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Socio-Technical System as Factors and Influences in Form Design Development

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Abstract

Since digitalization in the cyber-physical system has taken over design development, researchers attempt to improve the approach to new product development including brand recognition. This research attempt to determine the design strategy based on syntactic design meaning in analyzing the visual through design formulation, design treatment, and design standard inline socio-technical system. The concept of digitalization design scenario, the methodology was developed by observational study, laboratory study, and interview to analyze designer integrates with the strategy of design analysis. The design analysis was approachable to determine the design representation and potentially generalized the characteristic of product design and consumers' psychological preferences toward product forms.

Keywords: Socio-technical system; form development; design thinking; influence factors

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1.0 Introduction

Many researchers are attempting to improve the approach of design development with a lot of innovations and inventions have been developed. Since digitalization has taken over the design development, the industry currently already changes and midgrade from analog to cyber-physical (Trappey, 2016). The systematic of intelligent computers and the implementation of this artificial intelligence have become a design analysis in socio-technical was identified. It is widely acknowledged that adopting a socio-technical approach to system development leads to systems that are more acceptable to end-users and deliver better value to stakeholders. It also truly influences interdisciplinary influences, especially from engineering. However, such approaches are not widely practiced, especially in social science, which is still not well developed. There is still a lack of discussion about design development and the methodology of design practice was not carried out and the critical design situation faced by designers (Gretzel, 2011; Teegavarapu, 2008; Strickler, 1999; Anwar, 2015). Analyzing product development, design formulation, design treatment, and design standard among designers potentially provide a concrete product with local brand recognition. In this scenario, this research will develop a design structure analysis base on the interpretation of product recognition. The Socio-technical design approach is to produce product characteristics through synthetic design. Socio-technical is the strength of the conceptual design framework in achieving social innovation and product. The element that supports to structure of the design analysis will emphasize three area ideation needs: concept, material, and technical. The designer will implement

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the structure in product design development to empirical the relevance of the design analysis approach in determining the meaning and impact of design findings.

2.0 Product design characteristics

Explores the notion that religious product is fundamentally a sign of the human embodied mind in product design. The nature of the product design can be defined and interpreted, especially in terms of visual appearance, which aims to explain the object's shape and form. Human perception of product design recognition cannot possibly manipulate unless they recognize the main factor behind the designs and implements when encountering product development. Product development is about making 'sense of things, such that products are "understandable to their users" (Krippendorf & Butter, 1984). Understanding the characteristics, such as the degree of product quality and its nature, is composed of three core modes; the sensorial, the cognitive, and the affective modes of experience and related to perceptual product experience (figure 1).



Fig. 1: Framework of perceptual product experience (PPE), with core modes (centre) and the two dimensions of presentation (left) and representation (right) with sub-modes
(Source: Warell, 2008)

Perceptual product experience (PPE) interacts with the experience perceiver, and it emphasizes two dimensions of experience: presentation and representation. Presentation is an experience 'for what it is, and representation is an experience of 'what it stands for'. Based on that, toward the comprehension of product development, its perceivable references in the product point toward the product itself, providing meaning related to nature, behaviour, properties and characteristics of the product (Warell, 2008). The characteristics of the product it is an interpretation of visual appearance. Concepts such as form and shape are used when describing the form of the object. Traditional design methodology recommends that design be moved from existing problem descriptions to an abstract solution model. The problem described depends on an individual perspective of a person, and an abstract solution model is an abstract functional representation and concrete form representation – to open up new solution space. Abstract models are designed for concrete solutions through functional principles and principles (Blessing & Chakrabarti, 2009).

The role of the visual appearance of products was to create recognition for the characteristics and brand of the product. Product recognition is difficult to recognise without a characteristic of a brand or logo. There are a lot of studies that mention the difficulties in identifying a product without a brand. However, some of the products are easier to recognise only by observing the shape or style of the design. For example, recognising an Apple device or music player is often accomplished by straightforward use of colour schemes, materiality and logo. Moreover, the consistency of the grille across Audi vehicles is a common characteristic (Warell, 2008). The strategy to develop this type of product utilising the same component and element to create a strong awareness of product recognition is primarily significant with the customer-based brand value (CBBE) model. CBBE is a comprehensive approach; this is because the knowledge of the brand consists of awareness of the brand, and the image is fundamental to building the brand's equity. It was vital to building a brand's equity (Keller, 2001). (See figure 2)

The socio-technical approach has been identified based on the discussion on the design analysis. Socio-technical is an effective method of analysis while the industry shifts from analogue to cyber-physical to mid-grade. Using computational support tools in design enables the capture of knowledge generated at each design stage and the representation of this knowledge to provide design decision support (Meniru, 2003; Chandrasegaran, 2013). The socio-technical approach to system development is widely known to make systems more acceptable to the end-user and deliver better value to stakeholders (Baxter, 2011). Furthermore, based on the system of intelligent computers and the integration of this artificial intelligence has become a design analysis in design development, in this research socio-technical strategy in the design analysis. Where the ceramists will use this approach across all development design practices to empirical the relevance of the design analysis approach in determining the product design representation in the context of syntactic that can be generalised as a religious-based product design

3.0 Review of form development and the relation with socio-technical system

Design refers to those activities that essentially create and produce a product from a requirement, product concept, or technology. It is a fundamentally innovative process, and It has two aspects: product and practice, and it is an activity characterised by being iterative and

exploratory (Richey, 2014; Husin, 2009; Braha, 2003). Generally, design practice involves design thinking; it is a reflective practice defined as a process of analysis, and the creative process engages with a person in opportunities to experiment, create and prototype models, gather feedback, and redesign. It is a concept used to determine the significance and impact of design findings in theory and practice. (Razzouk, 2012; Johansson, 2013; Kimbell, 2009)

Design is a purposeful, social, and cognitive activity undertaken in a dynamic context, aimed "at changing existing situations into preferred ones". Design is a complex, multifaceted phenomenon involving people, a developing product, a process involving a multitude of activities and procedures, and a wide variety of knowledge, tools and methods (Simon, 1981; Charkabati, 2008). The explanation is that the complexity of design has been that too straightforward a definition of design interpretation will be insufficiently rich and impossible to relate to the different kinds of experiences encountered in design practice (Nelson, 2003).

According to Warell (2008), the emerging trend has shifted the focus of attention in product development from what is designed to what is experienced. Therefore, the design is related to product development perceptual product experience (PPE). PPE interaction with the experience is subjective and specific to each perceiver and depends on personal factors (experiences, background, cultural values and motives) and product-related factors (a type of product, properties and characteristics of a brand). Besides, PPE emphasises two dimensions of experience: presentation is an experience 'for what it is', and representation is an experience of 'what it stands for, it towards to the comprehension of product development, it is about making 'sense of things', such that products are "understandable to their users" (Krippendorf & Butter, 1984). In other views, the comprehension of product development its perceivable references in the product point toward the product itself, providing meaning related to nature, behaviour, properties and characteristics. Besides, Product development is most related to people and products: behaviour and product design demonstrate how to contribute to product design, enhance product utility, and determine product characteristics. (Kimmel, 2015).

The characteristic of product and product recognition is correlated when a human sees a product by perspective and representation in their mind (Keller, 2001). The recognition process can be conscious or unconscious, and therefore, consumers can recognise the product and its features without much awareness. Thus, the term recognition here includes both conscious (declarative) and unconscious (implicit) knowledge of a product, about both what the product is and what one can do with it. (Karjalainen, 2010). Moreover, to create strong awareness for product recognition, the Customer-Based Brand Equity (CBBE) model it is a comprehensive approach, this is because the knowledge of the brand consists of awareness of the brand and the image of the brand is fundamental to building the equity of the brand. Keller (2001) has a structured approach to explain the method of creating a brand, which is (1) constructing the proper brand identity, (2) creating brand meaning that is consistent with what is formulated, (3) stimulating the expected brand response, and (4) establishing the right brand relationship with consumers (see figure 2).

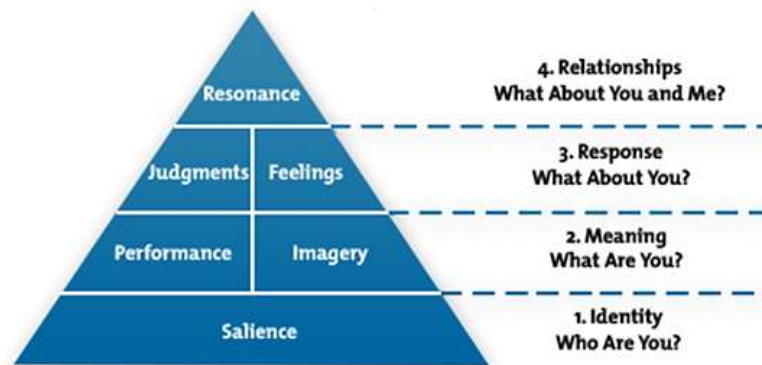


Fig. 2: The Brand Meaning developed
(Source: Keller, 2001)

The stunning example of this CBBE: Apple device, the iPad was developed to look great, be easy to use, and do everything its customers wanted and more customers loved it if any glitches that attracted negative responses were quickly patched. Also, the common consistency of the grille across vehicles is one characteristic that has been observed across Audi vehicles (<https://www.qualtrics.com/experience-management/brand/customer-based-brand-equity/>; Warrell, 2008;). However, based on research in current works of literature about characteristics of product religious or culture in design embedded based on the representation of mind by designers, there is no clear theory on that area, especially from the perspective of different knowledge experience practitioners influences in Malaysia. The Malaysian identity establishment's argument constantly refers to the three dominant races (Malays, Chinese and Indian). From this point of view, there is a research gap in this study, which were very difficult to be aligned as a local design representative in product recognition.

Syntactic structures have significantly influenced the development of knowledge, mind, and mental processes, being an essential field of study in the formation of cognitive knowledge. It also significantly influenced research on computers and the brain (Chomsky, 2002 and https://en.wikipedia.org/wiki/Syntactic_Structures). Moreover, based on the description of the characteristic of product and product recognition it shows the synthetic structure also correlated with them.

Based on the mention above, the categorise of design analysis is recognised as socio-technical was identified. Social-technical acknowledges that interaction between people and technology refers to the interaction between the complex infrastructures and human

behaviour. The principle of socio-technical thinking is that the design of systems should be a process that considers both social and technical factors that influence the functionality and use of computer-based systems (Baxter, 2011). This approach is frequently used in the final phase of design analysis, especially the detailed design stage, but in the ceramic industry, it is readily apparent and essential in an intermediate stage of design analysis. However, in design practice it enables the capture of knowledge generated at each design stage and the strengths of the socio-technical design approach, such as visual analysis and prototyping, are most readily apparent, and thus are the strengths of the conceptual framework in achieving social innovation (Meniru 2003; Chandrasegaran 2013; Ceschin, 2016; Gasson, 2003).

The industry is now moving from Industry 3.0 to Industry 4.0 (I 4.0) and almost the industry nowadays changes and midgrade from analogue to cyber-physical (Trappey, 2016). The systematic need for intelligent computers and the implementation of this artificial intelligence have become a design analysis in product development design. According to Bender (2002) and Teegavarapu (2008), Design analysis is genuinely interdisciplinary with influences from engineering, sociology, psychology, and economics. Since researchers from different fields are in the domain of design analysis, a wide range of research strategies are introduced, and many system developments have been designed and developed. It is widely acknowledged that adopting a socio-technical approach to system development leads to systems that are more acceptable to end-users and deliver better value to stakeholders. Despite this, such approaches are not widely practised (Baxter, 2011).

Based on Gretzel (2011), Teegavarapu (2008), and Strickler (1999) mentioned that a few approaches are formally adopted and applied in the design analysis of social science, however, there is still not well developed mainly in the ceramic industry. While the study of ceramic design practices has been carried out for decades, there is still a lack of discussion about design development and the methodology of design practice was not carried out and the critical design situation faced by ceramists (Anwar 2015). System design approaches and information systems present a common platform for researchers and designers. The concepts of socio-technical design have evolved with the design of information systems, design of information systems is to make the system support users, and to enable users to use the system effectively (Scacchi, 2004).

4.0 Conceptualizing design parameter as new product development

Product development and product recognition are activities that are directly connected to the design practice. Based on research, design practice is involved with design thinking, it is broadly defined as a process of analysis. Since the industry changed and midgrade from analogue to cyber-physical, this artificial intelligence has become a design analysis approach in design development and socio-technical was identified.

In the process of new product development (NPD), the method of personalisation character approach is commonly used in automotive design and product design. The approach is meant to emphasise the product's physical form, such as aesthetics, ergonomics, and user interfaces. Despite this, the approach will create more positive attitudes towards product design. It is possible to adapt the design by changing colour, covers, or casing and of users' own choices (Fossdal et al., 2016; Keogh, 2020). Personalisation is now more important than anything else in the market. People want to be able to personalise exclusively to their needs. There comes to the point where it has to be moved forward very quickly. For instance, a product that has a particular colour, for example—blue for a man, or pink for a woman. It shows that people want things that they can call their own where they can be associated with their character. Personalisation also refers to matching one object's nature with one subject's needs (Riemer & Totz, 2003). For example, the new Beetle Car models from Volkswagen have an identical iconic character of the beetle insect besides the strong personality of young, fun, and cuteness. The new model of Beetle managed to carry the old identity by reaming the original structure and form with more dynamic, masculine, and sporty characteristics. In these contexts, the approach of personalisation characters on design is capable of catering to a specific group or individual's interest, intention and demand.

The new product development (NPD) emphasises the importance of introducing new products in the market for business sustainability (Ahmad et al., 2018). Ahmad et al. (2018) added that to ensure success in global business, companies must introduce a new product through a carefully accomplished new product development process. Product development is a multiple disciplines task involving participation from practically all the departments of an organisation, such as manufacturing, design, and marketing. Designees who have not previously played an essential role in the substantive work of innovation bring the idea to the table and be considered a downstream phase in the production process. However, design has become an increasingly valuable asset, especially in the consumer electronics, automotive, and consumer packaged goods industries (Brown, 2008). According to Ulrich (2008), the design function plays the lead role in defining the product's physical form to meet customer needs best. The design function needs involvement from engineering design and industrial design. The designer must consider the aesthetics, ergonomics, and user interfaces to develop a new product. The generic product development process consists of six phases: planning, concept development, system-level design, detail design, testing and refinement, and production ramp-up.

5.0 Discussion on proposed design research methodology

A design research methodology is defined as an approach and a set of supporting methods and guidelines to be used as a framework for doing design research. Defining and interpreting product design in visual appearance by design methodologies as a reference point for product design. Traditional design methodology recommends on a model by Blessing and Chakrabarti (2008). Where moving from the existing problem descriptions to an abstract solution model. The existing problem described depends on an individual's perspective, and the abstract solution model is an abstract functional representation and concrete form representation – open up new solution space.

Abstract models are designed for concrete solutions through functional principles and principle structures. In product design, it seems to be a solution for the interpretation of visual appearance concepts such as form and shape to describe the form of the object (Chakrabarti, 2008; Hatchuel & Weil, 2009; Abidin, 2012; Razzouk, 2012; Rahim, 2015; Anwar, 2015).

The selection of this approach was widely used for studies in a related area of investigation and it most far-reaching in configuration inquire about design research methodology. Although the model framework represented in the Blessing and Chakrabati was consisting of four stages, the methodology developed to survey the constantly practised by designers in product industry including the academy, it is the main factor about product development which examines the design protocol analysis. The approach towards response was established by research enhancement through the analysis of any empirical research methodology as well as design research. The descriptive analysis was generated from literature-distinguished mitigating processes, while the prescriptive study used the situation identified in practice and replicated the same laboratory study. The summary is in the flow chart of the research system there are three stages involved in the methodology of this research as shown below:-

Phase 1: Observation Review of configuration research will be directed to characterize and recognize the information knowledge gap regarding the design issue. It can make it practicable to empirical significant methodological issues in current design practice and experimental investigations. Another source needs to be confirmed the activity system strategy for capturing the experimental information. This phase is important to capturing design thinking of ceramist during development process. Since conventional ceramist design anatomy hard to reveal an array of inspirations or influences, this observation attempt to interpret towards product recognition by examining designers' interpretation of product recognition during the product design development. Profiling how individual ceramist's think essentially can support the next phase of the profiling design strategy among designers.

Phase 2: Laboratory Study (Experiment – video observations). The approach of data collection and analysis focuses on design thinking and the socio-technical approach in product design development. The main area of this research is concentrated with an industrial ceramic perspective and specific design development, from the existing design ideas and has been developed as artifact (tableware ware industries) will be analyze. The development of design based on design thinking will concentrate on professionals taking part in this determination. The ceramist will be confined to various backgrounds from the institution and industrial company in Malaysia.

For the experiment part, the observational studies will base on design activities. The importance of this observation due to the lack of study have been conducted especially on video interviewing where, a process of capturing applicant reaction (Bauer et al., 2006) and many scholars have noted about the needs (Guchaita et al., 2014). Toldi (2010) depict, any conventional and video interview is still in its early stages. There is a requirement for qualitative and exploratory investigations alongside quantitative studies to completely comprehend the impact of utilizing video technology. Therefore, video observation will be done on the designers. They will record as recorded like the In-Vitro Design Protocol setup by Anwar, (2016) in mapping and analysing design activities. The individual task and group undertaking disconnected workstation format depends on perception set used research centre studies completed with Cash, (2012). Formulating socio-technical design strategy through profile data of design by formulation (concept), design by treatment (material) and design by standard (technical) conceivable call attention to define the the hierarchical design character of a local identity.

Phase 3: Data Validation (Interview) Validation will be concerned with establishing the relevance and meaningfulness of guidelines and theories. Validity is the degree to which a test measures what it is supposed to measure such as content area, constructions, concurrentness and predictions (Abidin, 2012). The selection of interview as a part of this study is important based on the knowledge gap revealed in the interview literature. Anderson et al. (2004) has concluded about most of the research trend for over the years has adopted an organizational perspective and few studies have focused on applicant reactions and decision-making. All data examined and profile during observation will undergoes meta-analysis design stage to validate the defined socio-technical analysis strategy model.

6.0 Finding the gap between form design development and the existence of ConMaTech

The role of the visual appearance of products was to create recognition for the characteristics and brand of the product. Product recognition is difficult to recognise without a characteristic of a brand or logo, there are a lot of studies that mention the difficulties in identifying a product without a brand. However, some of the products are easier to recognise only by observing the shape or style of the design. For example, the recognition of an Apple device, the iPad was developed to look great, be easy to use, and do everything its customers wanted and more customers loved it if any glitches that attracted negative responses were quickly patched. Also, the common consistency of the grille across vehicles is one characteristic that has been observed across Audi vehicles (Warrell, 2008).

An attempt has been made to develop or model the design process. Some of these models represent the sequences of the activities that usually take place in the design. A simple four-stage model of the design process consisting of exploration, generation, and evaluation is mentioned by Cross (2008). Some of these models simply define the sequences of activities usually occurring in design; other models aim to suggest a better or more acceptable pattern of practices. Descriptive models of the design process typically recognise the importance of creating a solution idea early in the process, indicating the solution-focused essence of design thinking. Cross (2008) mentioned that the process is heuristic. Designers using general guidelines, previous experience, and rules of thumb lead in what the designer hopes to be the right direction, but with no guarantee of success.

However, based on research in current works of literature about characteristics of product religious or culture in design embedded based on the representation of mind by designers, there is no clear theory on that area, especially from the perspective of different knowledge experience practitioners influences in Malaysia. The argument on the Malaysian identity establishment is constantly referring to the three dominant races (Malays, Chinese and Indian). From this point of view, there is a research gap in this study, which were very difficult to be aligned as a local design representative in product recognition.

The description of characteristic of product and product recognition indicated the synthetic structure also correlated with them. Syntactic structures have had a significant influence on the development of knowledge, mind, and mental processes, being an essential field of study in the formation of cognitive knowledge. It also significantly influenced research on computers and the brain (Chomsky, 2002 and https://en.wikipedia.org/wiki/Syntactic_Structures). Since the industry is now moving from Industry 3.0 to Industry 4.0 (I 4.0) and it was changed and midgrade from analogue to cyber-physical (Trappey, 2016). The systematic need for intelligent computers and the implementation of this artificial intelligence have become a design analysis in product design development.

Teegavarapu (2008) mentioned, that the design analysis is genuinely interdisciplinary with influences from engineering, sociology, psychology, and economics. Since researchers from different fields are in the domain of design analysis, a wide range of research strategies are introduced, and many system developments have been designed and developed. Based on Gretzel (2011), was mention in a few approaches are formally adopted and applied in the design analysis, especially in social science, which there is still not well developed, especially in the ceramic industry. The study of ceramic design practices has been carried out for decades, but there is still a lack of discussion about design development and the methodology of design practice was not carried out and the critical design situation faced by ceramists (Anwar, 2015).

Based on that scenario, the categorisation of design analysis use of computer-based systems is recognised as a socio-technical was identified. Social-technical is an approach to describe systems that involve a complex interaction between humans, machines, and the environmental aspects of the work system (Emery, 1960; Hughes, 2017). The principle of socio-technical is that the design of systems should be a process that considers both social and technical factors that influence the functionality and use of computer-based systems (Baxter, 2011). Recent reviews of the approaches available for ergonomists, have demonstrated that a variety of tools do exist to enable the application of systemic thinking, to organisational work problems (Hughes, 2017; Waterson et al., 2015; Salmon et al., 2016), It indicates that this approach is practical to achieve the goal of the development of research methodology.

Systems design approaches are a common platform for researchers and designers. A socio-technical approach leads to systems that are more acceptable to end-users and deliver better value to stakeholders. A designer's role is to make the system work for users and facilitate use (Scacchi, 2004; Baxter, 2011). This approach is frequently used in the final phase of design analysis, especially the detailed design stage, but in the ceramic industry, it is readily apparent and essential in an intermediate stage of design analysis. In this research, will use this approach across all development design practices to empirical the relevance of the design analysis approach, because design practice enables the capture of knowledge generated at each design stage, and the strengths of the socio-technical design approach, such as visual analysis and prototyping, are most readily apparent, and thus are the strengths of the conceptual framework in achieving social innovation (Ceschin, 2016; Chandrasegaran, 2013).

Based on the statement above, the strategy of design analysis proposes the development of principle design structures focused on the ceramic industrial design perspective, supported by the theories, practice, and innovation. Where the design thinking and socio-technical as a tool for ceramists to empirical the relevance of the design strategy approach to determine the product recognition base on the characteristic through syntactic design (see figure 3).

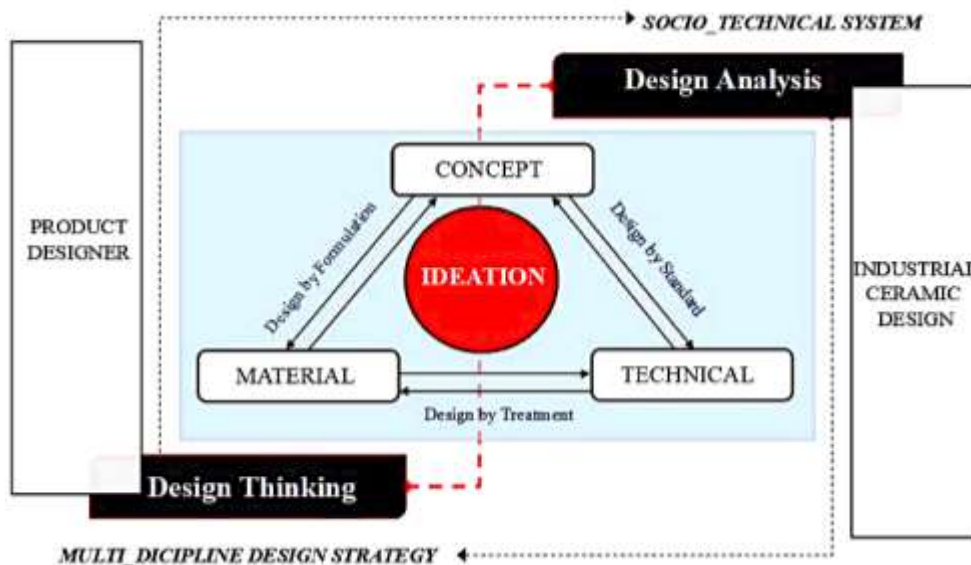


Fig. 3: The Conceptual Framework of Design Analysis Approach

Based on Fig 3., The design strategy offered a triangulation design analysis of ideation activity, which is concepts, material, and technical. The implementation of three elements is based on studies by Nilsson (1998). He addressed that producing product design especially in the specification, must incorporate the proceses of material and technical, therefore is supported by research from Anwar. Where several ceramic designers have been investigated in their case study and reported to be consistent with what Nilsson claimed, however, it's more of a concept, material, and technical research approach. (Anwar, 2015). The three-element of ideation represents for: "concept represents the design by standard," "material represents the design by formulation," and "technical represent the design by

treatment." The emphasis is on three elements based on the task undertaken in any product without a standard format, such as a tableware product. Based on three-element significant issues in industrial ceramic design components can be clarified into standard-formulation- treatment (SFT).

7.0 Conclusion and recommendation for future works

The relationship between SFT in the situation of the ceramic design was essentially discussed in several of the studies. Sample 1 by Noordin (2016), gives the introduction of the complex subject of determining the material, product, and production method. In the situation of determining the complex subject between material: represent for the material, product: represent for the concept, and product method: represent for technical. In his argument, Noordin explains that harmony between its material, product, and product method needs to be well designed. Products need to be fitted to the material properties. However, if the product is designed with a different application, it is difficult for the material to be in harmony with the product. Based on the explanation, this research emphasises materials and products, it can be concluded that it is more effective in design by formulation.

Sample 2 by Mohamed Raif (2013), this research introduces the complex issue to study the design of abluion stations in performing abluion by considering the design importance of hygienically, conveniently, and efficiently It is also environment-friendly design and safety sanitary standard. In the situation of investigating the complex subject between the design of abluion station: represent for the concept, the important element when performing the abluion: represent for technical. In its statement, the conceptual study on the ergonomics of product development will also discuss the wudhu facility to accommodate Muslim needs in the performance of abluion based on user expectations as well as safety and comfort. Based on the explanation of this research, it can be concluded that it more effective in design by standard, because this research it more emphasises the concept and technical.

Sample 3 by Zainuddin (2012), this research is introductory to the complex subject of determining the material, application of product method, and product design. Based on the discussion, this research it more emphasises materials and technical, so it can be concluded that it is more effective in design by treatment. In the situation of determining the complex subject between material: represent for the material, application of product method: represent for technical and product design: represent for the concept. In his research, Zainuddin discussed the application of material for product design through a design approach. The material development and methods of the proposed application, which is through slip casting technique, where the process of obtaining a solution to transfer the lab-scale knowledge into the manufacturing process will hopefully bring further assistance especially in generating a more cost conducive material and affordable for future.

The sample explains how often the designer emphasises the design by formulation, design by standard, and design by treatment in developing the product design, and the designer who is more inclined in which direction to produce the product can be identified with this structure. These elements of the ideation approach that believe establish design thinking and design analysis as an approach discipline in the product development process, thus it reacts to the primary purpose of research methodology by moving from the existing problem descriptions to an abstract solution model. Abstract models are designed for concrete solutions through functional principles and principle structures.

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