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Users' Perception of Digital Prototypes in Indonesian Fashion Industry: A Qualitative Study

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Abstract. During pandemic, the fashion industry is facing challenges that put the fashion and textile industry on transformation. Since it is not possible for business to go back to normal later during post pandemic time, hence it might be an opportunity to reevaluate the existing fashion industry, and transform it to a more sustainable and progressive future. Digital prototypes, such as virtual sampling in fashion, are believed to be the solution and it can create new opportunities in sustainability by reducing waste and carbon emission in the fashion industry. However, even though virtual prototypes are proven to make the industry more efficient, there have not been many researches that explore from the users' point of view. This research aims to identify the perceptions of 2 users groups, Academic Users and Independent Users towards digital prototypes in the fashion industry, including the opportunities, challenges, and barriers that need to be dealt with in order for digital prototypes to help increase the efficiency of the fashion industry on an integrated basis. The finding implicates that there are 4 aspects that influence users' perceptions towards digital prototypes: Functional Aspects (Visualization, Experimentation, Time), Financial Aspects (Cost , Materials , Time), Social Aspects (Decision Making, Access, Social Adaptation), and Psychological Aspect (Self-Efficacy, Confidence, Communication, Impression). Based on the answers of the users, functional aspect plays the most important and crucial role of the users' perception, whether from academic users or independent users' point of view.

Keywords: digital prototype, fashion, perception

INTRODUCTION

Covid-19 Pandemic has spread widely across the world, which results in undeniably significant impact on many aspects. During these times, the fashion industry is facing challenges that put the fashion and textile industry on transformation, especially in this post-Pandemic timing. The ongoing chaos has made people become more aware of health and the place they live in, earth. Since it is not possible for business to go back to normal, hence it might be an opportunity to reevaluate the existing fashion industry and transform it to a more sustainable and progressive future. The current condition pushes fashion retailers and designers to experiment with immersive technology to provide customers with new experiences to replace the physical experience they used to get in a physical store. This includes digital prototypes in the fashion and textile industry, which helps fashion retailers to visualize their products. This is also related to the important change of the growing digitalization era of all sectors. Fashion Industry is more connected with digital world, not only in the area of marketing, but also in terms of production process.

Nowadays, in the world of better and more educated consumers, virtual garment prototypes are desired more to enhance the fashion industry development. Digital prototypes, such as virtual sampling in fashion, are believed to create new opportunities in sustainability by reducing waste and carbon emission in the fashion industry. It offers manufacturers to simulate pre-production and production activities such as visualizing the shape, texture, colour, stitching, and fitting of the garment using various textile materials [1]. It also eases brands to sell products

worldwide efficiently during post-pandemic time which is believed to help the manufacturing process of fashion products.

However, even though virtual prototypes are said to make the industry more efficient, there have not been many research that explore from the users' point of view. Digital prototype is considered an emerging innovation, and it needs more feedback from the users to develop and grow. Delone & McLean stated that in order for innovation to be adapted by people, the innovation itself has to be reliable, available, and adaptable [2]. Users play an important role in such innovation; hence it is important to discover their perceptions towards it.

The purpose of this research was to identify and explore the perceptions of users towards virtual garment as digital prototypes. Hence, the study aimed to address the following Research Questions (RQ) :

RQ 1 What are users' perceptions of digital prototypes in fashion products and the factors that influence them?

RQ 2 What are the challenges and opportunities of using digital prototypes in the fashion industry?

During the process of perception identification, the author classified 2 groups of users that are impacted by digital prototype: 1) Academics in Fashion; 2) Independent Users (Designers and Small-Medium Enterprises). This research investigated the perceptions of 2 user groups towards digital prototypes in the fashion industry, including the opportunities, challenges, and barriers that need to be dealt with in order for virtual samples / digital prototypes to help increase the efficiency of the fashion industry on an integrated basis.

LITERATURE REVIEW

Users' Perceptions towards Innovation

Perception is the process by an individual which includes selection, organization and interpretation of information received to create a picture [3]. Every individual sets his/her own different variables to determine their perceptions towards products. This perception can define different quality, reliability, and feel. What may seem to be of reliable and high quality to one might be deficient to other people. According to Courtland L, Bovver, and John J. Thrill [4] , perception is built in three stages of process: exposure (to create awareness), attention, and interpretation. Perception does not stand by itself. It involves the perceiver (users), the situation, and the target (digital prototype as innovation).

In order to gain perceptions towards new innovation, people need to be aware of the innovation itself. Innovation should be perceived to have the characteristics of five things, they are: relative advantage, compatibility, complexity, trialability and observability. The innovation that is available, reliable, and adaptable will be accepted and adapted by people, stated by Delone & McLean [3]. Doyle [5] also stated that there are four essential values that add up to perception of value: 1) Functional Value: whether the product has functions or solve the problems for the consumers/users ; 2) Financial Value : whether the product has equitable price point; 3) Social Value : whether the product helps the user to connect with other people ; 4) Psychological Value : whether the product is able to bring certain psychological impact to the users.

Virtual Garment Simulation as Digital Prototype

In the past, every brand would have people to design and produce prototypes physically in order for them to see the results of the garment prototype right away - to check whether cutting, material flow, and pattern are faultless. But Gazzola, P.; Pavione, E.; Pezzetti, R.; Grechi, D [6] stated that fashion companies have changed their ways and transformed to digital to embrace the technology revolution that already happened in other industries. Garment simulation started in the late 80's and it has taken much advantage from the incremental development of computer performance nowadays. It was started with a simple model such as Weil's [7] approach and these days it has led to immersive development. The use of virtual garment as digital prototype is said to be efficient in fashion industry. Usually, for fitting analysis, users use photographs and videos. However, the validity is still questionable. Hence, a reliable and accurate digital prototype tool for fitting is needed [8]. The use of digital prototype is also necessary for design and product development in fashion industry [9]. It eases all steps in prototyping process and marketing as well. [10,11].

In the direction of visualizing a garment digitally, the software and techniques to transform 2D patterns into 3D models are essential. [12] There are softwares that support this visualization process that are already available in the market, such as CLO 3D (Clo Virtual Fashion Inc.), Haute Couture 3D (PAD system Technologies Inc.), Modaris 3d Fit (Lectra). In terms of its significance, these softwares are still developing and they have already had very

significant impacts on the fashion industry for the last 5 years. They were used for marketing and designing processes as well. According to Gerber, design visualization features in 3d softwares in the fashion industry feature complete production process, from designing, pattern making, production, and also manufacturing process which is now a crucial part of transformation in digital era [13].

METHOD AND DATA COLLECTION

In this research, a qualitative approach was adopted in order to answer the research questions written above. In depth interview was considered the most efficient method for data collection since the author needs to study consumer attitudes and opinions more detailed. During the data collection, the participants were classified into two groups of users based on their background: Academics in Fashion and Independent Users. Academics in Fashion includes lecturers and experts in Fashion Design School, while Independent Users are designers and entrepreneurs in the fashion industry. Both groups were asked to answer open-ended questions during the semi-structured interviews based on their classification. The sample was purposely selected to make the research more eligible (purposive sampling). Author used the purposive sampling technique to accurately project the related questions with the participants' background, which are academics in Fashion major, and Designers & Entrepreneurs in Fashion Industry.

The interview questions include:

- A) Demographic Section
- B) First impression of the implementation of digital prototype in fashion product (in the university & professional use)
- C) Design process (conventional without the 3d software and with 3d software)
- D) Benefits and Disadvantages of the use of digital prototype
- E) Further expectation of the 3d software for digital prototype

Other than interviews, data collection also relied on surveys and other information (such as observations). All data collected was analyzed using NVivo (computer-assisted qualitative analysis software) that enables the author to find the relationships between data sets.

RESULTS AND DISCUSSION

The author intended to interview a total of 70 participants, however the total that responded and was successfully interviewed was 61 participants, from different backgrounds - designers, entrepreneurs, and lecturers in fashion design. As stated above, the end users are divided into two groups: Academics and Independent Users (Designers and Entrepreneurs) (Fig. 1).

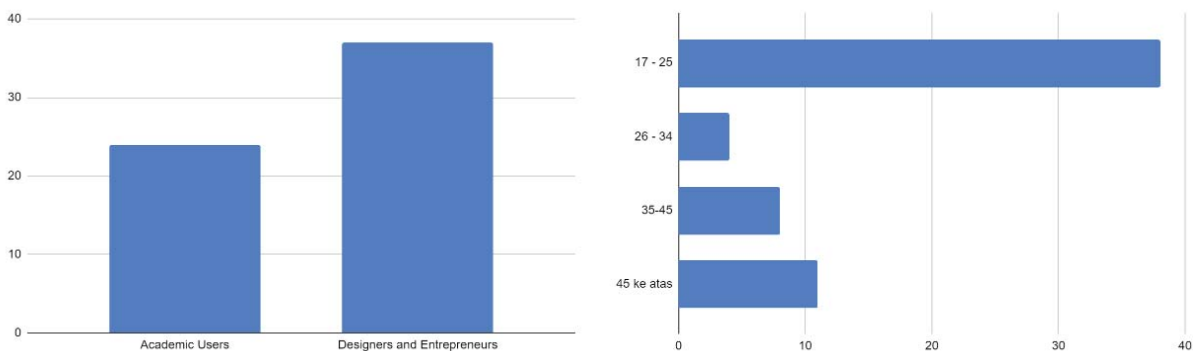


FIGURE 1. Attribute: Occupation and Age of Participants

The participants were asked to share their opinions, views, and experiences towards virtual sampling and the tools and software they have been using to create the virtual samples.

User's Perceptions Towards Virtual Prototype

Academics Users participants interviewed are mostly in the age group of 35-45 (45,8%) and above 45 (33,3%). The rest are between 26-34 years old. Meanwhile, for designers and entrepreneurs users are mostly in the age group of 17-25 years old and the rest are between 26-34 years old. The participants in the Academic Users group are lecturers and professors in fashion design, and the participants in the designers and entrepreneurs users groups are young fashion and product lifestyle designers from all over Indonesia. When they were asked whether they are aware of virtual samples in the fashion industry (the author gave them an example of a Clo 3D sample) , mostly they are familiar with the idea (including the ones that are above 45 years old). This means that 3d samples/ virtual samples are already exposed among academic users and designers and entrepreneurs users. However, although many of the interviewees are familiar with it, not many of them adapt and use it for design development in fashion classes. Even for the young designers and entrepreneurs, they have not used the technology for professional use. The author handed the participants some pictures of virtual garments made by using CLO3D, and the participants were mesmerized when they knew that it was only a 3D-prototype. They think it is very realistic and they were able to identify the materials used for the garment, also garment cut and details. Their first thoughts when seeing the picture of virtual garment are varied. Many of them are mesmerized, and they said that they could imagine the real garment, including the material, shape, and handle only by seeing the picture. Participants were asked to discuss their perceptions or this new technology, and their answers were classified into four essential values as stated by Delone & McLean (2003):

- **Functional Aspects**

In terms of functional value, many participants stated that 3D garments allow the students to visualize the garment concept better, because software like CLO3d makes it possible to transform the 2D visualization and garment pattern to realistic 3D models. It also has a layering effect for details like pleats, ruffles, smocks, and other special textile features that can be customized by the software users. The other thing that interested the author was one of the participants who was a lecturer for draping study - enunciated that 3D samples can ease the students in creating drapery from fabric and experimenting with draping styles. Participant 13 who was a fashion-design lecturer also said that by using virtual garment software, the students can save time in the design process and pattern making. Usually, it takes about 10 credit hours (= 500 minutes) to create alternative designs, including the materials and details, and making the basic pattern based on the design. This can be quite a long process since the students need to draw and cut the pattern on paper, test it on the mannequin, and if it does not fit, they have to redo the process all over again. By using 3d software that allows the students to test their pattern on the avatar, they can save time in the design process and pattern making up to 50%. It also broadens the possibility to check designs and patterns before manufacturing the garment.

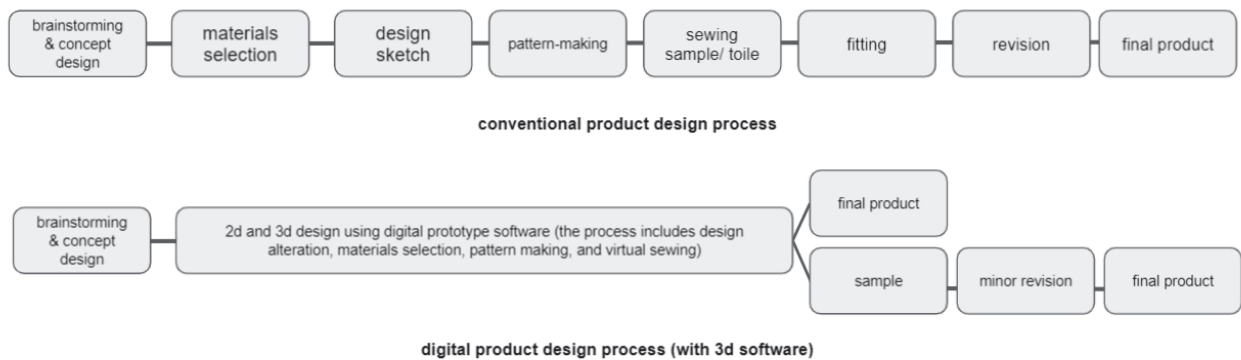


FIGURE 2. The comparison between basic/conventional design process without software and digital product design process with 3d software

Figure 2 compares conventional designs without software and digital product design process with 3D software. In terms of visualization, 3d software like CLO3D also gives a realistic view for fabric - including its physical properties, drapes, color, and texture. The properties are even editable, so when the students want to make a thicker

and denser cotton fabric, they just have to edit it in fabric properties. The other thing that also helps the functional value of virtual garment according to Academic User is it is very flexible. When the students design some collections and the lecturers think that they should be revised, the students can revise them easily, even the lecturers can see the process of the revision. Many participants stated that during pandemic, digital prototyping is one of solutions for the students and teachers to communicate in distance. It eases the consultation process that can improve the student's productivity. However, there are limitations. Many users are having difficulties in identifying the fabric real handle, and moreover, how the materials react on the body. Virtual samples cannot determine the fitting on the real body precisely, so there might also be fit problems. This problem is faced by both academic users and independent users like designers and entrepreneurs.

- **Financial Aspects**

Virtual samples can save time in the design development and create a faster process in pattern-making. Design development and pattern making process cost a lot, because the students need to buy more paper for sketching and pattern-making. With virtual samples, the students can save more money because less materials are used for designing and pattern-making. To some of the academic users, financially, virtual prototyping is cost-effective. But for some people, especially the ones in the age group 45 and up, it is not that efficient. They stated that they need high high-spec laptops/computers to run the software and it is expensive.

- **Social Aspects**

Social Aspects are the hardest to define. When the participants were asked about their perception towards virtual garment in terms of social aspect, the answers were varied. Many participants agreed that virtual garments are helping them in communicating with the students in online classes, meanwhile mostly there are lots of misunderstandings when teaching online. Some of them also stated that virtual garments can enhance their decision making for choosing the final designs, because they can give very clear visualization of each design. Participant 55 also stated that virtual garments support sustainability because it reflects effectiveness in materials usage. However, even though it helps a lot of people in the academic backgrounds, there is still a lack of knowledge in the area. It is still considered a new 'innovation' and many of the participants have no skills and knowledge. Some participants who are from SCM background also stated that this technology can change roles and jobs in fashion industries. For example, it pushes workers to learn new skills, knowledge, and technology for them to keep up in the digitalization era. Digital transformations can create many job losses as well as create new job sectors in fashion industries.

- **Psychological Aspects**

Psychological aspect also plays an important role in participants' perception. Many of the academic users stated that they feel proud to post their students' virtual prototype work. Since digitalization is all over this 21st century, the participants feel that they need to follow the trends and many of them are FOMO (Fear of Missing Out). The results of the interviews show that the use of virtual prototype software increases one's beliefs about their creative competence. This also leads to feeling an ability to finish goals and tasks, and the feeling of persistence to failure. As for the independent users like designers and entrepreneurs, they feel that with digital prototyping, they can create impactful change with innovation ideas. It eases them to execute their ideas and impress clients, therefore it has positive effect on psychological aspects like increasing self-efficacy of the users. Figure 3 summarizes these findings.

Opportunities and Challenges

There are rooms for improvement for virtual prototyping to develop since it presents one of the most crucial links in production of the garment process and other fashion or textile products. As most of the participants stated that the physical prototyping process is very time consuming and costly, virtual prototyping might be a way to move a conventional industry to a more advanced and higher level. By detecting early fault and mistakes in design process, it allows the students and designers to save time in product development. The other thing that makes the product development process easier is that to adapt this new technology, we do not need specific proficiency / skills in sewing. Software like CLO3D shows the users techniques that can be done in sewing garment virtually.

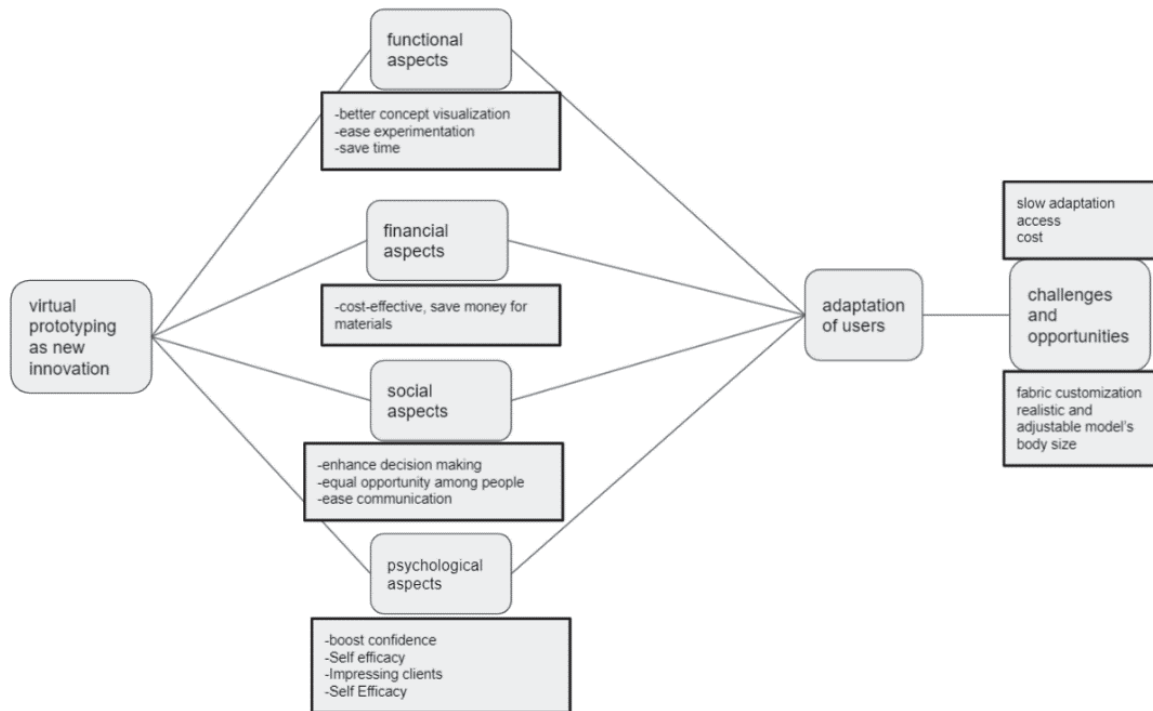


FIGURE 3. Diagram of Users' Perception towards Digital Prototype Based on 4 Aspects

However, there are limitations to this innovation. Not all people in the fashion industry are willing to adapt to this new technology. Software developers have to think of ways to communicate this new technology to industry because many of them are reluctant to change in terms of the way of working. Academic users can start to use virtual / digital prototyping regularly for people to get used to the technology. The second issue is cost. Even though most users mention that virtual prototyping reduces cost in product development process, the expenses needed for tools and equipment in creating the prototype is not cheap either. This was mentioned repetitively by the participants, both from academic users and independent users like designers and entrepreneurs. For further development, the users are hoping that virtual prototyping can get more advanced and customized. They mentioned several problems like fit problems and materials properties that can be misleading. The fitting process can be inaccurate in terms of body-size of models, and some of the users bring new ideas, like integrating the the real body size of models into the 3d software or scanning real-body size to be input to the software for better fit. Software like CLO3D and Modaris already allow the software users to adjust the model body-size, but somehow it has not reflected the real size of human body.

The customization of materials is also important. If the new technology someday is integrated with fabric suppliers, it would help the users to visualize the drape of the fabric better. Every fabric from different suppliers has different characteristic. If the big textile suppliers have their fabric properties and characteristic precisely recorded in 3D data, the digital draping process in the software can be done very easily and accurately.

CONCLUSION

In summary, digital prototype is a very promising technology that can be developed further, especially in fashion industry. It blurs the line between reality and digital world, and if it can be adjusted and advanced even more, it can be new solution towards this transformation era, especially in post-pandemic situation when people have not got back to usual activities like it was before the pandemic hits.

Based on the research question asked above, the author classified 4 aspects that influence users' perception towards digital prototypes in fashion industries: Functional Aspects (Visualization, Experimentation, Time), Financial Aspects (Cost , Materials , Time), Social Aspects (Decision Making, Access, Social Adaptation), and Psychological Aspect (Self-Efficacy, Confidence, Communication, Impression). Based on the answers of the users, functional aspect plays the most important and crucial role of the users' perception, whether from academic users or

independent users' point of view. It reflected from the users' answers about the time-efficiency they have when using the software. The comparison in the Figure 2 makes it even more obvious. To draw a conclusion, the 3d software can open new opportunities of new ways of working in fashion industries more efficiently and effectively.

LIMITATION AND FUTURE RESEARCH

The limitation of this study was the sample who are limited to academic users and independent users only, whereas another important part of the users are the consumers. Independent users' perceptions might be influenced by their consumers' opinions about the use of digital prototype to represent their product. Future research may be conducted to see from the consumers' point of view to validate the findings of this research.

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REFERENCES

1. Wacker, M. & all: Simulation and Visualisation on Virtual Textiles for Virtual TryOn. *Research Journal of Textile and Apparel*, vol. 9, no. 1, pp. 37-47, 2005.
2. Delone, W. H., and McLean, E. R, The DeLone and McLean model of information systems success: a ten-year update, *Journal of management information systems*, vol. 19, no. 4, pp. 9-30, 2003.
3. Kotler, Philip. (2000). Marketing Management, The Millennium Edition, Prentice Hall International, Inc.
4. Cortland L.Bouee and John V .Thill; Marketing; McGraw-Hill, Inc. U.S.A.1992. Pp.736- 7
5. Doyle P (2000) Value-based marketing. Journal of Strategic Marketing.
6. Gazzola, P.; Pavione, E.; Pezzetti, R.; Grechi, D. Trends in the Fashion Industry. The Perception of Sustainability and Circular Economy: A Gender/Generation Quantitative Approach. *Sustainability* 2020, 12, 2809.
7. Weil, J., The synthesis of cloth objects, *SIGGRAPH 86 conference proceedings annual conference series*, vol 20, Reading, MA: Addison Wesley, pp. 49–54, 1986.
8. Fan, J., Yu, W., & Hunter, L. (2004). Clothing appearance and fit. Cambridge: Woodhead.
9. Nwamara, C. (2016). Product Development in the Textile/Apparel Industry: A Beginners' Understanding.
10. Kotler, Philip.; Kartajaya, H.; Setiawan, I. Marketing 4.0. Moving from Traditional to Digital; Wiley & Sons Inc.: Hoboken, NJ, USA, 2017.
11. Mulhern, F. Integrated marketing communications: From media channels to digital connectivity. *J. Mark. Commun.* 2009, 15, 85–101.
12. Kim, S., & Park, C. K. (2007). Basic garment pattern generation using geometric modeling method. *International Journal of Clothing Science and Technology*, 19(1), 7-17. doi:10.1108/095562207107 17017
13. Gerber technologies (2016) Gerber White Paper: Technology Trends in Fashion.