fashion field in a semi-finished project with Ayna Herscher⁵ in more detail. Practical workshops were held by these two researchers in which participants were able to indicate the

1. Italian researcher and designer of the product with a sustainable approach and the professor of London and Shanghai Art University.

2 Cameron Tonkinwise. Professor of Sydney University in the field of sustainability of products and environment activists.

3Alister Fuad- Luke. Researcher of designing products with a sustainable approach and professor of Bolzano University.

4 Liz Sanders. Researcher and founder of American Sustainable Products Designing Association.

5 Anya Herscher. American designer and researcher of textile sustainability.

level of their skills and participation and started to work in designing, production, or modification of clothes with some support and protection (Niinimäki, 2013). According to them, this method caused the conversion of the user of the clothing from a passive individual just wearing ready-made clothes to a person active in designing and producing clothing that he wears. Fuad-Luke also proposed the pattern of conditional evolutionary products in which the products are designed in a way that is easily modified; an idea, as he said, which grandmothers were quite familiar with (Fuad-Luke, 2009). Liz Sanders discusses four levels of creativity in people's life and divides them into four topics of doing, adapting, making, and creating. She believes that from the beginning of creation demanding something had been among human being basic needs that, to attain them, started to invent objects. In this way creativity grew; meanwhile, aside from gaining skills and specialty, his interest and efforts multiplied. By putting this interest into practice for creativity in routine life, an ordinary user can be a member of a team designing various objects. But to be able to play his role correctly, Sanders explains adequate devices should be given to them so that they can present themselves (Sanders & Stappers, 2008). According to Sanders in case a user is a section of the production process, new effort and creativity would be presented. So, the function of a designer is to change a non-active customer to an active contributor. Diagram No. 1 displays the proposed difficulty level versus the ordered quantity and its relation with time cost for clothes made by the user. In this diagram, the vertical axis indicates the difficulty level which is measured with the user contribution rate in the clothes production process and the horizontal axis is the rate of user interference in clothing orders. The difficulty level and his interference rate for ready-made clothes are in

the lowest possible rate and both are on the highest for the clothes made by the user. In the meantime, the time that the user should spend, which means consumed time, has a direct relationship with both vertical and horizontal axes.

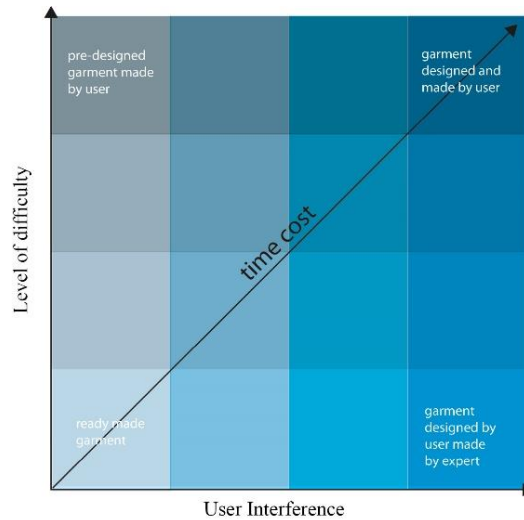


Figure 1. The proposed difficulty level versus the ordered quantity and its relation with time cost for the clothes made by the user (McQuillan, 2018)

The timeless design converts the presence of the user to a permanent issue. This means whenever he wants, he can fulfill modifications in his clothes. Therefore, in addition to being present in the production process, he is performing in the direction of sustainable promotion.

B.) Persuasion of the user to lack of consumerism

Niinimäki¹ and Koskinen², presented researches in which certain strategies for user optimal usage from clothes and textiles were identified and introduced. The result of these researches, user was persuaded and encouraged to move less toward consumerism (Niinimäki & Koskinen, 2011). These

1 Niinimäki. Finish fabric and clothes designer, researcher of sustainable textile, professor of Helsinki University.
 2 Koskinen. Finish clothes designer and researcher of sustainable textile.

strategies included three main groups of attention to emotional values, noting the efforts and performance, and consideration of qualities (Figure 2). Of course, these researchers proposed more conceptual suggestions such as the possibility to create future modifications, possibilities, and alignment with personal ideologies, which were placed on the second category (Fletcher, 2008). They also believed that attachment attributes provide abundant opportunities for designers and users to perform more creatively.

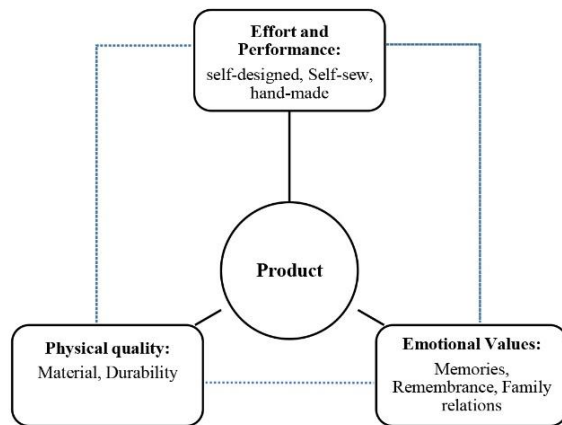


Figure 2. Surveying emotional values in attached attributes (authors)

These two researchers consider issues higher than just economical and environmental aspects in the field of clothing and turn to psychological dimensions presented in this field. Fletcher in a section of her universal project named "Local Wisdom" which was performed in London in 2009, put these opportunities and complexities under survey through collecting stories of normal people with their clothes. As she said she possessed a library of narratives of people about the clothes that they buy, earn, find, or borrow. Fletcher in the book of "*Craft of Use*" is trying to compel designers to learn these narratives and believes that through applying this knowledge (psychological aspects presented in the field of clothing) they can be

able to extend the skill of using for a long term (Fletcher, 2008). Based on this research, she proposed the theory of "Mitigate, Intensify, and Adopt" which is indicative of using clothes for ongoing and variable life. This theory, by itself, is an affirmation of strategies of timeless design. This means that a user reduces the exaggerated consumption of garments and accepts to use them for a longer period, regardless of fashion flow. In another word, where the user is a part of designing, external use, and also modifications through actions and opportunities that the designer considered for him/her, it is possible to use the clothes for a longer period. In this process, a strong and rich relationship between the designer and the user finds the possibility of existence.

The production of garments without waste provides an optimal use for the user and this relates with the experience of consumer who is, at the same time, acceptor of limitations with it, intensifier of skills, knowledge, needs, tendencies, and naturally acceptor of all of them. This method utilizes a key aspect of no waste fashion design in which no part of the clothing is omitted but made possible future modifications based on fashion change or according to needs. One of the new attitudes in this approach category is an intellectual wave of Do It Yourself (DIY). This movement which grew in western countries as a protest against the capitalist system refers to all activities, services, and products that are not under industrial conditions (Khademi-Vidra & Budoso, 2020). This matter aimed at the reduction of prices but was the first experience in the involvement of the user informing the product and his getting out of being passive (Davari *et al*, 2012)

C.) Designing and making predetermined patterns

In a two-day workshop that Fletcher held aiming at optimal use of cloth, the theory of

semi-finished clothes proposed by Fuad-Luke was under exploration. To involve the users in the production process and its expansion, this researcher needs to measure the different levels of creativity and abilities of the users (Fletcher, 2008); therefore 12 participants with various levels of sewing skills were invited to cooperate. The primary patterns of clothing were designed in the state of no waste and were given to the participant during the workshop. They were able to modify the length and width of the cloth by rotating the pattern to obtain a garment with different width. The basic aim of presenting these patterns was the creation of easy modifications and changes. These patterns were designed based on the Fletcher hypothesis expressing that the simplified structure of garment may, in addition to lack of waste production and preservation of the environment, increasing the life span of the product.

As various marking in sport fields results in performing different sports and competitions in distinct times in the same field, optimal use of information and marking in prefabricated clothe patterns enable the user to apply different changes during making and using it. The majority of the participants announced that they need more guidance for making the clothes? and the nature of the production process is horrific for them. They were not familiar with the predetermined patterns and were worried to waste the valuable textiles that the workshop made available to them for making dresses. Although the result of the workshop was the production of an unconventional garment, and despite being experimental and their remaining unfinished, some of the sewn clothes were still usable even after one year. The most important achievement of this experiment was the creation of a direct relation between a two-dimension pattern and a final three-dimension garment (Fuad-Luke, 2009). For attaining this

goal, a combination of fabric digital printing and designing no waste clothing was applied. As it can be seen in Figure 3, the pattern of seams and sewing instruction is indicated on a shirt with digital printing that theoretically provides the possibility of making and simpler and non-traditional sewing. Anyhow, the application of such strategies permits the reduction of difficulties in traditional workshops and at the same time, there is a possibility that this design remains very limited and eventually stops. So, there should be great care in order not to have heavy damages on the out comings and products (Lumsden, 2010).

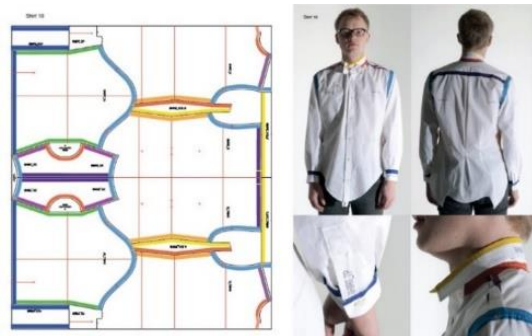


Figure 3. Men shirt with pattern and digital printing, display of direct relation between two-dimension pattern and three-dimension clothes (McQuillen, 2018)

Based on these goals, the application of no waste clothes production approach was the production of clothes that were simply made with an easy usual pattern that even after usage new reformations could be possible. So, each pattern is designed in such a way that multiple possibilities in pattern and fabric printing are embedded. For example, two sleeve rings with different forms and sizes, two collar lines, two sleeve models, and two body forms are designed for clothing. In this way, each pattern can be stretched or narrowed for the various body, the length of the hem is changed to form a dress or a short top. In this field, the application of digital printing on fabric makes these changes

possible in such a way that it would be easy for the user to access and work on it, and at the same time directly involves in the appearance beauty of the garment. Using these patterns makes the user be faithful to the topic of sustainable promotion and follow the DIY movement. The approach of clothing without waste contains two important strategies which include using digital patterns and embroidery machines for modeling that in this section is under study.

1- Using Fabric digital pattern

Rissanen as one of the researchers who paid much attention to challenges of no waste designing believes that zero-waste fashion is not good per se. It is necessary to test it in more expanded levels before presenting. Also, a new way of thinking is needed. Methods about the point that how this theory can continue its life whereas it permits flourishing of creativity of designers and human and this is in such a way that we know designing with no waste certainly necessitate the cooperation with other fields related to production and propaganda (Rissanen, 2005). Using the design of semi-finished patterns in clothing can reduce the waste of fabric to a high level. But the key point for access to clothing production without waste is the lack of definition for the garment model in these patterns. This method, in addition to lack of garbage production, involves the user in the production process and also provides the possibility for future modifications for both maker and consumer of the clothing. This method also provides the possibility for the user to determine the beauty of the dress based on his taste. In these patterns, the shape of the garment can be changed. The base of the performance of the patterns in the training of the user. During pattern making the producer should instruct and conduct the consumer how to make a dress from the ready-made pattern. By essence, these

patterns confirm three principles of goal, instruction, production and these three follow each other. Refer to figure 4.

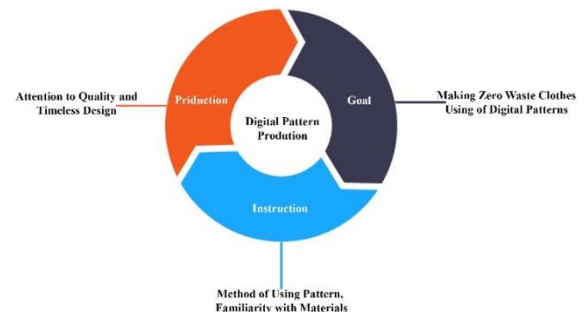


Figure 4. Process cycle of digital pattern production of clothes on textiles (authors).

In this method, steps such as where to cut, fold, or join are printed on the fabric and one can be hopeful that by applying these steps on the dress the considered reforming from a two-dimension cloth to a three-dimension garment and from an abstract instruction to a real performance would be fulfilled easily and all these actions can be practical for a person who even does not know sewing. In Figure 6 a sample of digital design of pattern and its final product can be seen.

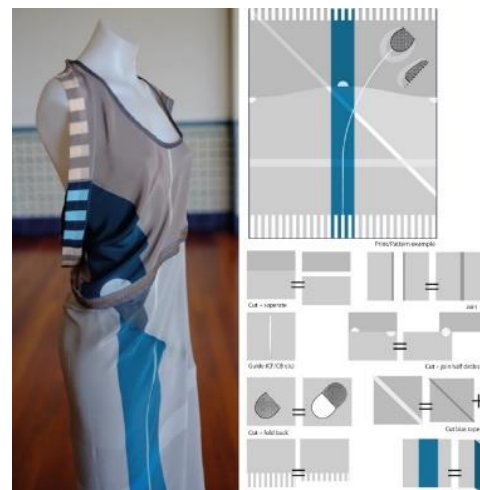


Figure 5. Digital printing on textile and dress production along with relevant instructions (McQuillen, 2018)

Undoubtedly, for achieving such a goal it is necessary to start with trial and error with simpler patterns with students and graduates

in the field of clothing and fashion or with tailors that can be able to sew clothes with more limited instructions. This action can be a test for the success of the attached instructions. Also, along with time passing and surveying the operational cases, it can be concluded that to what extent the audiences of these patterns need instructions. But another effective method in reaching the simple sewing is omitting collar in these patterns. The collar should be separated from the body of the dress and if a person needs, it can be stitched to the dress (Holland & Iten, 2008).

2- Using digital needlework machines for modeling

Using digital needlework machines which have recently increased in the world, pays special attention to the optimal use of cloth and minimizing the waste in fabric (Figure 6). In these machines, needlework, aside from carving the instruction of pattern on the fabric, assists the beauty of the dress as much as possible; and it can be said technical aspects and aesthetic existed together so that simplification of the production process, maintenance and application of different modifications would be accessible for the producer and user. In some of these machines, needlework does not exist and the machine just performs the stitching in which the user can easily split the stitches and separated the pattern and eventually sew them up manually or by sewing machine and to have a different garment. Of course, using these needlework machines contains some problems such as the size of the section of needlework and its effects on weight and application of the clothing. So, the researchers are seeking discovery in this field (Lin *et al.*, 2017).

Besides all the mentioned issues, the involvement of users in the production process not only encourages localization of products but also, reinforces the relations of

businesses and communities. For the involvement of users with the field of designing, patterning, and the making of clothing, there is no need for hyper-advanced devices. For example, patterns can be needle worked by simpler facilities such as sewing machines and the completion would be performed by the user. As was mentioned, the user can be a novice or a professional tailor; the important point is the creation of a predetermined pattern with adequate instructions. The clothing will arrive in the stage of using whose special characteristic is repeated and frequent use and performance of easy modifications on it in the future and this is a process that has been simplified by the designer of no waste design.

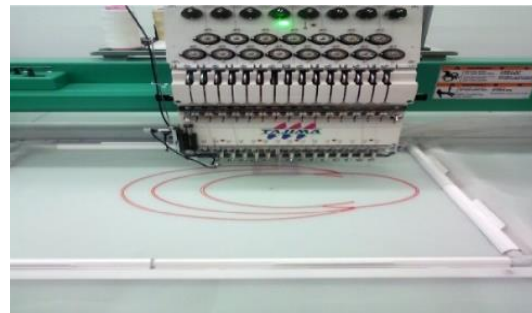


Figure 6. Modeling by using digital needlework machines (McQuillen, 2018).

In Figure 7, the relations between the level of user involvement in the production cycle and the final cost of the clothe are studied. The left axis displays the involvement and the right axis indicates the final cost. This diagram is an affirmation for the point that whatever the user is more involved in the process of designing and production of clothing, the final cost is lower. As an example, in the primary pattern of the garment without printing information (which means the user just has the pattern in hand and is well informed how to work with it), the final cost is on the lowest level. In the same order, whatever his involvement in the production process is lower, the final cost would be higher.

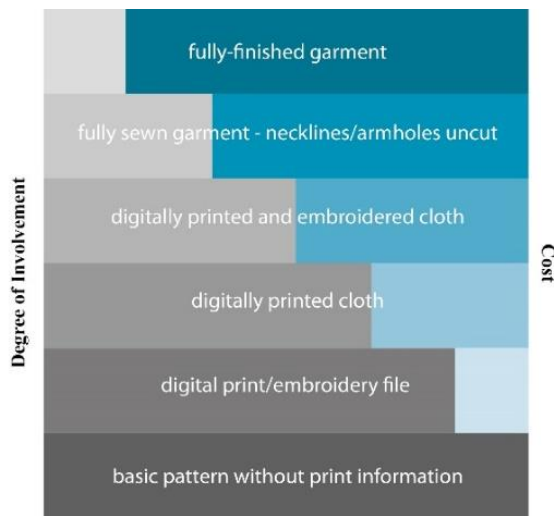


Figure 7. the relation between user involvement and the clothes final cost (McQuillan, 2018)

Conclusion

Despite the growing expansion of clothing products and increase in demand of consumers in this field of industry, consumerism phenomena are also increasing; and since the pollutions in environment resulted from the fashion industry is one of the most significant concern in the world for an environmental activist, many researchers in various countries proposed various strategies to confront with it. One of the most successful of these methods is the theory proposed by the

English designer, Kate Fletcher. In a short glance, she believes that the conversion of clothing users to clothes producers is an effective way of fabric production without waste which will result in the decrease of environmental pollution. Also, when a user participates in the fashion production cycle, optimal use of his skills and also enthusiasm displays in each operation. this results in a product with diverse levels of evolution and interference of usage. Simultaneously, Fuad-Luke and Anya Herscher presented the solution of semi-finished clothes. These two methods interlaced with Fletcher local wisdom project in 2009 and led to extensive researches about no waste clothing production in the world. In optimal use and without waste of cloth, presentation of methods such as pattern printing and digital needlework on cloth make the possibility of involvement of users in the production cycle and change his role from a passive user to an active producer. Meanwhile, the possibility of performing modification and reforming in the future and also longer use of the clothes will be provided.

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