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IMPACT OF TECHNOLOGICAL CAPABILITIES, DESIGN INNOVATION, AND OPERATIONS ON THE PERFORMANCE OF SMALL AND MEDIUM TEXTILE ENTERPRISES IN GHANA

Isaac Abraham [(a)1] *Christiana Konamah Okai-Mensah* [(b)] *Ebenezer Kofi Howard* [(c)] *Benjamin Kwablah Asinyo* [(d)]

[(a)] *Lecturer, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Ghana; E-mail: iabraham@aamusted.edu.gh*
[(b)] *Lecturer, Accra Technical University, Ghana; E-mail: cokai-mensah@atu.edu.gh*
[(c)] *Professor, Kwame Nkrumah University of Science and Technology, Ghana; E-mail: billhowardgh@yahoo.com*
[(d)] *Professor, Kwame Nkrumah University of Science and Technology, Ghana; E-mail: asinyo.cass@knust.edu.gh*

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ABSTRACT

Many developing countries, especially those in sub-Saharan Africa, struggle with design innovation as a result of a lack of infrastructure, skilled labour, and financial constraint, hindering their ability to compete in the global economy. The study investigates the effect of technological capabilities, design innovation, and operations on the performance of Small and Medium Textile Enterprises (SMTEs) in Ghana filling the knowledge gap and contributing to economic development in the region. A quantitative approach was employed, and data were obtained from 80 SMTEs using a self-administered questionnaire. The results show that there is a significant correlation between technological capabilities and the performance of SMTEs, indicating that current technologies are making textile companies more productive and efficient, resulting in improved performance. The study also found that technological capabilities positively influence design innovation practices, which, in turn, positively relate to the performance of the enterprise. Moreover, there is a positive relationship between the technological capabilities and operations of the enterprises. The findings of the study are consistent with previous research and suggest that enterprises that invest in the appropriate technology can improve their design innovation, operations, and overall performance. The study recommends that SMTEs in Ghana must invest in technological capabilities that are suitable for their business needs to improve their operations, design innovation, and overall performance. Additionally, policymakers should provide adequate support to SMTEs to enhance their technological capabilities, design innovation, and operations through funding, training, and infrastructure development.

INTRODUCTION

Studies on technological capabilities, design innovation, and operations of Small and Medium Textile Enterprises (SMTEs) in Ghana is a critical area that has received limited attention. Technological innovation has revolutionized economic sectors in the 21st century, leading to increased productivity and profitability for enterprises, which ultimately contributes to economic development (Diaconu, 2011). Design innovation is critical to this process as it drives creativity and inventions, resulting in new or modified products and processes that enhance productivity and profitability (Ulhøi & Gattiker, 2000).

However, many developing countries, including those in sub-Saharan Africa, face challenges in understanding design innovation and lack the necessary infrastructure, skilled labour, and financial resources needed to support it, hindering their competitiveness in the global economy (WIPO, 2020). In Ghana, the role of SMTEs is important in the country's economic development, but limited knowledge exists about the effect of design innovation, technological capabilities and operations on their performance. The aim of this study is to fill this knowledge gap by investigating the impact of technological capabilities, design innovation and operations on SMTEs performance in Ghana.

The research employed a quantitative approach and a questionnaire was used to collect data from 80 SMTEs using. The study was grounded on three core theories, viz. the Technology Acceptance Model (TAM), the Resource-Based View (RBV) of the firm, and the Dynamic Capabilities (DC). Based on the theoretical review, a conceptual framework

[1]*Corresponding author: ORCID ID: 0000-0002-9350-5459*

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representing the nexus between technological capabilities, design innovation, and operations on the performance of SMTEs was designed. The study findings will contribute to economic development in Ghana by establishing the influence of design innovation, technological capabilities, and operations on the performance of SMTEs.

To provide a clear understanding, this study is organized into different sections: Section two (2) reviewed relevant literature, encompassing theoretical review and conceptual framework. This review critically examines previous research and theories related to the topic, establishing a foundation for the study. It explores the existing knowledge gap and identifies the need to investigate the link between technological capabilities, design innovation, operations, and SMTEs performance. Section three (3) outlines the methodology employed. It describes the sample selection procedure, highlighting the rationale behind the chosen sample size and the process of data collection. This section also elaborates on the questionnaire used for data collection. The findings and discussions are presented in section four (4). The discussions provide insightful interpretations of the results, considering the theoretical framework and previous literature, and shed light on the implications for SMTEs and their contribution to economic development. Finally, section five (5) presents the conclusion of the study, incorporating key findings and their significance. Additionally, this section provides recommendations based on the study's outcomes.

LITERATURE REVIEW

Innovation refers to the process of creating or producing a novel product (Carlgren, 2013). Innovation can also refer to the invention of a new concept or the refinement of an already existing one. Technology advancement is fuelled by innovative ideas. Ulhøi and Gattiker (2000) pointed out that, the development of technology can be understood as a form of social construction that can be institutionalised. They tend to become paradigms once they become established over development for some time (Ulhøi & Gattiker, 2000). Chen et al. (2018) refer to technological innovation as a means by which businesses introduce new ideas to facilitate the operations of the enterprise.

Empirical studies such as Singh (2019), Wu and Atkinson (2017) and Wang (2007), among others, have established that design and technological inventions in small to medium businesses can result in high economic performance. Taneja et al. (2016), for instance, specified that worldwide, SMEs have a substantial impact on economic development, creating opportunities for employment and technological advancement. Thus, SMEs have become the economic bedrock for several countries because they provide employment and contribute to general economic growth.

Wu and Atkinson (2017) also detailed how technology-based start-ups have long been vital drivers of American economic growth and competitiveness. According to the authors, these businesses provide enormous contributions to employment, innovation, exports, and productivity growth. In West Africa, Oluwaseun et al. (2016) discovered that process and product innovation, which signify technological innovation, were significant in driving SMEs, and suggested that SMEs must incessantly engage in technological innovations to advance their productivity, which will eventually, increase their contribution to GDP.

The current study was grounded on three (3) core theories, viz. the Technology Acceptance Model (TAM), the Resource-Based View (RBV) of the firm, as well as the Dynamic Capabilities (DC) Theory. TAM suggests that when people are introduced to novel technology, their decision regarding its use is influenced by several factors. The TAM hypothesizes that a user's behavioural intention to use technology is informed by perceived usefulness and ease of use (Davis, 1989).

Usefulness was shown to be more strongly associated with adoption than ease of use when Davis (1989) evaluated the correlations between use and usefulness as well as ease of use-usage and usefulness. According to Davis' findings, the use of novel technology is influenced by the perception of the technology's usefulness. As a result of their influence on user behaviour, it is essential to acknowledge user beliefs in any system or technology adoption.

The RBV, is a managerial framework employed to establish the strategic resources a business can exploit to accomplish a sustainable competitive edge. A study on 'firm resources and sustained competitive advantage' has extensively been credited as pivotal in the advent of the RBV (Barney, 1991). Thus, the core assumption of RBV research on innovation is that its resources and capabilities determine a business's capacity for innovation. There are several vital resources, both tangible and intangible, that are crucial in generating innovative outputs by applying specific capabilities which could then be transmuted to a competitive edge for the enterprise in this case, the SMTEs.

The RBV has been employed in numerous management research and has undergone critical assessment and scrutiny regarding its contribution to business development (Ferreira et al., 2016; Barney et al., 2001). RBV was advanced to complement the industrial organization concept, which concentrated on the structure-conduct-performance (Bertram, 2016) paradigm. Originally, the determinants of business performance were taken from the industry's structure, which was external to the company. Nevertheless, RBV explored the internal sources of sustained competitive edge of an enterprise and elucidated the probable motives for the distinction in the performance of the companies from the same sector.

Another noteworthy theory that has significantly contributed to the study of business strategy is the Dynamic Capability (DC) Theory. The DC were introduced as an extension to and a reaction against RBV for not construing the redevelopment and advancement of resources to address rapidly growing businesses (Bleady et al., 2018). Dynamic Capability is, thus, viewed as a source of competitive edge. DC enables firms to marshal, integrate and reorganise resources in order to adjust to new business opportunity (Teece, 2018).

Notwithstanding there is a wealth of studies that have focused on the notion of TAM, RBV and DC of firms, to advance the concept of the theories further, it is necessary to additionally prove the concepts associated with the theory and how to connect them with empirical practices within the Small and Medium Textile Enterprises in Ghana as these enterprises need to have dynamic capabilities to address the rapidly changing business settings.

Conceptual Framework

Having enumerated the theoretical framework underlying the study, this section presents the resulting conceptual framework as a basis for the data collection and analysis. The conceptual framework shows the relationship between dependent and independent variables.

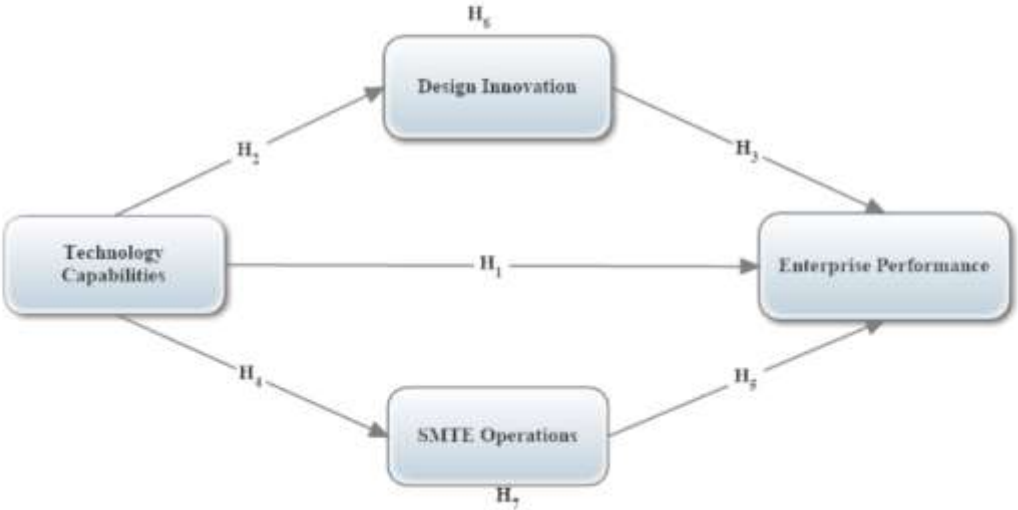

Figure 1

Conceptual Framework
Source: Researcher's Construct

Nexus between Technological Capabilities and Firm Performance

Schumpeter's (1934) theory of the link between technical progress and economic development forms the basis for economic growth through innovation. This research assumes a positive relationship between technological capability and firm performance, with evidence from studies in advanced countries (Hastuti et al., 2021. However, in low and medium-low-tech industries, investing in technological capability alone may not be enough to achieve performance (Carpio-Gallegos & Miralles, 2019). Accumulating resources and competencies and emphasizing the learning process can lead to innovation (Lee et al., 2020; Huda et al., 2019). Technological capability is crucial for advancing competitive edge, and a study by Salisu and Bakar (2020), confirm this relationship. Finally, this study hypothesizes that there is a positive relationship between technological capability and firm performance in the developing economy of Ghana. Consequently, it is hypothesized as follows:

H_1 *Technological Capabilities of SMTEs positively relate to Enterprise Performance*

Relationship between Technological Capabilities and Design Innovation

To survive, businesses must shift to changing business structures and respond to technological advancements through innovation. As a result, Wang (2007) proposed that businesses should adapt their current resources to rapidly changing business conditions. Technological capabilities are necessary for enterprises in adapting to changes in market and gaining a competitive advantage. More so, technological capabilities are also an important factor in determining the innovativeness of an enterprise.

Technological Capabilities for innovation are critical dynamic capabilities (Lahovnik & Breznik, 2013) that must be harnessed to improve performance. Technological capabilities enable firms to develop novel products and facilitate the development of innovative solutions (Burgelman, 1996). Also, they boost a company's technological inventions and business output (Yam et al., 2010). Firms can gain a competitive advantage through innovation if they improve their technological capabilities (Yam et al., 2010). As a result, the relationship was hypothesized as:

H_2 *Technological capabilities of SMTEs positively influence their design innovation.*

Relationship between Design Innovation and Enterprise Performance

Montresor and Vezzani (2017) discussed the influence of design on performance of business, indicating that investments in design can enhance a business's competitiveness through quality and non-price competition, and significantly improve innovation capacity. They argue that design investments can give businesses the capabilities for inventing new product. The authors suggest that innovations are generally design-led, but effective innovation requires the business to make design a central driver.

Studies have also shown that design-driven and design-led innovations positively influence business performance (Moultrie & Livesey, 2014), and companies that adopt design-based innovative strategies can increase revenue (Design Council, 2015). Accordingly, this relationship is hypothesized as:

H_3 *Design innovation practices of SMTEs positively relate to the performance of the enterprise.*

Relationship between Technological Capabilities and SMTE Operations

Technology enhances production efficiency and helps businesses survive negative shocks, leading to business longevity. In developing economies like Ghana, SMEs play a vital role, but their technological capabilities are still developing. Improving critical success factors and adapting to changing environments have the greatest impact on SMEs' operational performance.

Technological and relational capabilities correlate with SME success. Technological skills influence SMEs' financial and operational performance, and contextual factors moderate this relationship. Non-technological innovation does not significantly impact firm performance. These findings are based on research by various authors (Hofacker et al., 2020; Salisu & Bakar, 2020; Ali et al., 2020). On the basis of the above, the researcher proposes the ensuing Hypothesis:

H_4 *Technological capabilities positively influence the Operations of SMTEs*

Relationship between SMTE Operations and Enterprise Performance

For a business to generate outputs, predetermined actions must be carried out to enhance the value of primary or intermediate inputs (Bayraktar et al., 2009). Operations design, execution, and supervision are critical inputs into the production process (Lee et al., 2020). The inputs, design, implementation, and supervision of the manufacturing process determines the quality of result (Kumar & Suresh, 2009). Operations management must be ingrained in a firm's strategy to establish a competitive edge (Lee et al., 2020).

Operations management strategies, such as production schedules and quality control procedures, enable a company to enhance its competitive edge and boost enterprise performance (Kotlar et al., 2018; Chae et al., 2014). The functional synergy between appropriate operations management strategies can sustain business growth and profitability (Rajapathirana & Hui, 2018).

Innovative product development, just-in-time delivery, and quality-management activities contribute to the creation of a firm's operations capability, which has a direct and beneficial impact on company performance (Tan et al., 2007). Strategic innovation and innovative operation strategies mediate operational and market performance outcomes for manufacturing SMEs (Aghajari & Senin, 2014). Hence, the following hypothesis is proposed:

H_5 *SMTEs Operational Practices positively influence the performance of textile enterprises in Ghana*

The mediating role of Design Innovation and Operational Practices

According to Al-Ansari et al. (2013) innovation can mediate the relationship between technology and performance. However, the mediating impact of design innovation and operational practices on this relationship has not been tested. To investigate this, the study tested the role of design innovation and operational practices as mediators.

The conclusion is that technology has a positive impact on business performance by generating design innovation and improving enterprise operations (Hortinha et al., 2011). The study proposed the following hypothesis:

H_6 *Design innovation fully mediates the relationship between technological capabilities and enterprise performance.*
H_7 *SMTE Operations fully mediate the relationship between technological capabilities and enterprise performance.*

MATERIALS AND METHODS

Exploratory research design was adapted to know the effect of technological capabilities, design innovation and operations on the performance of SMTEs in Ghana. To Swedberg (2020), exploratory research refers to a study done to learn more about a phenomenon, find new ideas, or gain new insights. An exploratory design was employed in this study because of the need to discover more on the technological influences and operations on SMTEs in Ghana.

The study's population included all textile manufacturers located in the selected regions. The study focused on Four (4) regions. The regions have 99 SMTEs with a total population of 870 workforce as shown in Table 1.

Table 1. SMTEs in the four regions

SELECTED REGIONS	Number of SMTEs	Total Workforce
Greater Accra	38	316
Ashanti	25	213
Northern	20	161
Western	16	180
Total	**99**	**870**

Determination of the Sample Size

Yamane's formula was used in determining the sample size.

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

Sample size: $n=\frac{870}{(1+870(.05^2))}$ n = 274 = 275 app.

10% non-response rate was added to make it 302.5. The sample size was approximated to 300. Eighty (80) SMTEs from the ninety-nine (99) were selected using the same formula. The study employed multi-stage sampling techniques which includes purposive sampling, stratified sampling and convenient sampling. Determination of sample size in the regions are displayed in table 2.

Table 2. Determining the SMTEs in the four Regions

Selected Regions	Number of SMTEs	Total workforce	Sampled SMTEs	Sampled Workforce
Greater Accra	38	316	31	109
Ashanti	25	213	20	73
Northern	20	161	16	56
Western	16	180	13	62
Total workforce	**99**	**870**	**80**	**300**

Table 2 presents an overview of the sampling plan for both SMTEs selected for the study as well as the number of workers to be selected from each region. The table shows the total number of SMTEs (80) selected from the regions whereas a total of 300 workers were surveyed from the 80 SMTEs. The SMTEs in each region were conveniently selected and visited till the number determined for the region was reached. The workers were purposively selected. Self-administered questionnaire was used in data collection.

RESULTS

The data analysis findings were showcased through measurement model tables, incorporating EFA and CFA alongside other elements. Structural Equation Modeling (SEM) in AMOS was employed to test the hypothesis in the inferential statistics. Using SEM is critical when the model under consideration has one outcome variable and several latent variables based on many indications. Mediation was examined using the Preacher and Hayes bootstrapping procedure. A total of 273 questionnaires were deemed valid for additional analysis out of the 300.

Inferential Statistics: Exploratory Factor Analysis (EFA) on Datasets

The datasets for factor analysis, was subjected to data screening processes, including testing for unengaged replies, skewness, and kurtosis. Following the completion of the initial screening tests, 47 items were produced and employed as latent measures of the conceptual constructs. These were factored using SPSS version 26's Principal Component Analysis extraction procedure. Several coefficients of 0.6 and higher were discovered when the correlation matrix was examined. The Kaiser Meyer-Olkin (KMO) value was 0.868, which was higher than the suggested value of 0.6 (Kaiser, 1974), and Bartlett's Test of Sphericity was statistically significant at p=0.00 (Bartlett, 1954), indicating that the correlation matrix was factorable. In Table 3, the results of the KMO and Bartlett's Test are shown.

Table 3. KMO and Bartlett's Test

KMO Measure of Sampling Adequacy.		.930
Bartlett's Test of Sphericity	Approx. Chi-Square	17397.036
	Df	595
	Sig.	.000

Table 3 displays the outcomes of the KMO Test and Bartlett's Test. The KMO value can range from 0 to 1. A value of 0 indicates that the sum of partial correlations is approximately equal to the sum of correlations, suggesting that the correlation pattern has spread out, rendering Factor Analysis unsuitable. Conversely, a value close to 1 indicates a tight correlation pattern, indicating that Factor Analysis can yield distinct and reliable factors. According to Kaiser (1974), values above 0.6 are considered good and acceptable, while values below 0.6 warrant either obtaining more data or reevaluating the choice of variables.

In this study, the KMO value was 0.930, exceeding threshold of 0.6 as suggested by Kaiser (1974). Additionally, Bartlett's Test of Sphericity yielded a significant result with a p-value of 0.00 (Bartlett, 1954), indicating that the correlation matrix was suitable for factorization.

Table 4. Analysis of eigenvalues to determine the total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Tot.	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	11.662	37.619	37.619	11.662	37.619	37.619	8.598	27.735	27.735
2	6.184	19.949	57.568	6.184	19.949	57.568	5.956	19.213	46.949
3	3.361	10.843	68.411	3.361	10.843	68.411	5.636	18.182	65.131
4	2.507	8.087	76.498	2.507	8.087	76.498	3.524	11.368	76.498
5	.864	2.788	79.286						
6	.687	2.216	81.502						
7	.569	1.835	83.337						
8	.530	1.711	85.048						
9	.477	1.538	86.586						
10	.448	1.444	88.031						

11	.373	1.202	89.233						
12	.366	1.180	90.413						
13	.328	1.059	91.472						
14	.298	.961	92.433						
15	.268	.866	93.299						
16	.247	.797	94.096						
17	.222	.716	94.812						
18	.194	.625	95.438						
19	.180	.581	96.018						
20	.168	.543	96.561						
21	.157	.507	97.068						
22	.141	.455	97.523						
23	.130	.419	97.942						
24	.120	.387	98.329						
25	.105	.340	98.669						
26	.095	.305	98.974						
27	.089	.287	99.261						
28	.076	.244	99.505						
29	.066	.214	99.719						
30	.051	.166	99.885						
31	.036	.115	100.000						

Table 4 indicates the eigenvalues and percentage of data variation explained by each of the 31 factors that could explain the correlations between the variables under consideration. Only four of the 31 factors have eeigenvaluesgreater than one. By itself, the first of these has an eigenvalue of 37.6% of the variation in the data. Together, the four variables account for 76.5% of the variation. This indicates that the number of underlying factors for the data cannot exceed four. The first factor has a disproportionately large impact, as shown in the graph. The diagram's "elbow" occurs at the third factor, as shown in Figure 2.

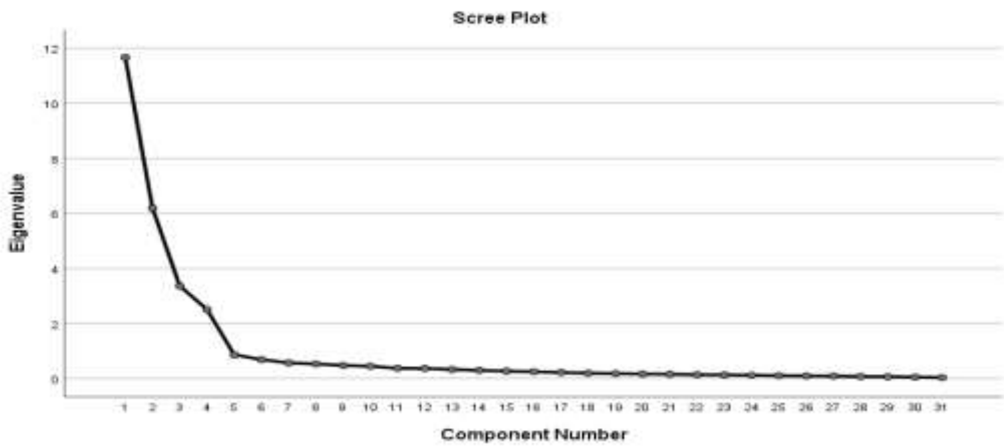

Figure 2. Screen Plot of underlying components

Table 5. Rotated Component Matrix

Code	Item	Factor			
		1	2	3	4
OPIG2	We improve or modify old designs for our customers.		.943		
OPIG3	Our designs are inspired by things we see in the environment.		.942		
OPIG4	Our designs are inspired by images and stories from the World wide web.		.925		
OPIG5	Our designs are inspired by images and stories from social media.		.771		
OPIG6	The inspiration for our designs is derived from images and narratives found in books, journals, and magazines		.869		
OPSW1	We use Embroidery Software Suit.		.943		
OPSW2	We use CorelDraw and Adobe Photoshop for creating designs.		.918		
OPPM1	We undertake manual screen printing		.919		
OPPM2	We use Semi-automated screen printing in our firm		.934		
TC1	We play a significant role in setting technology standards for textiles.			.858	
TC2	We have robust technological processes in our textile operations.			.804	
TC3	We regularly offer on-the-job training to enhance the technical skills of our employees.			.800	
TC4	Our machines and equipment are upgraded frequently to meet customers' needs.			.854	
TC6	We are competent in using innovative problem-solving technology in the textile industry			.847	
TC7	We possess the capability to attract and recruit skilled professionals to join our operations.			.848	
TC8	We make sufficient investments in R&D activities			.824	
TC9	We possess a robust ability to merge external technological resources with our internal resources within the enterprise.			.860	
DIE4	We consider customers in developing new products.	.696			

DIE5	We observe and gain insights from user interactions with our products, utilizing those experiences as a learning opportunity.	.726			
DD1	We closely monitor and analyze user interactions with our products, utilizing these experiences as valuable opportunities for learning and improvement.	.887			
DD2	We carefully examine the collected information in order to define identified the problem.	.870			
DD3	We analyse the observations and synthesise them to define the problems that have been identified by the team.	.873			
DI1	We actively seek innovative and unconventional problem-solving approaches to meet our customers' diverse needs.	.861			
DI2	We find novel solutions to problems	.878			
DI3	We explore alternative methods of observing and understanding the problems at hand.	.894			
DI4	We employ multiple techniques to address and innovate our problem-solving approaches.	.884			
DP1	We are aware of the inherent limitations of our product.	.796			
DP2	We have an idea of how customers react to our final product.	.827			
PEFP3	Our firm has grown consistently for the last 3 years.				.679
PEFP4	Our competitive position in the industry has seen consistent growth.				.854
PSP1	Network with other SMTEs to exchange ideas.				.756
PSP2	Make donations to schools and other organisations as part of our corporate social responsibility				.716
PSP3	We train free apprentices within the community				.694
PSP4	We take into account the local community's interest in decision making				.846
PSP5	We are concerned about the development of the community				.799

A varimax rotation was used to determine which variables loaded on which factors in order to better understand the four extracted factors. Pallant (2020) found a basic structure in the rotation solution, with solid loadings on all variables and significant loading on only one of the four elements. As a result, variables that did not meet the predetermined criteria were left out of the final analysis. In total, 34 entries were eliminated from consideration.

Measurement Model Analysis

The measurement models of the study were tested using CFA in AMOS version 24. This was done to help the researcher figure out the link between the observed measurements and their main concept. In evaluating the model, the researcher used a multi-criteria approach. The average variance, inter-variable correlations, Cronbach alpha, composite reliabilities, and inter-variable correlations were all extracted. As a result, the items of each construct had discriminant and convergent validity. This was done to ensure the validity and reliability of the study's findings and the robustness of the analysis procedure.

Construct reliability

Internal reliabilities of the identified constructs were evaluated. The reliability of a scale determines its internal consistency, which indicates how free it is from random errors. Therefore, to ensure that the individual items within a factor effectively measure the same construct, Pallant (2020) suggests evaluating the reliability of scales employed in data analysis. Cronbach's alpha (ɑ) coefficient is commonly used to assess internal consistency. This study utilised Cronbach's alpha coefficient to verify the reliability of the four factors derived from the exploratory factor analysis (EFA). The Cronbach's alpha (ɑ) coefficient, according to Krabbe et al. (2017), should be greater than 0.7 to be considered credible. Tabachnick et al. (2007) advised that the item-to-item correlation should be set at a minimum threshold of 0.3 for assessing the significance of variables loading onto factors.

Table 6. Reliability Scores for Factors Loaded

Item	Variables	Loading	Variance Explained	Cronbach's alpha	Item-total correlation	alpha if the item is deleted
Factor 1	DI3	.894	37.619	0.964	.879	.959
	DD1	.887			.877	.959
	DI4	.884			.870	.960
	DI2	.878			.870	.960
	DD3	.873			.857	.960
	DD2	.870			.858	.960
	DI1	.861			.833	.961
	DP2	.827			.813	.961
	DP1	.796			.781	.962
	DIE5	.726			.740	.964
	DIE4	.696			.727	.964
Factor 2	OPIG2	.943	19.949	0.978	.944	.974
	OPIG3	.942			.942	.974
	OPIG4	.925			.928	.975
	OPIG5	.771			.752	.981
	OPIG6	.869			.853	.978
	OPSW1	.943			.939	.974
	OPSW2	.918			.915	.975
	OPPM1	.919			.915	.975
	OPPM2	.934			.933	.975

Factor 3	TC1	.858	10.843	0.962	.896	.955
	TC2	.804			.843	.958
	TC3	.800			.855	.957
	TC4	.854			.856	.957
	TC6	.847			.844	.958
	TC7	.848			.884	.955
	TC8	.824			.846	.958
	TC9	.860			.810	.960

Table 6 presents the internal consistency measures, along with the measurement characteristics obtained from the Principal Component Analysis and Varimax rotation of the selected variables after the exploratory factor analysis (EFA). These measures include Cronbach's alpha (α), item-total correlation, and the alpha value if an item is eliminated.

During the EFA, the researcher took into consideration the theoretical justification while choosing the final set of measuring items for further analysis. Consequently, the final scales utilized for measuring SMTE Operations, Technological Capabilities, Design Innovation, and Enterprise Performance are reported, along with their factor loadings, explained variances, and internal consistency as assessed by Cronbach's alpha (α), item-total correlation, and the alpha value if an item is excluded.

Structural Equation Modelling and Testing of Hypothesis

The researcher employed structural equation modelling (SEM) to assess the hypothesis put forth in the study model. In conducting the SEM analysis, Anderson and Gerbing's (1988) two-stage technique was utilized. This approach was chosen as it enabled the researcher to examine the causal relationship between observed variables and the underlying theoretical constructs during the measurement stage.

Measurement Stage

The Confirmatory Factor Analysis was done to see if the data gathered was in line with the study model that had been established previously. The overall fit of the measurement model, which included four factors and 35 observations, was examined using CFA. As all the standardized parameter estimates for the variables were found to be statistically significant at a significance level of p=0.001, it was evident that the first measurement model required specification. This conclusion was drawn based on the fit indices, which indicated that certain indices did not meet the acceptable thresholds of acceptability.

Convergent Validity

To assess the convergent validity of this study, commonly used fit indices recommended by empirical studies were employed. These fit indices included the Chi-Square to Degrees of Freedom Ratio (2/df), Root-Mean-Square Error of Approximation (RMSEA), Goodness-of-Fit Index (GFI), Incremental Fit Index (IFI), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) (Hair et al., 2014). The variables of Design Innovation, SMTE Operations, Enterprise Performance, and Technological Capabilities were all examined.

In order to improve the model fit, adjustments were made based on the fit indices, as indicated in Table 7. The initial level analysis provided model modification indices, which guided the removal of redundant items from selected variables. As a result, 18 items were eliminated prior to further analysis.

Table 7. Fit Indices for the measurement model

Fit Indices	Criteria	Initial Level	Adjusted
$\chi 2/df$	≤ 2 or 3	5.683	2.925
GFI	≤ 0.9	0.622	.915
IF	≥ 0.95	0.852	.970
TLI	≥ 0.95	0.841	.963
CFI	≥ 0.95	0.852	.970
RMSEA	≤ 0.06 to 0.08	0.110	.070

CFA was conducted again following the removals, but without the 18 items removed. The individual fit indices met the required criteria for acceptance, as outlined by Schreiber (2008). The results showed a chi-square value of 330.556 with 113 degrees of freedom and a significant p-value of 0.000. The ratio of chi-square to degrees of freedom was 2.925, indicating an acceptable fit. Additionally, the Comparative Fit Index (CFI) was 0.970, the Incremental Fit Index (IFI) was 0.970, and the Tucker-Lewis Index (TLI) was 0.963, all of which exceeded the acceptable threshold. The Root Mean Square Error Approximation (RMSEA) value was 0.070, and the Goodness of Fit Index (GFI) was 0.915, both indicating a reasonable fit to the data (Table 7). While chi-square is influenced by sample size, the satisfactory values of the remaining fit indices suggest that the model adequately fits the data, as noted by Hair et al. (2010). Therefore, no further adjustments to the model were deemed necessary.

Furthermore, to satisfy convergent validity, the literature is suggestive that GFI and CFI are always more than 0.9 (Perry et al., 2015). Another criterion assessment includes the RMSEA, which is also expected not to be less than 0.08. Another model fit indicator, the normed Chi-Square, is typically anticipated to be below 5, with a p-value greater than 0.05, as stated by Hair et al. (2014). In this study, the results indicate that all the model fit indices surpassed the acceptable thresholds, confirming the satisfactory fit of the measurement model. These findings provide evidence of convergent validity. Therefore, the measurement models are deemed suitable for further statistical analysis. Figure 3 displays the finalized measurement model.

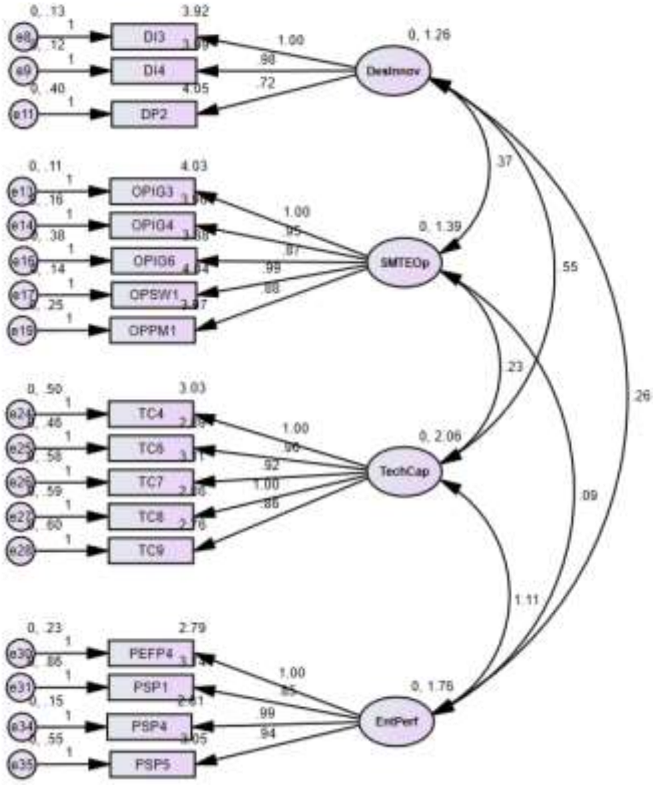

Figure 3. Final CFA Measurement Model

Table 8. Confirmatory Factor Analysis

Item	Variables	Loading	t-value	CR	AVE	α
Design Innovation	DI3	.89***	Fixed	.928	.813	.925
	DI4	.88***	35.139			
	DP2	.82***	22.401			
SMTE Operations	OPIG3	.92***	Fixed	.967	.853	.972
	OPIG4	.86***	42.053			
	OPIG6	.94***	29.073			
	OPSW1	.94***	44.964			
	OPPM1	.91***	34.397			
Technology Capability	TC4	.85***	Fixed	.944	.771	.944
	TC6	.84***	26.913			
	TC7	.84***	24.868			
	TC8	.82***	25.820			
	TC9	.86***	23.626			
Enterprise Performance	PEFP4	.85***	Fixed	.935	.784	.933
	PSP1	.75***	21.289			
	PSP4	.84***	38.022			
	PSP5	.79***	27.270			

Table 8 presents the standardized regression weights for the four constructs examined in the study: SMTE Operations, Design Innovation, Technological Capabilities, and Enterprise Performance. Design Empathy, Design Ideation, and Prototype are the three items that indicate Design Innovation. These three predictor variable indicators were all 99.9% significant. Furthermore, the findings show that SMTE Operations were evaluated as an influencing variable in this study using three indicators: Idea Generation, Software Application, and Marketing/Advertising. Again, these three indicators had 99.9% significant regression weights. This was followed by the Technological Capabilities, represented by five indicators, all of which had significant regression weights of 99.9%. Finally, Enterprise Performance, which served as the outcome variable, was evaluated using two indicators: Financial and Social performance items. Items from two indicators achieved significant regression weights at a similar rate of 99.9%.

The constructs were computed using the items with high factor loadings and passed the model fit indices. The variables were converted into composite variables using IBM's SPSS variable computation feature for further analysis and hypothesis testing.

Table 9. Discriminant Validity

Variables	1	2	3	4
DesInnov	**.902**			
SMTEOp	.279***	**.924**		
TechCap	.339***	.135*	**.878**	
EntPerf	.175**	.059	.581	**.886**

To assess the discriminant validity of the study instrument, the AVEs were compared to the shared inter-construct correlation of the four identified constructs underlying the study. The four constructs were derived from the items that demonstrated high loadings. According to Hair et al. (2014), discriminant validity is established when the average variance extracted (AVE) score for each construct is significantly greater than the correlation between that construct and other constructs. The inter-construct correlations among the variables in this study can be found in Table 9. These coefficients were then compared to the AVE scores, depicted diagonally in Table 9. As can be seen, all of the AVEs are greater than the shared variance for each construct; thus, discriminant validity is justified in this study. Therefore, it can be accepted if the AVE is less than 0.5 but the composite reliability is greater than 0.6 (Fornell & Larcker, 1981). Table 4.23 shows that the constructs were found to be discriminantly valid.

Hypothesis Testing

AMOS's SEM was used to assess the study's hypotheses. The application of SEM enabled a more thorough evaluation of the measurement model and path linkages. Using SEM is critical when the model under consideration has one outcome variable and several latent variables based on many indications. The results of the structural equation analysis are shown in Table 10.

Table 10. Structural Equation Results

Relationships	Beta	T - values	P values
Technological Capabilities → Enterprise Performance	.538	12.074	.000
Technological Capabilities → Design Innovation	.305	6.307	.000
Design Innovation → Enterprise Performance	.040	.901	.365
Technological Capability → SMTE Operation	.137	2.729	.006
SMTE Operation → Enterprise Performance	.049	1.143	.253

Hypothesis Six and Seven

Table 11 simplifies the explanation of the results of the mediation effects. In testing the mediation effect of design innovation and Operational Practices, the researcher followed the procedure used by Preacher and Hayes (2008). This approach indicates that bootstrapping, which involves resampling from the sampling distribution, offers greater statistical power in estimating the indirect effect compared to alternative procedures such as the Sobel test.

Following this procedure, the number of bootstrap samples for percentile bootstrap confidence intervals was set at 5000 at a 95% confidence interval level. In order to establish full mediation in the study, it is necessary for the direct effect of X on Y to diminish nearly completely after introducing the indirect path (M). Conversely, partial mediation occurs when both the direct path between X and Y and the indirect path is statistically significant. However, no mediation will exist when the indirect path proves not to be significant compared to the direct path after the introduction of the mediators (Abu-Bader & Jones, 2021).

Table 11. Analysis of Mediating Effects

Mediator Relationship	Direct Effect	Indirect Effect	Lower CI	Upper CI
Technological Capabilities → Design Innovation → Enterprise Performance	.4197	.0161	.3520	.4874
Technological Capabilities → SMTE Oper. → Enterprise Performance	.4260	.0080	.3609	.4910

DISCUSSIONS

Hypothesis One (1)

Table 10 displays the results indicating a significant and positive correlation between technological capabilities and the performance of small and medium-sized textile enterprises (β=.538, t=12.074, $p<0.01$). This finding supports the hypothesis that there is a positive association between technological capabilities and enterprise performance.

The results align with previous research, such as the study conducted by Wang (2007), which also observed a positive relationship between technological capabilities and firm performance. However, Camison and Villar-Lopez (2014) found that both technological capabilities and organizational innovation can lead to superior firm performance. Overall, the study concludes that the current technologies used by textile companies are making them more productive and efficient, resulting in improved performance.

Hypothesis Two (2)
The results of the study in Table 10 indicate that the technological capabilities of textile enterprises have a positive impact on their design innovation practices (β = .305, t=6.307, p < 1%), and this has enabled them to solve product-related problems. The findings support hypothesis 2, which stated that the technological capabilities of textile enterprises positively influence their design innovation.

The study's results align with the literature, which suggests that technological capabilities are an essential determinant of an enterprise's innovativeness, and they facilitate the development of new products and innovative strategies (Burgelman, 1996).

Hypothesis Three (3)
Table 10 presents the results depicting the relationship between design innovation and enterprise performance. The analysis revealed a statistically significant relationship between these two variables (β = .040, t=.901, p=.365). The findings indicate that the extent to which textile-producing enterprises engage customers in problem-solving related to their products significantly influences their performance. This helps to create a very productive channel of information between the enterprise and customers, allowing the enterprises to know what customers' needs are exactly. This finding also provides enough evidence to support hypothesis 3, which indicates that design innovation practices of textile enterprises positively relate to the performance of the enterprise.

As indicated in the literature, this finding is consistent with Moultrie and Livesey (2014) who discovered that design-driven and design-led innovations positively affect the economic performance of businesses. Not only does design innovation influence innovative strategies, as noted by the Design Council (2015), but also significantly impacts product development and firm performance. The results imply that should enterprises make the right investments in the appropriate technology; it would improve their design innovation and impact positively on the enterprise performance.

Hypothesis Four (4)
Additionally, the results in Table 10 Shows that there is a significant and positive relationship between the technological capabilities and the operations of the enterprises (β =.137, t=2.729, p < 5%). The results imply that the technologies the enterprises have adopted have positively impacted their operations. That is suggestive that with the technologies adopted, their processes have become efficient and effective, thereby positively impacting their operations. Thus, hypothesis 4 is likewise supported. Therefore, hypothesis 4 theorised that the technological capabilities of SMTEs positively influence their processes.

The study examined the association between technological capabilities and the operations of textile enterprises. The findings reveal a statistically significant positive relationship between technological capabilities and the operational aspects of the enterprises. This finding aligns with the research conducted by Raymond (2005), who investigated the impact of operations management and advanced manufacturing technologies on small and medium-sized enterprises (SMEs). Raymond's study found that improved critical success factors and the adoption of advanced manufacturing technologies directly influenced operational performance, leading to increased productivity and cost reduction. Similar conclusions were reached by Salisu and Bakar (2020), who examined the relationship between technological capability, relational capability, and the performance of SMEs in Africa.

Hypothesis Five (5)
In the same vein, it could be seen from Table 10 that the operations of the enterprises also attained a positive relationship with the enterprise performance (β =.049, t=1.143, p=.253). The results point to the direction that technologically impacted operations of small-scale enterprises have had a positive impact on the textile business performance; with the efficiency created by technological adoption in the operations of the enterprises, the enterprises can increase their profitability. Given this, Hypothesis 5 theorises that textile enterprises' operations practices positively impact the enterprise's performance.

Literature support is evident in this regard as Rajapathirana and Hui (2018) observed that appropriate functional synergy between operational practices could sustain business growth and profitability; even large companies operating in hostile settings must use this synergy to sustain their growth. Furthermore, Tan et al. (2007) also confirmed a positive correlation between firms' operations and business performance

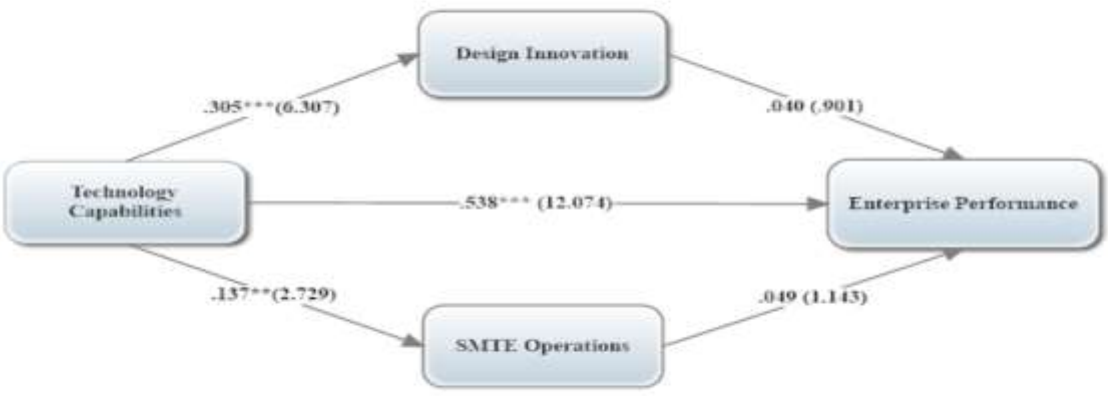

Figure 4. Structural Path

Hypothesis Six and Seven (Mediating Variables)
Table 11 indicates that there is partial mediation observed for all three indirect effects. This is evident as the direct path remains significant even after introducing the mediation paths. The direct effect of X (Technological Capabilities) on Y (Enterprise Performance) is statistically significant, with an effect size of 4.2% ($p < 0.05$). Furthermore, the confidence intervals provided in the table, including the lower limit confidence interval (Lower CI) and upper limit confidence interval (Upper CI), demonstrate that the confidence intervals for each indirect effect do not encompass zero. This leads to the conclusion that Design Innovation and SMTE Operations partially mediate the relationship between Technological Capabilities and Enterprise Performance. Hence, Hypothesis 6, which proposed that design innovation partially mediates the relationship between technological capabilities and the performance of SMTEs, is not supported. Additionally, Hypothesis 7 was not supported as there was no evidence to show that the operations of the enterprises fully mediate the relationship between the technology capabilities of the enterprises and its attendant impact on their performance.

Aghajari and Senin (2014) said that enterprises can improve their performances by engaging in strategic orientation and innovative operation strategies. Adopting the customer-centred approach, which is a central theme in the design thinking approach, is the surest way to enhance the direct effect of the technological capabilities of the enterprise on its performance. Regrettably, the existing literature falls short in providing insights comparable to those of Al-Ansari et al. (2013), who emphasized the importance for managers to regard innovation as a mediating factor to technology. This novel finding, which establishes that design innovation partially mediates the relationship between technological capabilities and enterprise performance in textile SMEs, has not been previously documented. Consequently, this study fills an important gap in the literature by shedding light on this specific aspect of the relationship between technological capabilities, design innovation, and enterprise performance in the textile industry.

On the side of enterprise operational practices mediating the relationship between technological capabilities and enterprise performance, the study found that the mediator (SMTE Operations) partially mediates the relationship. This proves that the impact of technological capabilities on the performance of enterprises can be improved if enterprises attempt to innovate in their operational processes.

CONCLUSIONS

The study was aimed at assessing the impact of technology capabilities, design innovation and operations on the performance of SMTEs in Ghana. It was hypothesized that the Technological capabilities of the textile enterprises positively related to their performance. This is because the enterprises' improved capabilities are expected to influence their operations positively, i.e., make them efficient and effective in their operational activities, which is likely to improve their performance. The study provided sufficient evidence in this regard by supporting the hypothesis that the technological capabilities of textile enterprises positively influence their performances.

It was hypothesized that the technological capabilities of textile enterprises would positively influence their design innovation. This was because by using integrated technology, workers have leverage over their work processes which allows them to be very innovative in their businesses. In this regard, the research has established that the technological capabilities of the enterprise positively influence the design innovation of SMTEs. Additionally, the study tested the impact of the enterprises' design innovation abilities on their performances. Again, the study proved that the design innovation strategies implemented by textile enterprises positively influence their performances.

The study looked at the effect of technological capabilities on enterprise operations. The study discovered that the technological capabilities of SMTEs positively influence their operations. That is suggestive that with the technologies adopted, their processes have become efficient and effective, thereby positively impacting their operations.

Again, the study sought to test the relationship between the operational practices of SMTEs and their performances. Furthermore, the study observed a positive relationship between the operational practices and the performance of the enterprises. The results point to the direction that technologically impacted operations of small-scale enterprises have had a positive impact on the performance of the textile business; with the efficiency and effectiveness created by technological adoption in the operations of the enterprises, the enterprises can increase their profitability.

The study sought to determine whether design innovation and SMTE operations mediate the relationship between technological capabilities and the performance of SMTEs. The study showed that Design Innovation and SMTE Operations partially mediate the relationship between Technological Capabilities and Enterprise Performance.

SMTEs operating in dynamic markets must prioritize developing innovative capabilities and exploring new opportunities. Cultivating innovative capabilities should be integral to SMEs' operations and development, such as through continuous investment in R&D of novel products and technologies. By developing novel strategies, SMTEs can enhance product offerings, increase efficiency, and identify new growth opportunities.

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