ENHANCING DESIGN PROCESS EFFICIENCY WITH ERGO-AESTHETIC CHARACTERISTIC THROUGH DESIGN QUALITY, VISUAL ASSESSMENT AND CULTURAL BEHAVIOUR OF YOUNG DESIGNERS

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By

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June 2020

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The industrial designer plays a vital role within the consumerism cycle by making a new technology or an item a pleasure to be owned. The joy of owning an item lies inside the aesthetic and ergonomic principle where the user's preferences have been placed as a priority. The basis of this study is seeing the current practices among Malaysians who specialize in the design field, implementing ergonomic and aesthetic principles. The synergy between these two principles through design quality, visual assessment, and the cultural behaviour criteria has been named as the ergo-aesthetic. In general, the concept of ergo-aesthetic discloses the equilibrium of human behavioral character with form, shape, and symbolism inside a designed product. The coaction between these two aspects, ergonomic and aesthetic, can facilitate optimizing the efficiency of the design process, which contributes to higher output quality. Furthermore, the discrepancy between the users and the object may lead to an unpleasant effect, especially towards the user. Using a non-probability purposive sampling survey, data from 603 respondents have been obtained throughout 32 institutions and firms that practice design-related activities, with 562 respondents who are fit to be analyzed based on a specific underlined criterion. This research is a perfect reflection of young Malaysian designers on their practice throughout the design process based on the positive demographic tendency towards young designers. A general overview of Malaysian young designers' preference on the design process, ergonomic domain, and aesthetic domain during the design development process has been organized accordingly, i.e. towards the design quality, visual assessment, and cultural behaviour. This tabulation on the designer's preference contributes to the development of a new design framework consisting of the enhanced aspect by highlighting the most vital element in a design process. The finding has shown that there is a significant relationship between ergonomic and aesthetic attributes. Thus, an ergo-aesthetic framework

has been generated based on the designer's preferences level to assist the designers in the earlier stage of the design processes. The major findings of this research show each of ergo-aesthetic element are exclusively connected, and the priority levels inside the ergo-aesthetic framework assist designer determine the essential elements that are important while designing. Thus, this research has shown that ergonomic, and aesthetic are related to each other, which then contribute towards the design process enhancement through design quality, visual assessment and cultural behaviour element. In this context, ergo-aesthetic principles replace the traditional method of evaluating and adapting ergonomic and aesthetic into the design process to achieve a better output product.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MENINGKATKAN KEBERKESANAN PROSES REKABENTUK DENGAN KARAKTERISTIK ERGO-ESTETIK MELALUI KUALITI REKABENTUK, PENILAIAN VISUAL SERTA TINGKAH LAKU BUDAYA BAGI PEREKA BENTUK MUDA

Oleh

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Pereka bentuk industri memainkan peranan penting dalam kitaran kepenggunaan dengan menjadikan teknologi baru lebih menarik untuk dimiliki. Keseronokan memiliki sesuatu item itu berkait rapat dengan prinsip estetik dan ergonomik di mana kehendak pengguna menjadi keutamaan. Kajian ini dijalankan bagi mengkaji amalan semasa di kalangan rakyat Malaysia yang mahir di dalam bidang reka bentuk yang menerapkan prinsip-prinsip ergonomik dan estetik di dalam proses rekaan mereka. Perkaitan di antara dua prinsip ini berdasarkan kualiti reka bentuk, penilaian visual, dan kriteria perilaku budaya adalah ergo-estetik. Pada umumnya, konsep ergo-estetik mendedahkan keseimbangan interaksi perilaku manusia dengan rupa, bentuk, dan perlambangan di dalam produk yang direka. Perkaitan di antara kedua-dua aspek iaitu ergonomik dan estetik dapat meningkatkan tahap kecekapan proses reka bentuk yang berlaku, di mana ia akan menyumbang kepada kualiti pengeluaran produk yang lebih baik. Selain itu, ketidakserasian di antara pengguna dan objek boleh membawa kepada impak yang negatif terhadap pengguna. Dengan menggunakan kaji selidik persampelan tanpa kebarangkalian, data dari 603 responden telah diperolehi melalui 32 institusi dan firma yang menjalankan aktiviti berkaitan reka bentuk, dengan 562 responden adalah sesuai untuk dianalisis berdasarkan kriteria kajian yang telah ditetapkan. Kajian ini merupakan refleksi praktis pereka bentuk muda di Malaysia terhadap proses reka bentuk berdasarkan dapatan demografik yang lebih cenderung kepada pereka bentuk muda. Dapatan mengenai keutamaan pereka bentuk Malaysia mengenai proses reka bentuk, domain ergonomik, dan estetik semasa proses pembangunan reka bentuk telah diatur secara sistematik berdasarkan kualiti reka bentuk, penilaian visual, dan perilaku budaya. Perangkaan mengenai

keutamaan pereka bentuk ini menyumbang kepada pembangunan rangka kerja reka bentuk baru yang terdiri daripada aspek reka bentuk yang dipertingkatkan dengan mengutamakan unsur yang paling penting di dalam proses reka bentuk. Oleh itu, satu kerangka ergo-estetik telah dihasilkan berdasarkan tahap kecenderungan pereka untuk membantu proses reka bentuk. Dapatan utama kajian ini adalah pembuktian bagi perkaitan diantara elimen ergo-estetik dan tahap keutamaan yang telah digariskan dapat membantu pereka bentuk mengenalpasti elemen-elemen yang penting semasa proses reka bentuk berlaku. Kajian ini menjelaskan bahawa ergonomik dan estetik adalah berkaitan diantara satu sama lain, yang kemudiannya menyumbang kepada peningkatan prestasi proses reka bentuk melalui kualiti reka bentuk, penilaian visual dan elemen perilaku budaya. Prinsip ergo-estetik menggantikan kaedah tradisional menilai dan menerapkan ergonomik dan estetik ke dalam proses reka bentuk bagi menghasilkan suatu produk yang lebih baik.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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CHAPTER 1

INTRODUCTION

1.1 Background

Ergonomic and aesthetic are theoretically irreconcilable—ergonomic shows how a system or a product interacts comfortably towards the users. Ergonomic can be classified as human behaviour throughout the fundamental theory of performance in purposeful interactive socio-technical systems, where the knowledge will be transmitted into the real world (Wilson, 2000). Contrarily, aesthetic embraces the understanding of finding the perfect balance between the principle of design and the element of design which relate to shapes and form, where emotion plays a vital role in interpreting the empathy which refers to symbols and icons (Duncum, 2010).

The market positioning and segmentation for industrial design item is highly related to users preference and positive interaction between the user and an object. Three critical factors affected the purchasing decision of users which is quality, price and design (Šupín & Kaputa, 2010). Also, for the Malaysian market, the same attributes, which are quality, design and price, will determine the purchasing behaviour (Mohamed & Yi, 2008). Thus, ergonomic as in quality and aesthetic as in design is highly essential to ensure a successful product proposition which is related to the product quality and the design element.

Thus, a common ground between ergonomic and aesthetic should be made to ensure that each of the designed product will be balanced in terms of its function and outlook. Concerning this matter, behaviour and culture seem to be a perfect medium in synthesising both of these elements harmoniously where culture is the dominant substance towards aesthetic characteristic by affecting the visual communication of a person towards an item (Christensen & Ball, 2015; Duncum, 2010; Manning & Amare, 2013; Xenakis & Arnellos, 2013). Moreover, other external influences, such as the senses may contribute a significant change in human interaction with an object.

Malaysia has recorded a total export of RM22.3 billion of timber and timber-based product, where RM7.8 billion of it are gained from the wooden furniture industries (Malaysia Timber Council, 2019). This shows that furniture industries are one of the most significant sectors that contribute to the country's wealth. As a developing nation, Malaysia is now striving towards changing the Original Equipment Manufacturer (OEM) scenery towards a more aggressive and creative oriented manufacturing nature which is the Original Design Manufacturer (ODM), and a user-oriented business strategy which requires users' brand trust, i.e. Own Brand Manufacturing (OBM). The fact is most manufacturers nowadays are reluctant to change because of the cost that they

will have to bear in implementing new technologies as well as hiring an expert in design. According to the National Timber Industry Policy (NATIP) 2009-2012, a manufacturer of a timber-based product in Malaysia should be able to absorb the pressure and the cost by being involved in ODM and OBM to penetrate a higher valued market (Ministry of Plantation Industries and Commodities Malaysia, 2008). Right strategies in imposing the design process may help to reduce the overall cost by consistently producing an exceptional design in the manufacturing line. This synthesis of ergonomic and aesthetic philosophy may help to find a perfect route in adapting design in the industries nowadays.

The industrial designer plays a vital role in exploring the possibilities of changing the OEM industry towards the OBM industry. An excellent industrial designer always synthesises an excellent combination of the visual appearance of a product, consumer demand, as well as the capability to optimise the production line. Here is where the role of aesthetic and ergonomic comes in, where visual appearance, the comfort level, colour and material combination, as well as organisation of the overall process are proportionally important.

1.2 Problem statement

The uncommon ground between ergonomic and aesthetic may become a repulsive value to a designer, either highly bias in ergonomic or aesthetic in each design process. This dilemma may result in an ineffective design process flow, which indirectly increases the cost of developing a product. The combination of ergonomic and aesthetic principles may come in handy when dealing with these issues. Thus, few issues have been raised within the ergonomic and aesthetic relationship, which has been listed below.

There is a problem in developing an excellent behavioural-oriented product among industrial designers

An industrial designer should always put a priority on consumers' demand and perspectives in developing a product or an item. The discrepancy between the users and the object may lead to an unpleasant effect, which consists of pain and uncomfortable body posture (Castellucci, Arezes, et al., 2014). Thus, ergonomic and aesthetics play a significant role in specifying the design details to suit consumers' needs. Ergonomic and aesthetic are both affected by the changes in human behaviour and culture (Aromaa & Väänänen, 2016; Cai & Chen, 2016; Lin et al., 2016; Manning & Amare, 2013; Taifa & Desai, 2017). Without knowing the specific element in ergonomic and aesthetic that co-relates with the behaviour and culture, the designer will have a problem in developing an excellent consumer-oriented design. As for the standard product range and design style, contemporary product misses not only its appearance but also its character and value (Yong-xiang & Jie, 2007).

There is a deficiency of aesthetic and ergonomic relationship appreciation within the design process flow

The synergy between these two principles is essential to have a right and balanced product. Aesthetic is related to the daily behaviour of a person, and it reflects on how he or she reacts towards the environment. The aesthetic characteristic is highly influenced by the culture and behaviour exposure of a person which will indirectly affect his or her visual communication expression (Christensen & Ball, 2015; Duncum, 2010; Manning & Amare, 2013; Xenakis & Arnellos, 2013). Thus, the aesthetic and ergonomic association should be regarded as a prioritised consideration in the design process flow.

A study on a Brazilian furniture manufacturing company has shown that the implementation of proper workstation design and process flow has tremendously increased the productivity level, and reduced the workload by more than 40% (de Guimarães et al., 2015). Thus, an efficient and useful design process is highly essential to initiate an excellent design output.

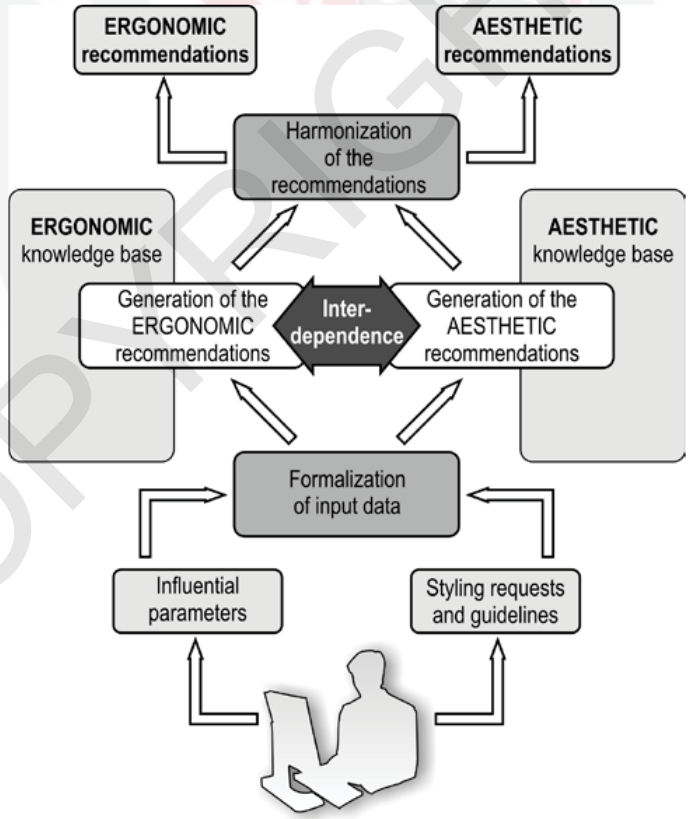

Figure 1.1: An intelligent system for ergonomic and aesthetic in the design process
[Source: Kaljun & Dolšak (2011)]

As shown in Figure 1.1, if the process only using one section of the process, the knowledge will be based on the used part only. On the other hand, if both processes are used, the system should use both knowledge bases (Kaljun & Dolšak, 2011). The separate system that has been shown in Figure 1.1 in applying the ergonomic and the aesthetic element may be a hassle task for a designer who may lead to an unproductive design process journey. Finding common ground between ergonomic and aesthetic throughout the design process may effectively solve these identified issues.

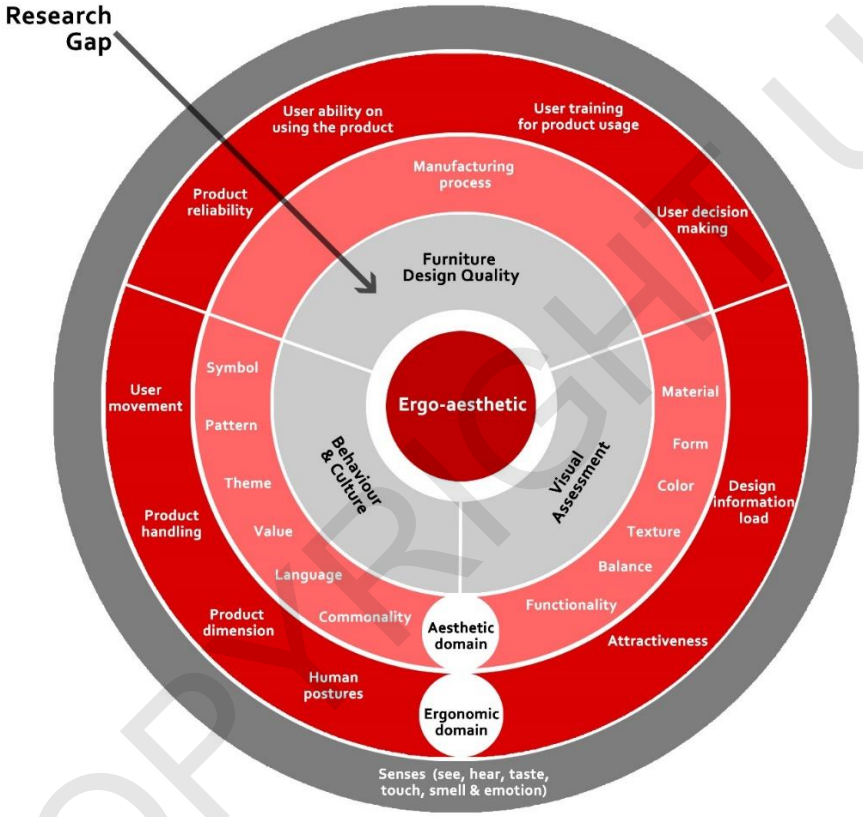

Figure 1.2: The ergo-aesthetic conceptual framework where senses play a vital role in enhancing the adaptability between ergonomic and aesthetic

Design quality, visual assessment and behaviour and culture are the fundamental elements inside a design process. The cross-linkages between each core and the aesthetic and ergonomic can generally demonstrate the existence of a connection between these two domains. Based on Figure 1.2, a research gap can be justified between the establishment of the ergo-aesthetic framework with the element inside ergonomic and aesthetic, which has been arranged accordingly towards three values- design quality, behaviour and culture, and visual assessment. The prioritised justification among the elements is crucial to ensure that designers will keep the essential element as their top

primary concern. The details explanation regarding the conceptual framework construction will be explained in the next chapter.

1.3 Research question

Based on the ergonomic and aesthetic problem statement, the main research question for this research is as stated below.

Main Research Question

How can the relationship between ergonomic and aesthetic enhance the design process efficiency through design quality, visual assessment, and behaviour and culture?

The main research question has led to another three sub-research questions, and they are as follows:

i. What is the essential characteristic of ergonomic and aesthetic?
ii. What is the relationship between the design process stages with ergonomic and aesthetic?
iii. How does ergonomic and aesthetic relate to design quality, visual assessment and behaviour and culture?
iv. How can ergonomic and aesthetic relationship enhance the design process efficiency?

1.4 Research objectives

The research objectives for this study have been listed accordingly:

i. To understand the essential characteristic of ergonomic and aesthetic;
ii. To analyse the relationship between the design process stages with ergonomic and aesthetic;
iii. To develop an ergonomic and aesthetic framework based on design quality, visual assessment, and the criteria of behaviour and culture;
iv. To validate the ergonomic and aesthetic framework into the design process.

1.5 Scope of Research

This research investigates the possibility of a relationship between ergonomic and aesthetic, the purpose of which is to enhance the efficiency of the design process through three ergo-aesthetic vital components which are, design quality, visual assessment and cultural behaviour. The primary survey has been conducted across the region of peninsular Malaysia, comprising the states of Johor, Melaka, Selangor, Kuala Lumpur, Perak, Pulau Pinang, Kedah, Perlis, Kelantan and Terengganu. All the respondents are well-trained designers or practitioners who are familiar with the design process. Thus, a

data cleaning procedure has been strategised to ensure that every single respondent is familiar with the design process. On the other hand, the expert's validation process has been conducted among industrial design practitioners and academicians to ensure that the proposed ergo-aesthetic framework can fit extensively into the design process.

1.6 Chapter organisation

This thesis has been structured into six chapters which systematically represent the flow and findings of this research. Each chapter's content has been summarised accordingly as follows:

Chapter 1 is a concise explanation of each research problem and how research questions become the basis of the empowerment of the research objectives. The deficiency in the relationship between aesthetic and ergonomic appreciation becomes the main argument as to why this research is most needed.

Chapter 2 distinguishes the essential element inside ergonomic, aesthetic as well as the element inside the user behavioural culture, design quality, and visual assessment. The possible linkages between the ergonomic and aesthetic domain with the association of behavioural culture, design quality, and visual assessment have been obtained, which become the basis of the conceptual framework of this research.

Chapter 3 explains the overall methodological approach of this research from how the sampling has been done, validating the domain in ergonomic and aesthetic, validating the ergo-aesthetic framework, as well as the validity and the reliability of the approach.

Chapter 4 intensively interprets the analysis section of this research. The obtained data have been analysed descriptively to get the exact priority level among all the elements inside ergonomic and aesthetic. A normality test, correlation, and regression analysis have been conducted to seek whether there is a relationship between ergonomic and aesthetic with each specific design activity.

Chapter 5 highlights the proposed ergo-aesthetic framework where behaviour and culture, design quality and visual assessment become the construct of the framework establishment. The Organisational ergonomic priority framework has also been proposed to enhance the adaptability of the ergo-aesthetic framework. This chapter clearly shows the position of adapting the ergo-aesthetic framework and organisational ergonomic priority framework onto the design process stages.

Chapter 6 summarises the significant findings of this research through the theoretical, methodological and practical contribution. Recommendation for future research has also been highlighted to ensure the synergy of adaptability and the progression of the ergo-aesthetic research area.

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