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INTERACTIONS BETWEEN APPAREL DESIGN AND SEAMLESS TECHNOLOGY

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ABSTRACT

The fashion industry has in its essence a constant need for renewal “spirit of time” in order to survive and preserve its delight, and appeal. In order to win the race against time and differentiation in products, fashion design relies very much on technologies, being seamless technology an available tool that still remains to be unleashed. Considered as relatively new, regarding to its application in Fashion Industry, seamless technology can start from one dimension (yarn) directly into three dimensions (ready to wear garment). According to the present demand, seamless products can satisfy the consumers’ requisites regarding the functionality, performance and aesthetics.

Although these knitting machines are quite versatile, capable of producing a significant amount of different models, the innovations made on those machines are usually disseminated by their manufacturers. But the message sometimes does not correctly reach their direct clients and, consequently, retail. Basic products such as underwear are the most produced, being also easily copied and susceptible to fierce competition, due to the low knowhow necessary to produce them.

Taking into account the identified weaknesses and understanding that this technology has space to expand, and in order to understand the knowledge and adoption of garments using seamless technology by consumers, an inquiry was conducted, and the subsequent analysis of results is discussed in this paper. Beyond other conclusions, the study points the development of a specific design methodology for the development of fashion clothes products exploring this technology.

INTRODUCTION

The concept of seamless knitting is as old as knitting itself, as it can be observed by the ancient fragments of Egyptian socks, dated of V and VI century. Right after the Industrial Revolution, time when the knitted fabric started to be produced with the help of full mechanic knitting machines. From then until now, knitwear is produced on flat and circular machines, in large amounts of knitted fabric which require further operations such as cut and sewing. Producing seamless knitwear in separate units, with few or none subsequent operations concerning the apparel production, is from long time ago a quest pursued by machine manufacturers [1].

Hosiery industry recently evolved into a new kind of machinery, in order to adapt its competences and abilities to the production of fine hosiery, made with manmade fibers. This evolution allowed the production of new kinds of lingerie, swimsuits and underwear, which have been infiltrating in the mass market quite discretely, by means of brands such as Wolford, Benetton and Marks & Spencer [1]. Presently, a significant amount of lingerie is made without seams on the human body sides. As Catarino [2] states, seamless technology results from the merging of hosiery technology with large

diameter weft knitting machines, resulting in a new kind of medium sized knitting machine, more adequate to human body.

As a brief history regarding seamless knitting machines, one can say that they appeared in late 80's (20^{th} century), as an answer to a huge economical crisis that had devastated the hosiery industry, and consequently the knitting machines' manufacturers. In order to overcome this crisis, professionals proposed many solutions, namely American industrials challenged the Italian company Lonati to propose a new kind of knitting machine able to produce knitted fabric, especially focused on the underwear business area. This machine would be an evolution from hosiery knitting machines. As a result to this challenge, Lonati in 1988 came out with a new knitting machine, the LM9. Starting up on 1989, the Santoni Company, from Lonati's group, assumed the responsibility of producing and further developing this new technology, baptized as seamless technology [2-3]

Seamless designates the concept of cloths with no seams, where a significant number of seams – mainly the lateral seams - are eliminated or drastically reduced in number. Catarino [2] understands that as far as weft knitting is concerned, this concept can be understood as a knitted fabric product ready to wear (excepting models that need some few addition clothing finishing operations) made with no seams, some of them made while the fabric is being knitted. These machines integrate one or two needle beds, with diameters ranging from 10" to 17", involving more than 1500 needles, with gauges from 16E to 32E (16E means 16 needles per inch). In terms of size these machines usually require a cube area of with 3 meters in each size.

One of its most important advantages remains in its high productivity, when compared with electronic flat knitting machines. Since it is based on circular knitting concept, seamless fabrics preferably assume a tubular shape. However it is possible to knit different shapes with the expense of not using the machine at its full production capacity.

Besides the high productivity and consequently the reduction time for producing fabrics due to less operations concerning assembling the clothes parts, seamless technology stands out from other technologies due to the comfort offered by the products made with this technology. Other advantages, cited by consumers are: "invisibility" (seamless clothes do not mark the body silhouette when dressed as underwear), comfortable compression, air permeability, performance, durability, easy care, style, beyond others depending on the kind of clothing. On the other hand, seamless knitwear manufacturers understand that the purchase of seamless machines represent an investment that result in less work hour costs and energy, less knitting machines, less required space for the knitting stand, reduction in raw material, faster prototyping, production flexibility, among other advantages [3]. Reduction costs involved in production when compared with other more traditional technologies can assume substantial numbers, up to 40%.



Figure 1. Products made using seamless technology (Scala, Wolford, Impetus, Tefron).

Seamless fulfils the requirements in terms of aesthetical and functional point of view. This is due to the capability of producing different patterns combined with different structures and raw materials in predefined areas of the knitted fabric. It is possible to produce preforms as pockets, breast pads as well as interesting drawings and patterns, of surface design. Other important difference is the possibility of using elastomeric yarns in specific areas for different compression in order to achieve spatial shapes. There are still other important features, such as the fact that seamless knitted fabrics arrive faster into the cut and sew stage, with the possibility

for some outfits to eliminate cutting operations. Regarding sewing, when not completely discarded or eliminated, the seams can be drastically reduced. The cutting operation can be guided and accelerated due to special borders already knitted as part of the seamless fabric, borders that will instruct the worker about the position to cut and sew. Other possibility is the use of special yarns that will react during washing operations and thus discarding the exceeding fabric [2].

The Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) system is of paramount importance for programming the seamless knitting machine. It is organized in two parts: one that deals with the patterns that will be knitted, and the other related with programming the knitting machine. The creation process of a seamless-based fabric requires expertise and special attention, both for technical programming as for the design. One important factor is the communication between the fashion designer and the technician who programs the knitting machine, communication that requires a constant feedback and pursuit for new approaches and solutions.
The most of the times this communication is difficult because, in contrast of the other sectors of the clothes production, there is not a written technical common code between technician and designers. After designing the outfit, the fashion designer gives the drawing to the technician that in his turn will start drawing the patterns with the help of the CAD system. In a second stage, this pattern is included in the application that is responsible for commanding the knitting machine. The resulting program contains several instructions for different parts of the knitting machine as well as the patterns previously made. Then, the resulting program is converted into the machine language and uploaded, starting the production of a prototype. The prototype is then carefully inspected; a sample of the outfit is produced with the desired raw material, and if it fulfills the predetermined requirements established by the fashion designer, this model can be transferred into the mass production stage. In case of no approval, the cycle repeats, which can mean a new design, pattern construction or knitting machine programming. The cycle will naturally repeat until the model is approved.

METHODOLOGY

This work is part of a master thesis in Textile Design and Marketing. The adopted methodology of this work is based on bibliographic review, interviews with professionals, and a consumer survey as the form of problem identification according to the design approach.

In a first stage, an exploratory research was conducted, with the main goal of understanding the principles behind the focus of this work – seamless technology applied to outerwear – by means of interviewing different agents directly related with this particular market segment, such as seamless knitwear producers, knitting machine manufacturers and education professionals. As Fornasier & Martins [4] state, "...exploratory research intends to provide the necessary familiarity with the problem, making it more explicit or formulate hypothesis".

Qualitative analysis was firstly used in this research, bay means of a reduced number of people using small unstructured questionnaires. This method considers opinions, attitude and feelings rather than numerical data. Personal interviews were made, with the purpose of obtaining the maximum information possible about the subject from thoughts and opinions expressed by the interviewed person. The advantage of this method consists in obtaining more detailed information [5].

Some hypotheses were considered in order to investigate the reason for not having a wider offer in terms of design and fashion regarding to these clothes as the exterior layer. The first hypothesis considers the lack of special machinery being able to produce this kind of garments. After interviewing major knitting machine manufacturers, one was able to identify that these technical solutions do exist, but the Portuguese knitwear manufacturers are not really interested on purchasing them. On the other hand, Portuguese producers admitted that are not interested in investing in more sophisticated machines, appropriate to outwear, rather they prefer to optimize the production of their own machines for underwear. The second considered hypothesis considers the lack of specialized education regarding creative fashion design specially conceived for seamless garments. It was found that there is only one design school, located in Breschia, Italy, that teaches and orients their students to this specific niche. The other kind of specialization available is provided by knitting machines' manufacturers and it is mainly technical, programming oriented and thus

do not properly attract creative professionals like designers. The third hypothesis, which will be obtained by analyzing the results obtained from the survey to possible consumers, assumes that these consumers do not know what seamless technology stands for, or do not indentify these products enough appealing in terms of fashion and design for exterior clothes.

After analyzing the formulated hypotheses and the information already collected, a survey was designed. Its purpose was to obtain information regarding the consumers knowledge about seamless technology and the use of this products. The survey was made in a simple and clear structure in order to stimulate the reply and thus maximizing the number of respondents. Available through an internet website, the survey was disseminated through the academic community – students, teachers and other employees – from University of Minho (Guimarães, Portugal) and the University Feevale (Novo Hamburgo, Brasil). The questionnaire is composed by fourteen questions, with open and closed answers, some mandatory, and also free answers. Some pictures were also used whenever it was needed in order to give better understanding about the products under research. A pre questionnaire in paper format was firstly used with the purpose of detecting errors and reformulate questions. This step allowed reformulating the questionnaire and reevaluating it for an online version, just before dissemination. The questionnaire remained open for fifteen days. Some results are presented and discussed in the following sections.

RESULTS

The survey presented in the following paragraphs was conducted between May and June of this year; it has a total of 205 valid participants. Part of the results is presented in this paper while the entire set of results is part of a master thesis “Seamless technology applied to fashion design”. The programs used for data processing and subsequent analysis were SPSS and Excel.

From the results obtained, one can observe that the majority of participants are female (81%). One can argue that since this survey involves a fashion approach, women fell more motivated to answer. When it comes to nationality, about 63% are Portuguese, 36% Brazilian citizens and 1% from other Portuguese spoken countries. This difference is probably due to the fact that this survey was based in Portugal. The respondents were organized in groups regarding the age: Young (less than 25 years old); Young adults (between 25 and 35 years old); Adults (between 36 and 45 years old) and Mature (more than 45 years old).

The first question was intended to know about the knowledge of the responders regarding the seamless knitted products and technology. In this question, a definition was given together with some pictures and it was asked if the responders agree with that definition. About 82% knew what seamless stands for and agree with the definition. The remaining 19% does not agree or does not know this technology and products. Thus one can assume that the majority of consumers do know what it is seamless technology.

The second question is multi answers, and asks about the way respondents knew about this technology. The possibilities of selection are: shops; information in cloth labels; brand publicity; articles in magazines and/or internet websites; universities or educational courses; through this survey; other. By frequency response analysis, one can observe on figure 1 that for Young people, the option “through this survey” and “brand publicity” were the most selected options, with 27% and 25% respectively. Young Adults selected mostly the options “brand publicity” and “shops” with 23% and 20% respectively. The Adults and Mature groups select “shops” with 23% and 25% respectively. The results in this question suggest that responders with more than 35 years old have more knowledge about this technology and pay more attention to information available in stores as well as brands publicity.

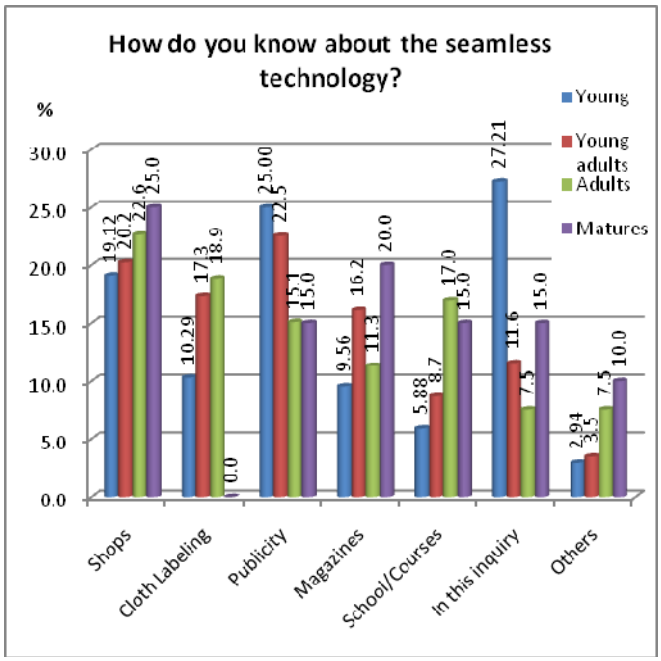


Figure 2. Results for question two of the survey.

The third question deals with habits while buying seamless products. The available options were: underwear; external clothes or outerwear; sportswear; Beach/bathing suits; medical/, therapeutic and aesthetical products; others. As it can be seen on figure 2, all groups purchase mainly underwear, sportswear comes next, together with swimsuits. Exterior outfits, the goal of this study, has a very small representation in sales: about 4% for Young people, 12% for Young Adults, 6% for Adults and almost 19% for Mature people. Some reasons can be presented, such as the lack of offer of this products concerning to the outerwear, and the high cost of the available products, mainly when one perceived a gradual increase of the purchase of these kinds of items with the increase of the age, which probably can be related with the economic stability as a person becomes older.

With the fourth question it was intended to know the behavior of the consumer when it comes to periodicity in purchasing. The available options were: whenever a new collection is available; promotions and sales, whenever I find one that pleases me; replacing old garment; special occasions; others. In a generally way, responders purchase with more frequency when they like a particular piece (between 38,5% up to 47,7% for all the groups), for replacement purposes (23,1% up to 28,4% within the different classes); in promotions and sales (10,1% to 24,3%, mainly for the young people) and for special occasions (15,4% to 2,8%). It seems that only the Mature people usually buy whenever there is a new collection (7,7%). The figure 3 shows the most voted options, those evidence that the buying is most driven by impulse and desire (they buy whenever they find a pace that pleases them) or in the second option the motivation is the necessity, for substitution of the old ones.

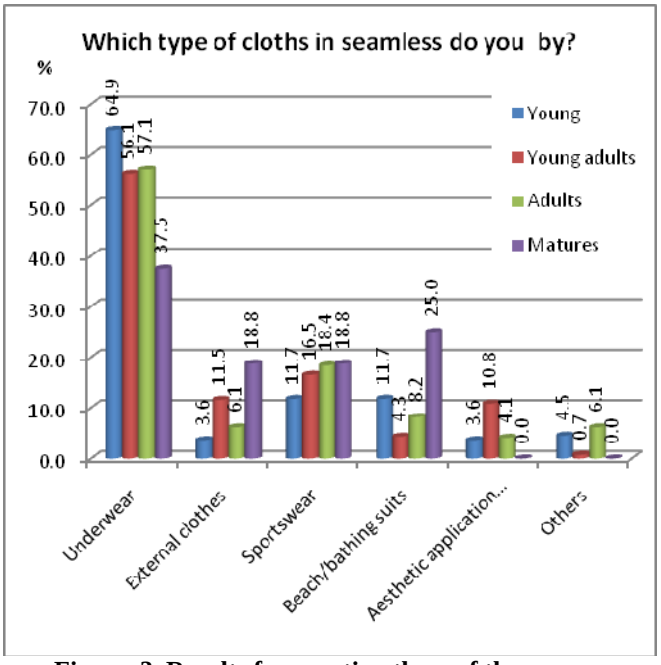


Figure 3. Results for question three of the survey.

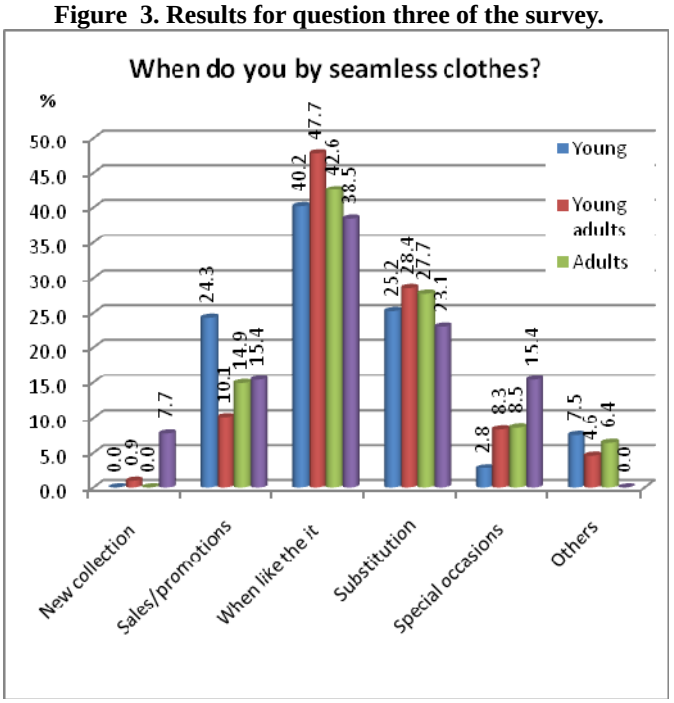


Figure 4. Results for question four of the survey.

Question five deals with the strong and weak points (positive and negative factor) regarding to the seamless technology concerning the: comfort/mobility; performance; body fitting, raw-materials used, size diversity; model diversity; aesthetic and fashion; costs. The Figure 4 shows the most representative results for each option. Almost 90% selected comfort as a strong factor, which is in fact, one of most important features of seamless garments. Performance is also recognized as an important strong factor, with 60%. Body fitting, which is an inherent characteristic of the products commercially available, is also recognized as a strong factor as 87,8% of the respondents select it. Raw-materials used in this cloths show some division on the answers, with 48,3% assuming as a strong factor and 37,6% stating that do not have an opinion about it. This result reflects also some lack on the knowledge about the fibers and filaments used in seamless products.

Considering now the available sizes, 27,3% understand as a strong factor, while 32,2% see this as a weak factor, and the remaining majority 40,5% assume that do not have opinion. As a remark to this particular result one can say that the sizes normally available in market are S (small), M (medium) and L (large), beside the so called unique size due to their capability for adjusting to several biotypes.

The diversity of models is recognized as a weak factor, justified by almost 59% of answers with that opinion. As a remark, one can say that, from the exploratory research previously made concerning the commercial offer, the majority of the available products do not present a significant variety of styling forms or shape. The aesthetical appeal of these products showed that is also a feature of opinions divisions, 38% assumed it as a strong factor, while 35,6% as a weak factor. When the prices are considered, 62,9% recognizes it as a weak factor. This observation can be explained by the fact that the majority of the respondents are young or young adults, probably with an unstable economical situation or it can also be the direct effect of the present crisis.

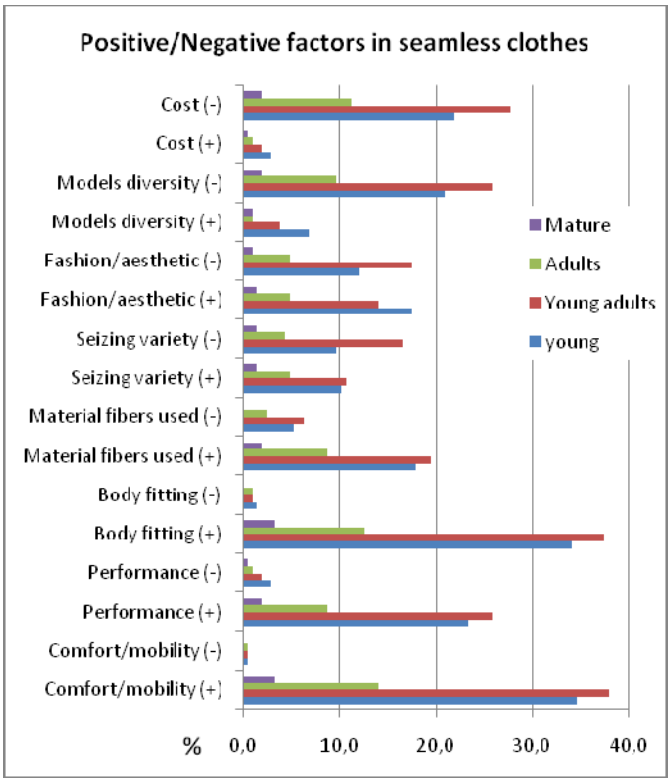


Figure 5. Results for question five of the survey.

Other question of particular relevance for this research is the one that deals with the fact that these seamless products may or may not have fashion elements. As it happened in the previous questions, more than one answer was possible, and is illustrated in figure 5. One can observe that 88,4% of the inquired persons indicated the presence of basic colors. On the other hand only 22,4% recognizes the presence of fashion colors in seamless products. Basic style models have 73,2% of the total answers, while 19% recognize fashion style in the models. Only 8,3% identify the presence of embroidery/prints applications, however this figure increases to 16,1% when the option selected is patterns and textures applications. The presence of natural fibers is recognized by 13,7% while synthetic/artificial fibers assume 38% of the total answers. The option “others” has 5,9%. This result can be visualized in its partial form distributed by the different age classis in the figure 5.From these results one understand that there is a significant design component to be further explored when it comes to integrating fashion in seamless garments, by inserting fashion trend elements that will give higher added value to these products.

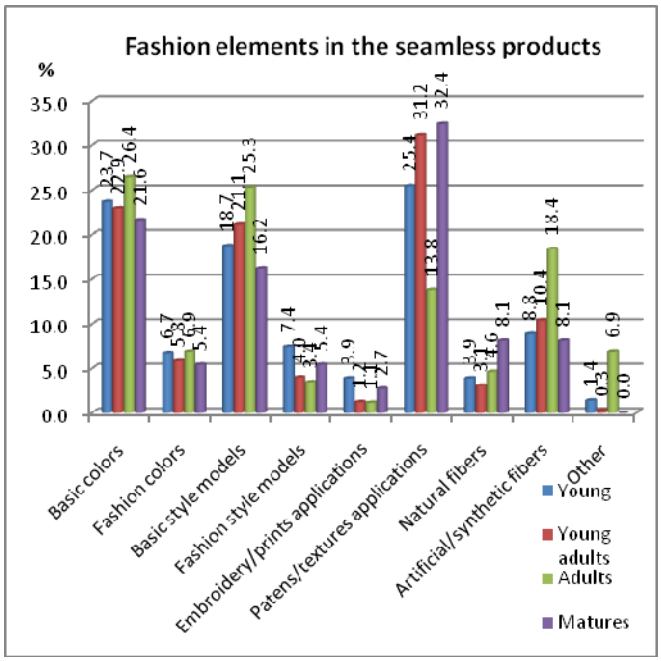


Figure 6. Results for question six of the survey.

CONCLUSIONS

The Seamless technology presents a vast research area, in particular when one considers fashion and textile design. There is not much literature available about this technology, and when there is, the focus is on technical issues, rather than design and fashion. This paper, as well as the master thesis which supports this work, deals the relationship between seamless technology and design, exploring its inherent advantages and capabilities, both from the aesthetical and technical point of view.

The bibliographic review as well as the exploratory interviews and the survey, conducted about the possibility of seamless technology, having in consideration the point of view of knitting machine manufacturers, garment producers and consumers.

Presently, most of the outerwear made with seamless technology comes from those knitting machines used for underwear. On the other hand, the knitting machine manufactures, by proposing a brand new machines especially focused on outerwear, are launching a new epoch for this technology and the possibility to expand the exterior clothes gamma in seamless offered to the consumers.

The results obtained from the survey, allowed to observe that consumers, even though they are aware of this technology and its numerous advantages, they still do not buy a significant quantity of this specific type of exterior clothes. One of the hypotheses that one can formulate from these observations is that there is a weak offer when it comes to fashion valued and appealing products. That can be due to the low investment by knitwear manufacturers on this technology especially designed for this purpose, or on the other hand, the lack of fashion designers with know-how in seamless technology compromises the final product in terms of textures, colors, shapes. The communication between designer and technicians based on the lack of technique language and specific codes inhibits the creation of innovative products.

It is the conviction of the authors of this paper that, by merging the technical knowledge to fashion and textile design knowledge, it will be possible to develop and suggest a language that will facilitate the communication between these two worlds: the creative and the technical. This two skills, together with a technical language would definitely result in innovative products.

As a contribution to this proposal, in this project the authors have been developing a methodology for creating outfits with seamless technology, by proposing common coding and lexicon in order to facilitate communication between technicians and fashion designers, able to stimulate and manufacturers, technicians and designers to invest in seamless outerwear market.

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