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Design Thinking in Design Innovation among Small and Medium Textile Enterprises in Ghana

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Abstract

Design thinking which emanates from the concept of Design is used as an analytic and innovative process that engages a person in opportunities to experiment, generate ideas, create models and solicit feedback. The current study attempted to provide further insight into Design Thinking in textile design innovation with reference to Stanford's Design Thinking model by Hasso Plattner Institute of Design at Stanford. This is because the understanding of design thinking, which is a human-centred approach to innovation has not been fully explored among Small and Medium Textile Enterprises in Ghana. The study adopted the quantitative research approach, with the descriptive survey as the research design. The accessible population for the study included all small and medium-scale textile manufacturers located in the selected regions. A multi-stage sampling procedure involving convenient, purposive, and stratified sampling techniques was employed in this study. A sample size of 300 was drawn from the 80 Small and Medium Textile Enterprises (SMTEs). Of the 300 questionnaires administered, 273 were considered valid for further analysis, with a 91% valid response rate. The findings revealed that a wide range of concepts are gathered and analysed to define the core problems that have been identified and defined in a human-centred manner, including features, functions, and any other elements necessary to solve problems or allow customers to solve issues on their own with the minimum of effort. In view of that, SMTEs must continuously strive for innovative and creative solutions and develop innovative ways to handle problems to fulfil clients' needs.

Keywords

Design Thinking, Human Centered, Innovation, Ideation, Prototype.

Introduction

Business practitioners, researchers, policymakers, innovation experts and other stakeholders are increasingly becoming interested in comprehending the connections between innovation and design (Mortati, 2015). Thus, the buzz around the subject has lately deepened with efforts stemming from several sources to understand these complex issues. Mutlu and Er (2003) specified that there is a mutually proactive connection between the practice of design as well as the theory of economics on the common ground of innovation. Hence, innovation is crucial for both technological as well as economic development of a country, judging by the experiences of industrialized nations such as Europe and the USA.

The term innovation refers to a creative output or process or the activities involved in creating or producing innovative output (Carlgren, 2013). Innovation is sometimes understood as the invention, creation, or improvement of an existing idea. Innovation is a driver for technological development.

Innovation offers the leeway for innovative technology adoption by companies, particularly small and medium enterprises (SMEs), to catch up with the dominant technology frontier for sustainable development and economic growth (Agwu et al., 2020; Anderson et al., 2019; De Mel et al., 2009). The economic, as well as technological contributions of innovation to national development, have widely been discussed both empirically and theoretically (Akinwale et al., 2017; Fan, 2011; Booyens, 2011; Longenecker et al., 2006). Expósito et al. (2019) and Wolf (2006) emphasized the importance of innovation in economic development, indicating that increases in the productivity of SMEs are connected with their capabilities and abilities to innovate, adopt innovative technologies and employ innovative processes in domestic settings.

Mytelka (2000) specified three cores mutually reinforcing rudiments in the innovation process, viz. learning, linkage and investment. The four key typologies of innovation as conceptualized and advanced by the OECD's (2005) Oslo Manual include product, process, marketing as well as organizational innovations. Ringberg et al. (2019) and Coccia (2017) infer three core forms of technological innovation, namely major innovations, revolutionary innovations and incremental innovations. The former category is more germane to SMEs, which account for the mainstream textile firms. The core requirements for innovation are that they satisfy a need; it is technologically critical in keeping with contemporary concepts, environmentally friendly as well as profitable.

Design Thinking

The usage of the term Design was originally applied in the field of Art and Design. Application of the term Design Thinking which emanated from the concept of Design is now used as an analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign (Razzouk & Shute, 2012). It has received increasing attention in business, social science, natural science, education, etc. as a way of critically analysing issues to come out with the desired solution. In the view of Müller-Roterberg (2018), Design Thinking is a comprehensive customer-oriented innovation approach that aims to generate and develop creative business ideas or entire business models. Even though the term *Design* is generally linked to product quality and/or aesthetic appearance, the key objective of design as a discipline is to improve consumers' well-being.

According to Brown (2008), Design Thinking is a human-centred approach to innovation that draws from a designer's toolkit to integrate people's desires, the potential of technology, and the need for business success. Thus, design thinking, as specified by Suciu and Baughn (2016), Goodwin (2011), and Merholz et al. (2008), is a human-centred approach to innovation anchored in appreciating client's needs, swift prototyping, and generating creative ideas that will alter the way products, services, processes, as well as how organizations are developed (Shapira et al., 2017; Johansson-Sköldberg et al., 2013; Tschimmel, 2012). The application of Design Thinking aids firms to make decisions based on what customers desire rather than on historical statistics or instinct instead of evidence.

Businesses need to develop and enhance skills to comprehend and address rapid shifts in customers' environments and behaviours, necessitating design thinking. The world has become increasingly complex and interrelated; thus, businesses require an advanced creative process to address human needs in contemporary times. 21st century firms from a wide range of sectors find design thinking a valuable means to solve their customers' problems in terms of their products and/or services (Kleinsmann et al., 2017; Brown & Wyatt, 2010). Of all the design methodologies, design thinking is practically the best for thinking outside the box.

One Design Thinking model that is widely used to solve problems is the Stanford Design Thinking model by Hasso Plattner Institute of Design at Stanford. The five stages of Design Thinking, according to the institute, are as follows: Empathise, Define, Ideate, Prototype, and Test.

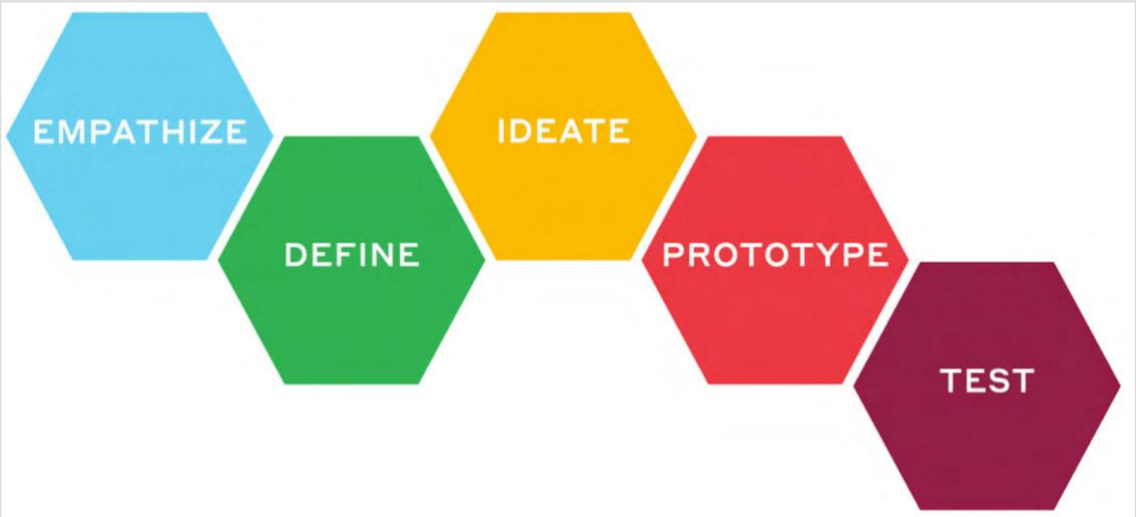

Figure 1: *Stages in the design thinking process (Plattner, 2010).*

The first stage of the process is to identify the problem that needs to be solved. This comprises consulting specialists to learn more regarding the area of concern through observation, engaging and empathizing with persons to appreciate their experiences as well as motivations, and immersing the business in the physical environment to obtain a deeper understanding of the matters involved. Empathy is placing yourself in the shoes of the person impacted by the problem, understanding that impact from their perspective as opposed to an outsider looking in. It allows design thinkers to reserve their conjectures to understand problems regarding time limitations. A considerable amount of data is collected at this phase to utilize during the subsequent stage and to advance the best possible understanding of the customers, their desires, and the issues that cause the development of that particular product (Siang, 2017; Plattner et al., 2017; Dam & Siang, 2016; Plattner et al., 2012).

During the Define stage of the process (Siang, 2017), there is the need to assemble the data you created and gathered during the Empathize stage. This is where the firm analyses the observations and synthesizes them to define the core problems that the team has identified and defined in a human-centred manner. The Define stage aid designers in the team to gather countless ideas to establish features, functions, as well as any other elements that will permit them to resolve the problems and/or allow customers to solve issues themselves with the minimum effort. Again, in the Define stage, the firm starts to progress to the third stage (Ideate) by asking questions to generate ideas for solutions.

In the third stage of the design thinking process (Ideate), designers, according to Plattner (2010), are equipped to generate ideas by thinking outside the box to identify novel solutions to the problem statement created and begin searching for alternative ways of observing the problem. Several techniques can be used. It is imperative to generate several ideas or problem solutions as thinkable at the beginning of the Ideation phase.

As specified by Siang (2017),the design team will then formulate several inexpensive, scaled-down types of the product or explicit features found within the product to explore the problem solutions generated in the preceding stage. Prototypes may be shared and tested within the team itself, in other units in the firm, or on a small group of individuals outside the design team. This is an experimental phase (Siang, 2017), and the objective is to recognize the best possible solution for each of the problems detected during the first three stages. The solutions are then executed within the prototypes and, in sequence, are examined and either accepted, enhanced and/or re-examined or rejected wholly, based on customer experiences. By the end of the prototype stage, the design team will know the limitations inherent to the product and the issues present and have a more precise interpretation of how customers could think, behave, and feel when interacting with the final product.

Designers meticulously test the complete product utilizing the best solutions identified during the prototyping phase. This is the concluding stage of the five-stage model; however, in an iterative process, the outcomes generated during the testing phase are frequently employed to redefine one or more problems that inform the understanding of customers, the conditions of use, how individuals think, behave, and feel, and to empathize (Siang, 2017; Plattner et al., 2017; Dam & Siang, 2016; Plattner et al., 2012). The process may have outlined a direct and linear model in which one stage ostensibly leads to the next with a logical assumption at the testing stage. Nevertheless, in practice, the process could be conducted in a more flexible and non-linear manner.

Empirical studies on design thinking relative to small and medium textile enterprises, notably in the Ghana context, are lacking. There exists a considerable research gap in the comprehension of the notion of innovation and design thinking at the firm level in the context of developing countries (Daksa et al., 2018; Pisoni et al., 2018; Fu et al., 2011). Explicitly, within the framework of sub-Sahara Africa, there has been a vociferous call for the study of innovation in SMEs, which considers the unusual circumstances of this context because of their importance to economic development (Akosile, 2017).

The current study attempts to provide further insight into design thinking in textile design innovation with reference to the Stanford design thinking model by Hasso Plattner Institute of Design at Stanford. This is because the understanding of design thinking in textile design innovation in Ghana is quite limited. Not enough is known about how much and what kind of innovation is occurring, whether or how these innovations are spread, or what ultimately drives firms to innovate (Mcsherry, 2017).

Methodology

The study adopted the quantitative research approach, with the descriptive survey as the research design. The descriptive design was employed to analyse and discuss Design Thinking in design innovation among STMEs in Ghana. Descriptive design was considered apt for the study since it is versatile and practical; given that, it identifies present conditions and points to current needs (De Vaus, 2001). Other specific reasons for using descriptive research design include the fact that it determines and reports accurately the way things are; makes it plausible to observe, describe and document aspects of a given situation as it naturally occurs (Opie & Brown, 2019).

Table 1: *Regional Distribution of SMTEs in the selected regions (Fieldwork, 2021).*

Region	SMTEs	Number of Workers
Ashanti	25	213
Greater Accra	38	316
Western	16	180
Northern	20	161
Total	99	870

Population

A population, according to Rahi et al. (2019), is the complete set of subjects that can be studied. The accessible population for this study included all small and medium-scale textile manufacturers located in Greater Accra, Ashanti, Northern and Western Regions. Preliminary enquiries showed that the four regions have a combined population of 99 Small and Medium Scale Textile enterprises with a total of 870 workers.

Sample Size Determination

The sample size for the quantitative aspect of the study was computed using the following mathematical approach by Yamane (1967);

$$n= \frac{n}{(1+Ne^2)}$$

Where;
N= Population for respondents
n= Sample size for employees
e= level of precision (5% margin of error)

Sample size:

$$n= \frac{870}{(1+870x.05^2)} \text{ ,n= 274 = 275app.}$$

A non – response rate of 10% (27.5) was added → *n*=275+27.5=302.5

The actual sample size was approximated to 300.
Again, the same formula was used to determine the number of SMTEs sampled from each region.
Sample size:

$$n= \frac{99}{(1+99x.05^2)} \text{ ,n= 79}$$

Approximated to 80 SMTEs selected from the four earmarked regions.

Sample Selection Procedure

A multi-stage sampling procedure involving convenient, purposive and stratified sampling techniques was employed in this study. From the 90 SMTEs from the four regions, the researcher sought to conveniently select 80 SMTEs from the four regions. Stratified sampling was subsequently employed to determine the number of respondents to be drawn from each region. Based on the required sample size of 300, the number of respondents from each region was proportionately calculated using the formula:

$$A/B \times C$$

Where A is the total number of SMTEs in the region, B is the total number of workers in region C is the determined sample size.

For example, the sample size for the Ashanti Region was calculated using the above formula where;

A=213, B=870, C=300; thus, 213/870 × 300=73.

The same procedure was used to obtain the proportion of SMTEs in each of the selected regions and the summary is shown in Table 2.

Table 2: *Sample Determination of SMTEs in the selected regions (Fieldwork, 2021).*

Region	SMTEs	Number of Workers	Sample (SMTEs)	Sample (Workers)
Ashanti	25	213	20	73
Greater Accra	38	316	31	109
Western	16	180	13	62
Northern	20	161	16	56
Total	99	879	80	300

Data Collection Instruments

A self-administered questionnaire was designed to gather data from the sample regarding Design Thinking in design innovation among SMTEs in Ghana. The response format was based on a 5-point Likert-scale rating pattern with weightings of very frequently;

(SA) = 5, Frequently (A) = 4, Occasionally (NS) = 3, Rarely = 2, and Never (SD) = 1.

The average of these points is 3.0;

$$(5 + 4 + 3 + 2 + 1) / 5 = 3.0.$$

This was used in quantitative data analysis. Data were processed using Statistical Package for Social Sciences (SPSS).

Results

Descriptive information on design thinking in design innovation among SMTEs is discussed. The results of the data analysis were presented in the form of frequency tables and standard deviation tables. Of the 300 questionnaires distributed, 273 were considered valid for further analysis, with a 91% valid response rate. The remaining 27 questionnaires were partially responded to, or some were barely readable.

Design Thinking Approach in Design Innovation

Table 3: *Descriptive Statistics on Empathy in Design Innovation of SMTEs (Fieldwork, 2021).*

Statement	N	Min.	Max.	Mean	±SD
We immerse ourselves in the lives of our customers before we come out with designs.	273	1	5	4.48	.859
Our works are influenced by our appreciation and understanding of the desires of our customers.	273	1	5	4.58	.627
We listen to and share the experience of customers to offer the best possible solution.	273	1	5	4.61	.702
We listen to the voice of the customer in the development of new products.	273	1	5	4.62	.620
We observe how users interact with our products and learn from that experience.	273	1	5	4.45	.753

To meet unmet human needs, innovation involves revamping business structures and creating whole new markets (Vianna et al., 2012). Against this background, respondents were asked to indicate their approach to design innovation in their processes. Table 3 presents the results of the descriptive statistics on empathy in design innovation among the textile producers surveyed. The items were measured on a 5-point Likert scale where;

1= *Strongly disagree* to 5= *Strongly agree*.

From the table, it could be observed that the means of the measurement items for empathy in design innovation are generally high. The results show that the majority of the respondents strongly agree that they listen to the voice of the customer in the development of new products (M=4.62, ±SD=.620), and share in the experiences of customers to offer the best possible solutions (M=4.61, ±SD=.702), and their works are influenced by their appreciation and understanding of the desires of their customers (M=4.58, ±SD=.627), immerse themselves into the lives of their customers before they come out with designs (M=4.48, ±SD=.859) while observing how users interact with their products and learn from that experiences (M=4.45, ±SD=.753). From the trend of the responses, it could be inferred that the textile enterprises are empathic in their approach to designing the textiles such that customers are listened to, share in their experiences to develop solutions, influenced by the desires of the customers, immerse themselves in the lives of their customers while also learning from how customers interact with their products.

Table 4: *Descriptive Statistics on Define in Design Innovation of SMTEs (Fieldwork, 2021).*

Statement	N	Min.	Max.	Mean	±SD
We gather countless ideas to establish features, functions, as well as any other elements necessary to resolve the problems and allow customers to solve issues themselves with the minimum effort.	273	1	5	4.04	1.272
We analyze and synthesize the information gathered to define the core problems identified.	273	1	5	4.08	1.220
We analyze the observations and synthesize them to define the core problems that the team has identified and defined in a human-centered manner.	273	1	5	4.00	1.329

Table 4 presents the descriptive statistics on what the respondents do at the design stage of the design innovation process. The responses were along a 5-point Likert scale where;

1= *Strongly disagree* to 5= *Strongly agree*.

The results show that most of the responses were generally high. The results show that the majority of the respondents strongly agreed with the assertions that they analyze and synthesize the information gathered to define the core problems identified (M=4.08, ±SD=1.272), and gather countless ideas to establish features, functions, as well as any other elements necessary to resolve the problems and allow customers to solve issues themselves (M=4.08, ±SD=1.220). The majority also strongly agreed that they analyze the observations and synthesize them to define the core problems that the team has identified and defined in a human-centered manner (M=4.00, ±SD=1.329).

The trend of the responses suggests that a wide range of concepts are gathered and analyzed to define the core problems that the team has identified and defined in a human-centered manner, including features, functions, and any other elements necessary to solve problems or allow customers to solve issues on their own with the minimum of effort.

Table 5: *Descriptive Statistics on Define in Design Innovation of SMTEs (Fieldwork, 2021).*

Statement	N	Min.	Max.	Mean	±SD
We search for novel and alternative ways to solve problems to satisfy customers' needs.	273	1	5	3.89	1.290
We find novel solutions to problems	273	1	5	4.03	1.347
We identify alternative ways of observing the problems	273	1	5	4.03	1.169
We use several techniques to solve and innovate our problems	273	1	5	4.12	1.111

In Table 5, respondents were asked about their approach to ideation in the design thinking approach in the textile production process. The responses were measured along a 5-point Likert scale where;

1= *Strongly disagree* to 5= *Strongly agree*.

It could be seen that most of the responses placed generally high on the scale. Relative to finding novel and alternative ways to solve problems, the majority of the respondents (M=3.89, ±SD=1.290) agreed that they search for novel and alternative ways to solve problems to satisfy customer needs. More so, many of the respondents agreed strongly to the effect that they find novel solutions to problems (M=4.03, ±SD=1.347), identify alternative ways of observing problems (M=4.03, ±SD=1.169), and as well use several techniques to solve and innovate problems (M=4.12, ±SD=1.111).

From the results, it can be concluded that relative to meeting customer demands, textile enterprises look for new and creative solutions and come up with new ways to solve challenges while employing various methods to find solutions and develop new ideas.

Table 6 presents the descriptive statistics on the prototype in design innovation in textile production processes. The responses have been presented along a 5-point Likert scale where;

1= *Strongly disagree* to 5= *Strongly agree*.

On the prototype development, most of the respondents strongly agree (M=4.28, ±SD=.903) that they make prototypes to eliminate all forms of error before final products are made.

Additionally, most of the respondents also agreed strongly (M=4.11, ±SD=.887) that they examine and either accept, enhance, re-examine or reject wholly based on customer experiences and know the limitations inherent in the product and the issues present in the prototype product (M=4.12, ±SD=.834). However, many respondents agreed that they have a more precise interpretation of how customers could think, behave and feel when interacting with the final product (M=3.93, ±SD=1.013).

Table 6: *Descriptive Statistics on Define in Design Innovation of SMTEs (Fieldwork, 2021).*

Statement	N	Min.	Max.	Mean	±SD
We make prototypes to eliminate all forms of error before final products are made.	273	1	5	4.28	.903
We examine and either accept, enhance and re-examined or rejected wholly based on customer experiences	273	1	5	4.11	.887
At this stage, we know the limitations inherent in the product and the issues present in the prototype product	273	1	5	4.12	.834
We have a more precise interpretation of how customers could think, behave, and feel when interacting with the final product	273	1	5	3.93	1.013

From the results, it could be resolved that at the prototype stage of the design thinking approach of the textile production process, before the final products are made, prototypes are built to ensure that all potential sources of errors have been ruled out. Also, based on client feedback, the enterprises assess and either approve, enhance, re-examine or reject the product completely, considering the product's limitations and the difficulties present in the prototype.

Table 7: *Descriptive Statistics on Define in Design Innovation of SMTEs (Fieldwork, 2021).*

Statement	N	Min.	Max.	Mean	±SD
We test the complete product utilizing the best solutions identified	273	1	5	4.04	.837
The outcomes generated during the testing phase are frequently employed to redefine one or more problems that inform the understanding of customers	273	1	5	3.85	1.035

In Table 7, the respondents were asked to rate their activities at the testing stage of the design thinking approach. The stage was measured along with two items where they were measured on a 5-point Likert scale with;

1= *Strongly disagree* to 5= *Strongly agree*.

A summary of the responses shows that the majority of the respondents were in strong agreement with the effect that the test of the complete product by utilizing the best solutions identified (M=4.04, ±SD=.837) and that many of the respondents also agreed that the outcomes generated during the testing phase are frequently employed to redefine one or more problems that inform the understanding of customers (M=3.85, ±SD=1.035).

From the results, it could be concluded that textile companies make certain that finished products are tested using the best solutions throughout the testing stage of the design innovation process and that challenges are continually redefined to inform consumers' understanding of the problem.

Discussions on Design Innovation in Design Thinking Approach

Relative to the design innovations of the enterprises, the study noted that the textile enterprises are empathic in their approach to designing the textiles such that customers are listened to, share in their experiences to develop solutions, are influenced by the desires of the customers, immerse themselves in the lives of their customers while also learning from how customers interact with their products.

Additionally, the study found that textile enterprises use a wide range of concepts to define the core problems that the team has identified and defined in a human-centered manner, including features, functions, and any other elements necessary to solve problems or allow customers to solve issues on their own with the minimum of effort. When the ultimate purpose is to meet customer demands, textile enterprises look for new and creative solutions and come up with new ways to solve challenges while employing various methods to find solutions and develop new ideas. The results found support in the works of Siang (2017), Plattner et al. (2017), Dam and Siang (2016), and Plattner et al. (2012), who believed in their respective studies that at the empathy stage of the process, a considerable amount of data is collected just so to be able to advance the best possible understanding of the customers, their desires and the issues that cause the development of that particular product.

Furthermore, the study found that before the final products are made, prototypes are built to ensure that all potential sources of errors have been ruled out at the prototype stage of the design thinking approach of the textile production process. Also, based on client feedback, the enterprises assess and either approve, enhance, re-examine or reject the product completely, considering the product's limitations and the difficulties present in the prototype. On the final products, textile companies ensure that finished products are tested using the best solutions throughout the testing stage of the design innovation process and that challenges are continually redefined to inform consumers' understanding of the problem. Knight et al. (2020), Maistry et al. (2017), Camisón and Puig-Denia (2016), and dos santos Ferreira (2014) recognized the importance of finding innovative approaches through continuous improvements in processes as a pathway to innovation. The study will therefore help the SMTEs in Ghana to continuously strive to improve and develop new products for customer satisfaction. It is therefore encouraging to note that the approach adopted by the SMTEs towards design innovation in their operations is supported by the work of Brown (2008) who in a study explained that design thinking is a human-centered approach to innovation that draws from a designer's toolkit to integrate people's desires, the potentials of technology, and the need for business success.

Conclusion

Relative to the operations of SMTEs, it is concluded that a wide range of concepts is gathered and analyzed to define the core problems that have been identified and defined in a human-centered manner, including features and functions. The study established that the products produced by SMTEs are influenced by the desires of customers as a result of constant interaction. SMTEs employ various strategies to find solutions e.g. before final products are made, prototypes are built to ensure that all potential sources of errors have been ruled out. Notwithstanding the utilization of the design thinking approach by SMTEs in Ghana, they must continuously interact with customers to address their needs and concerns. Textile enterprises must continuously strive for innovative and creative solutions and develop innovative ways to handle problems to fulfil client needs.

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