Materials of Characterization for Development and Fabrication of Ergonomics Sofa

Ahmad Hafizi Abdul Nasir¹, Ahmad Rasdan Ismail¹², Khairul Azhar Mat Daud¹, Nurul Husna Che Hassan¹ and Norfadzilah Jusoh¹

¹Faculty of Creative Technology & Heritage, Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia
²Centre for Management of Environment, Occupational Safety and Health (CMeOSH), Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

Email: rasdan@umk.edu.my

Abstract. The basic material in an ergonomic sofa is a design process that has a specification of the basic material that is adapted to the sofa design. This is because the human factor is very much related to the ergonomics of the design in which this specification will affect the physical human. To achieve this goal, a survey questionnaire involving 30 people among the sofa makers was distributed to get feedback on the type of material used in the ergonomic sofa reconstruction process. Survey questions focus on type of material used. Based on the data analysis, results show that the type of material used such as frame and sponge is very much influenced by the design of the sofa as it is related to ergonomic features. These surveys are important to look at the specification of the key ingredients in the design of ergonomic sofas through perceptions of the maker sofa.

1. Introduction
The development of sofa design was initially considered to be the most critical, sensitive and quite difficult design in creating a product [1]. There are several ergonomic features that need to be emphasized in the design process of the sofa as stated by [2] which that the ergonomic features of the product design will attract the consumer as ergonomic features will provide comfort and suitability to the limits of human physical capacity. Ergonomics is one example of a system that can help to improve the performance of users in the context of comfort when sitting on a chair. In addition to aesthetics, ergonomic sofas need to have additional features related to ease of use, ease of maintenance, comfort of seats, durability, and so on [3][4].

This ergonomic efficiency will make the creation more effective and at the same time contribute to good health and work performance [5]. The future development of this industry depends on the extent to which it is able to respond to the needs of present and future conditions and government support should be towards strengthening the competitiveness Malay entrepreneur furniture [6]. Specification of demand becomes one of the guidelines in the design process [7].
Although, the function and objectives of a design are not entirely clear but ergonomics in product design often receives the attention of the consumer as a high quality product will generally provide comfort and suitability to the limits of human physical capabilities [2]. The development of the sofa design should emphasize the specifications of basic materials in process design as a perfect combination of establishing a quality product [8]. History shows that most of the people do not want to think about the seats they sit on, but the chairs are so complex that they have to learn to sit and finish them [9]. However, this risk is mitigated when the seat supports the dynamic nature of the existing seating and movement. Although ergonomics is one of the functions that is taken lightly, its contribution has many positive effects on a product [8][10]. Therefore, human factors in determining the function and role of a product are emphasizing in the process of product design.

Therefore, this study aims to establish some basic types of basic materials that are very important in the development of ergonomic sofa design in line with current usage. The researcher also found that the types of basic materials used in the design of the sofa are very supportive in the process of improving the ergonomic sofa design development. Product design is rarely involved in the creation of a completely new product, but in the refinement of existing products to more effective and efficient level [11]. Also, the frame and sponge design used in a sofa design greatly influences the comfort of the seating. Technological advances are closely related to ergonomics as they consider human and product compatibility when used together [12]. Ergonomics is more dependent on human capabilities because the design of a product needs to be tailored to the physical characteristics of the human being emphasize the aspects of the movement of human activity, perception, thinking and others in the current situation [13][14].

2. Research Methodology

The type of instrument used to collect respondents' feedback in this study was a questionnaire. A survey questionnaire was developed to identify the perception of sofa makers in relation to the basic materials used in developing an ergonomic sofa design. Respondents from the public can come up with a new idea and provide a better understanding of the specific local context and reflect the ideas of the community in Malaysia [15]. The subject of the study was distributed randomly around the industry and small entrepreneurs in Kelantan with 30 respondents to identify sofa makers' perceptions of the basic types of materials that fit the current design requirements of ergonomic sofas.

2.1. Development of design methods

2.1.1. Questionnaire. In this study, researchers have developed a survey questionnaire to distribute to existing sofa makers around the industry and small entrepreneurs in Kelantan state involving 30 respondents to identify sofa makers' perceptions of the types of basic materials used in modern ergonomic sofa design. In addition, unstructured observations such as manufacturing photos and field notes are also identified. Flow chart (figure 1) of development method for ergonomic sofa design.
3. Result and Discussion
Feedback was obtained as a result of a survey of 30 people involved in sofa makers in Kelantan. The design of the research questions consists of structural materials such as frame, spring system, fundamental sponge, middle sponge, wadding and fabric.

![Figure 2. Percentage of respondents' interest in frame structure.](image)

**Figure 1.** The flow chart of the methodology used in this study.
The findings show that the structure of ply wood frames is very popular among sofa makers. The data analyzed indicated that 50% of respondents were more likely to choose frame ply wood compared to other frame types such as solid wood (40%), and rattan (10%) only. The sofa maker found that the structure of the ply wood frame is a lightweight and sturdy material according to its use as shown in figure 2.

Figure 3 shows that 50% of sofa makers have opted for the Eight-way hand tied spring coils system for comfort and durability to safely handle heavy loads. While, the type of spring Sinuous ("S") Springs was 40% and 10% rattan as shown in figure 3. This proves that spring systems are very important and should be emphasized in a quality ergonomic sofa product.

![Figure 3. Percentage of respondents' interest in the general characteristics of sofa.](image)

According to figure 4, basic spacing choices used by the respondents were high density polyester sponge 70% while polyurethane, high resilience foam and rebond had the same range of 10% respectively.

![Figure 4. Percentage of respondents' interest in sponge fundamentals.](image)
Respondents chose high density polyester sponge because it has the perfect elastic properties to suit the physical properties of humans. This is because the sofa is ergonomically related to the physical comfort of the consumer. Sofa-based materials technology is closely related to ergonomics as it looks at human and product compatibility when used together [12].

In addition, figure 5 shows that the middle sponge selection base has a similar reach of 50%. This clearly indicates that the respondents chose a middle sponge that is similar in the process of making a sofa. The structure of this sponge plays an important role as it is closely linked to the human physical system. Respondents selected a combination of several quality sponges to be fitted to the middle layer of the ergonomic sofa. This indicates that there are still some types of sponges that still need improvement.

![Middle sponge](image)

**Figure 5.** Percentage of respondents' tendency toward middle sponge.

According to Figure 6, 70% of respondents chose the high density sponge wadding price and only 30% chose high density polyester sponge. This indicates that the respondent selected a high quality sponge wadding suitable for the heavy load. Sponge design also needs to be detailed according to the physical shape of the human body. This is because ergonomic assessment will make the creation more effective and at the same time contribute to good health and work performance [5].

![a. Natural Fabric](image)

**Figure 6.** Percentage of respondents' preference for ward selection.
Figure 7 shows the basics of fabric selection on the exterior of the sofa and has two criteria: natural fabric and synthetic fabric. Respondents chose leather for natural fabric which is 90% and silk only 10%. For synthetic fabric respondents prefer polyester fabric which is 50% while microfiber, vinyl, acrylic, nylon and olefin have a similar reach of 10%. This shows that leather has high demand among consumers as it is likely that leather has aesthetic value and features with luxurious, attractive, cool and easy to wash. As for synthetic fabric, polyester fabric was chosen by the respondents as it is durable, thick, not easily torn and easy to wash.

![Figure 7. Percentage of respondents' interest in fabric selection.](image_url)

Based on the results of the overall analysis data in table 1, the criteria for the types of basic materials used by the sofa maker are identified. An overview of the sofa's anatomical framework has been developed as shown in figure 8.

The continuity in table 1 above shows that sofa design factors are closely related to ergonomic design. This is because the perception of the sofa maker is taking into account in the process of designing the product. The purpose is to understand what is being asked in the market today and to collect research data then interpreted into product design. In addition, the sponge design of the sofa frame also plays a key role in meets the features of the sofa. As a final step the ergonomic sofa, design developed into a final product and translates all the details of the essentials until a marketable product is achieved. This design was developed by taking into account the perspective of the sofa maker to produce a new ergonomic sofa design suitable for Malaysian use.
Table 1. The overall results of the analysis.

| Overall result analysis sofa makers | Percentage (%) | Design need proposal |
|------------------------------------|----------------|----------------------|
| **Frame**                          |                |                      |
| Solid wood                         | 40             | √                    |
| Ply wood                           | 50             |                      |
| Hollow metal                       | 0              |                      |
| Solid metal                        | 0              |                      |
| Aluminum                           | 0              |                      |
| Plastic                            | 0              |                      |
| Polymer                            | 0              |                      |
| Rotan                              | 10             |                      |
| Eight-way hand tied spring coils   | 50             | √                    |
| **Spring system**                  |                |                      |
| Sinuous (“S”) Springs              | 40             |                      |
| Rotan                              | 10             |                      |
| Polyurethane                       | 10             |                      |
| High density polyester sponge      | 70             | √                    |
| High resilience foam               | 10             |                      |
| Rebond                             | 10             |                      |
| **Fundamental sponge**             |                |                      |
| High density polyester sponge      | 50             | √                    |
| High density sponge                | 50             | √                    |
| Rebound                            | 10             |                      |
| **Middle sponge**                  |                |                      |
| High density polyester sponge      | 30             |                      |
| High density sponge                | 70             |                      |
| Leather                            | 90             | √                    |
| **Wadding**                        |                |                      |
| Natural fabric                     |                |                      |
| Silk                               | 10             |                      |
| Microfiber                         | 10             |                      |
| **Fabric**                         |                |                      |
| Vinyl                              | 10             |                      |
| Synthetic fabric                   |                |                      |
| Polyester                          | 50             | √                    |
| Acrylic                            | 10             |                      |
| Nylon                              | 10             |                      |
| Olefin                             | 10             |                      |
4. Conclusion

In this study, the researcher proposes to establish some of the key specifications in the process of ergonomic sofa design development in line with Malaysian identity in order to formulate a successful new idea in the development of sofa design in Malaysia. The researcher also recognizes that the basic structure of the product comprising the market, technology, and public perception of ergonomic sofas for the process of product improvement. Therefore, to ensure the product's perfection, the ergonomic aspect needs consider in line with the needs and tastes of consumers in Malaysia. Thus, it will have a huge impact on the development of ergonomic sofa designs to enhance the productivity of the Malaysian furniture industry.

References

[1] Eppinger SD 2000 Product Design and Development Second Edition (McGraw- Hill: New York)
[2] Gonzalez M, Rivas S, Sanchez O and Conejo M 1998 Costa Rican National Problem: The School Furniture Situation. Technical Report. (Cartago, Costa Rica: Institute of Technology of Costa Rica) 12-17 22-38
[3] Vink P, Porcar–Seder R, de Pozo AP and Krause F 2007 Office chairs are often not adjusted by end users Proceedings of The Human Factors and Ergonomics Society 51st Annual Meeting. Santa Monica, California: HFES (vol 51) p1015 –1019
[4] Onawumi AS 2016 Kinematic description of hip and knee marker link system of taxicab operator Innovative System Design and Engineering 7(3) 42-52
[5] Gonzalez M, Rivas S, Sanchez O and Conejo M 1998 AQ3 Costa Rican National Problem; The School Furniture Situation. Technical Report. Cartago, Costa Rica: Institute of Technology of Costa Rica, p 12 – 17 22 – 38
[6] Jean-Claude Sagot, Valérie Gouin, Samuel Gomes 2003 Ergonomics in product design: safety factor J.-C. Safety Science 41 137–154
[7] Ahmad Hafizi Abdul Nasir, Ahmad Rasdan Ismail and Khairul Azhar Mat Daud 2015 Pencirian Rekabentuk Konsep Sofa Ergonomik Mengikut Persepsi Pengguna: Kajian Kes di Malaysia,
International Journal of Creative Future and Heritage (TENIAT) 3(1) 31 - 44

[8] Gonzalez M 2001 QFD; A Road to Listening to Customer Q3 Needs. 1st ed. (Mexico: McGraw-Hill) p 42 – 50, 69 – 77,107 – 126

[9] Montmollin M de 1995. Ergonomies. In: de Montmollin, M. (Ed.), Vocabulaire de l’Ergonomie. Octares, Toulouse, p 117–24

[10] Chapanis A 1995 Ergonomics in product development: a personnal view Ergonomics 38(8) 1625–1638

[11] Springer TJ 2008 Workplace Performance in Minds at Work (Kimball Office.: Jasper, Indiana) p 142–148

[12] Akao Y 1990 Quality Function Deployment: Integrating Customer Requirements into Product Design.Translated by Glenn Mazur (Cambridge MA: Productivity Press) p 1 – 15

[13] Kamaruzaman Othman, Loke Sim Wah and Norazimah Sarkom 2008 Development of the furniture industry in Malaysia and its challenges, International furniture conference exhibition, Kuala Lumpur, 28 Julai 2008

[14] Yazid Y 2010 Public Participation in The Urban Landscape and Park Development Process in Kuala Lumpur: Planning for Real in Datuk Keramat Lake Garden.

[15] Sagot JC, Gomes S and Zwolinski P 1998 Ergonomics in design: a safety and innovation factor International Journal of Design and Innovation Research 1(2) 22–35