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Technological Innovation: An Assessment of Operational Practices of Small and Medium Textile Enterprises in Ghana

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Abstract

Fundamentally, technology is the key to achieving a competitive advantage. Novel and advanced technologies and manufacturing systems have turned the attention of labour-intensive firms towards technological attractiveness. In the textile industry, advancements in technology and products are massive. The study sought to assess the extent to which managers of Small and Medium Textile Enterprises (STMEs) are taking advantage of the technology available in textile designing, production and marketing space, as there is a growing interest worldwide to boost the innovative activity of enterprises, especially technological innovation. The study is quantitative research. 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 SMTEs. The study discovered that most of the textile enterprises in Ghana mostly use computer-generated designs, manual screen printing and digital embroidery technologies in their production. The study also established that SMTEs continually resort to traditional advertising techniques rather than contemporary marketing and advertising mediums for marketing their products. In view of this, SMTEs should seek more knowledge regarding innovative contemporary marketing strategies to increase patronage.

Keywords

1. Introduction

The 21st century has seen massive development in all sectors of the economy as a

result of technological innovation. Society is witnessing technology paradigms as a result of man's quest for cheaper, quicker and easier ways of doing things. Creativity and inventions are driving technological innovations and paradigms. Design and technological innovations comprise new or significantly modified technological products and processes, where technological novelty emerges, unlike improvements, from their performance characteristics [1]. Technological paradigms often become embedded in designers' frameworks of perceptions, calculation, and routines which eventually inspire creativity and innovation [2]. Innovation thus becomes the result of creative activity [3].

Technological development can be seen as social construction capable of being institutionalized [2]. Once institutionalized, they tend to become paradigms, dominating development for some time [2]. See technological innovation as a process by which enterprises master and implement the design and production of new products to the business irrespective of whether the products are new to their competitors or their customers, or the world [4].

One of the core functions of the Ministry of Trade and Industry (MOTI) in Ghana is to promote the application of science, technology and innovation (STI) in industry and entrepreneurship [5]. Design and technological innovation in Small and Medium Enterprises (SMEs) in the textile design sector can contribute immensely to economic growth, as posited by Mcsherry [6]. Unfortunately, much is not known about the technological innovation of textile SMEs in Ghana. It is also not clear whether textile SMEs are making use of the current design and technological innovation available in the textile design sector to yield the expected output.

The lack of access to the most current technology has left the SMEs in Ghana behind in today's competitive economy [7]. Technology and innovation are essential means of implementing the 2030 Agenda for Sustainable Development because of their potential to drive innovative entrepreneurship that delivers growth and productive employment [8]. According to a study conducted in OECD countries, of which Ghana is part, less than 20% of SMEs adopt digital technologies in production and marketing, even though the effective use of design and the right technology is fundamental to the creation of innovative products and processes [9].

Textile Production Technologies

Fundamentally, technology is the key to achieving a competitive advantage. Novel and advanced technologies and manufacturing systems have turned the attention of labour-intensive firms towards technological attractiveness. In the textile industry, advancement in technology and products is massive. Even though some of the initial technologies advanced in the textile sector are still being used currently, technological developments have added to this global industry [10].

Technology offers a predictable outcome for most of the manufacturing industries, improving manufacturing leading to an improved outcome. This has made technological advancement a prerequisite for success in most sectors. The textile industry has not been left out in this regard as it has witnessed numerous

technological improvements that have transformed the sector globally [11].

Technological progress in the textile sector is a difficult subject to determine as it covers several diverse things. Owing to this complexity, it is essential to explore the significance of technological advancement vis-a-vis the shifts and/or transformations it has brought to the global textile industry [12]. Technology has unquestionably made it much easier to meet production deadlines as it has revolutionized processing, making it possible to shift to innovative ways of fabric production in general. The application of these innovative technologies has had a profound impact on the manufacture of textiles, expanding globally the production of high-level specialty fabrics produced as woven, knitted and non-woven made from natural, synthetic and inorganic materials [13].

The current study, therefore, seeks to assess the extent to which managers of STMEs are taking advantage of the technology available in textile design, production and marketing space, as there is a growing interest worldwide to boost the innovative activity of enterprises, especially in technological innovation. Technological innovation is required to ensure new production patterns to maintain or enhance the competitiveness of national economies [1]. Investigating how design innovation and technology are utilized in textiles concerning SMEs will not only ensure sustainable development of the enterprises but also contribute to sustainable economic growth at the national level.

Empirical studies have shown that design and technological innovations in SMEs can lead to high economic growth [14] [15] [16] [17] [18].

2. Methodology

This research made use of the quantitative research approach. Descriptive design was considered apt for the study since it is versatile and practical; given that, it identifies present conditions [19]. This approach is used to describe variables rather than to test a predicted relationship between variables. In the view of Glass and Hopkins [20], descriptive research involves gathering data that describe events and then organizes, tabulates, depicts and describes the data collection. Thus, the approach was chosen to analyse and discuss the operational practices of small and medium scale textiles enterprises in Ghana.

Population

A population is the complete set of subjects that can be studied [21]. 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 as shown in Table 1.

Sample Size determination

The sample size for the quantitative aspect of the study was computed using the following mathematical approach by Yamane [22];

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

Table 1. Regional distribution of SMTEs in the selected regions.

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

Source: Fieldwork (2021).

where,

n = sample size for employees;

N = Population for respondents;

e = level of precision (5% margin of error);

Sample size: $n = \dfrac{870}{1 + 870 \times 0.05^2}$, $n = 274 = 275$ app.

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: $n = \dfrac{99}{1 + 99 \times 0.05^2}$, $n = 79$ approximated to 80 SMTEs selected from the four (4) 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. The 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, $213/870 \times 300 = 73$.

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.

Data Collection Instruments

A self-administered questionnaire was designed to gather data from the sample regarding the operational practices of SMTEs in Ghana. Questionnaires were used largely because they are more likely to produce honest responses due to the anonymity of respondents and are less likely to be influenced by the characteristics of the researcher.

Table 2. Sample determination of SMTEs in the selected regions.

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**	**870**	**80**	**300**

Source: Fieldwork (2021).

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, never (SD) = 1. The average of these points is 3.0 (5 + 4 + 3 + 2 + 1) = 3.0 thus 15/5. This was used in quantitative data analysis. Data were processed using Statistical Package for Social Sciences (SPSS).

3. Presentation and Discussion of Results

This section presents the data analysis and discussions on the operational practices of SMTE's in Ghana. Producers in the area of embroidery, printing, weaving and dying were considered for the study. The results of the data analysis were presented in the form of frequency 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 and some were barely readable.

Operations of Small Medium Textile Enterprises in Ghana

This section discusses the operations of the small and medium scale textile enterprises.

Table 3 asked questions relative to the source of ideas and inspirations behind the textile designs. The responses were anchored on a five-point Likert scale where 1 = never to 5 = frequently. From the responses, it could be observed that the means of the measurement items for idea generation are generally occasional.

Furthermore, the majority of respondents stated that things they see in the environment (M = 3.96, ±SD = 0.868), images and stories from books, journals, and magazines (M = 3.92, ±SD = 1.093), and the internet (M = 3.71, ±SD = 1.052) occasionally inspire their designs. The majority of respondents, however, stated that their designs are rarely inspired by intuition (M = 2.95, ±SD = 1.228) and that they never repeat existing designs for customers (M = 1.89, ±SD = 1.168) but rather occasionally improve or modify old designs (M = 3.52, ±SD = 1.137).

From the analysis, it could be concluded that textile designs are occasionally improved or modified for customers; inspired by the environment; images and stories from the internet; books, journals, and magazines.

Table 3. Descriptive statistics on idea generation.

Statement	N	Min.	Max.	Mean	±SD
We repeat existing designs for our customers	273	1	5	1.89	1.168
We improve or modify old designs for our customers	273	1	5	3.52	1.137
Our designs are inspired by things we see in the environment	273	1	5	3.96	0.868
Our designs are inspired by images and stories from the World Wide Web	273	1	5	3.71	1.052
Our designs are inspired by images and stories from books, journals and magazines	273	1	5	3.92	1.093
Our designs are inspired by intuition	273	1	5	2.95	1.228

Source: Fieldwork 2021.

Table 4 asks respondents how frequently they use various software applications in their operational activities, particularly their designs. The responses were tallied on a 5-point Likert scale, with 1 = never and 5 = very frequently. Most of the respondents (M = 3.03, ±SD = 1.818) said they use embroidery software suites like embird D.O Digital, My Editor, Hatch Brother Embroidery, and TrueSizer on a limited basis for their designs. In comparison to the use of WeavePoint (M = 2.15, ±SD = 1.618), most respondents (M = 4.15, ±SD = 1.445) stated that they frequently use Adobe Photoshop suits for generating their designs.

The responses suggest that textile enterprises mostly prefer to use Adobe Photoshop/Adobe Illustrator/CorelDraw for generating their designs, whereas others use other embroidery software suits.

Table 5 presents the descriptive statistics on textile production methods used by the textile enterprises in their production processes. The responses were measured on a 5-point Likert scale where 1 = Never to 5 = Very frequently. The results show that the majority of the respondents (M = 4.18, ±SD = 1.274) frequently use computer-generated designs in their production. Manual screening (M = 3.78, ±SD = 1.487) and Digital embroidery (M = 3.75, ±SD = 1.626) technologies are occasionally used in the production processes by the producers. More so, Dye sublimation printing (Digital printing) (M = 2.43, ±SD = 1.682) and semi-automatic screen printing (M = 2.41, ±SD = 1.532), are rarely adopted and used by textile producers.

However, the results showed that Automatic screen printing (M = 1.98, ±SD = 1.518), manual embroidery (M = 1.41, ±SD = 1.061) and digital weaving (M = 1.41, ±SD = 1.034) were technologies never used by the textile producers.

From the response, it could be concluded that textile producers mostly use computer-generated designs, manual screen printing and digital embroidery technologies in their production relative to the textile technologies used in the production process. However, it is observed that they rarely use dye-sublimation printing, semi-automated screen printing, automatic screen printing, manual dyeing, manual embroidery and digital weaving technologies in their production.

Table 4. Descriptive statistics on software used by SMTEs.

Statements	N	Min.	Max.	Mean	±SD
We use an embroidery software suite (Embird D.O. Digital, My Editor, Hatch, Brother Embroidery and TrueSizer) for generating embroidery designs	273	1	5	3.03	1.818
We use Adobe Photoshop/Adobe Illustrator/CorelDraw for generating designs	273	1	5	4.15	1.445
We use WeavePoint for generating weave patterns	273	1	5	2.15	1.618

Source: Fieldwork 2021.

Table 5. Descriptive statistics on textile production by SMTEs.

Statement	N	Min	Max.	Mean	±SD
We use computer-generated designs	273	1	5	4.18	1.274
We undertake manual screen printing	273	1	5	3.78	1.487
We offer digital embroidery services for our clients/customers	273	1	5	3.75	1.626
We manually dye (batik, tie-dyeing etc.) in our production	273	1	5	2.45	0.968
We offer manual weaving in our enterprise	273	1	5	2.55	1.061
We undertake dye sublimation printing	273	1	5	2.43	1.682
We use Semi-automated screen printing in our enterprise	273	1	5	2.41	1.532
We use automatic screen printing in our enterprise	273	1	5	1.98	1.518
We undertake manual embroidery for clients/customers	273	1	5	1.73	1.465
We undertake digital weaving	273	1	5	1.41	1.034

Source: Fieldwork 2021.

Table 6 summarises the responses concerning the type of advertising media mostly used by the textile producers. Also, this was measured on the 5-point Likert scale, where 1 = never to 5 = very frequently. The results reveal that respondents resort to fliers, posters, signboards, billboards (M = 4.39, ±SD = 1.167) and face-to-face (M = 4.13, ±SD = 1.416) advertising to promote their business. Additionally, they use WhatsApp (M = 3.63, ±SD = 1.713), Facebook (M = 3.53, ±SD = 1.680) and Instagram (M = 3.23, ±SD = 1.781) platforms are used occasionally whereas the Websites (M = 2.35, ±SD = 1.711), radio (M = 2.13, ±SD = 1.527), television (M = 2.02, ±SD = 1.592) and YouTube (M = 2.00, ±SD = 1.544) are the rarely used media platforms adopted by the enterprises. The responses imply that textile producers prefer to use the traditional forms of advertisements: fliers, posters, and face-to-face engagements. However, the results showed less preferences for contemporary advertisement media platforms by the producers.

Table 6. Descriptive statistics on advertising by SMTEs.

Statement	N	Min.	Max.	Mean	±SD
We advertise using fliers, posters, signboards and billboards	273	1	5	4.39	1.167
We resort to face-face adverts with customers	273	1	5	4.13	1.416
We use our WhatsApp business platform to reach out to our customers	273	1	5	3.63	1.713
We have a Facebook account where we advertise	273	1	5	3.53	1.680
We use Instagram to advertise	273	1	5	3.23	1.781
We advertise our products on our Website	273	1	5	2.35	1.711
We undertake Radio adverts	273	1	5	2.13	1.527
We undertake Television adverts	273	1	5	2.02	1.592
We advertise our products on YouTube	273	1	5	2.00	1.544

Source: Fieldwork 2021.

The results of the study suggest that the textile production approach adopted by the SMTEs in Ghana was to occasionally improve or modify old designs for customers; take their inspiration for their designs from the environment, the internet, books, journals, and magazine. Furthermore, it was discovered that most of the textile enterprises in Ghana mostly use computer-generated designs and manual screen printing and digital embroidery technologies in their production. However, it was observed that they rarely or never use dye-sublimation printing (digital printing), semi-automated screen printing, automatic screen printing, manual dyeing, manual embroidery and digital weaving technologies in their production.

Subject to the marketing of textile products, the study found that textile producers prefer to use traditional marketing tools such as fliers, posters, and face-to-face engagements. However, the results showed more minor preferences for contemporary advertisement media platforms by the producers. The results relative to the use of the traditional marketing tools by SMEs are not surprising. The outcome is given extra weight by the works of Gaweseb [23], who in his dissertation argued that discussion on marketing methods has always focused on large firms, corporations and organisations, whereas little has focused on those adopted by SMEs. From this background, the results confirm that because of the unique characteristics and constraints SMTEs operate in, there is a lack of resources to implement or adopt the same marketing tools and platforms as those adopted by large-scale enterprises.

4. Conclusion

The study concludes that textile producers generally use computer-generated patterns, manual screen printing, and digital embroidery in terms of textile technol-

ogy but rarely use dye-sublimation printing (digital printing), semi-automated and automatic screen printing, manual embroidery and digital weaving in their production. The study established that SMTEs continually resort to traditional advertising techniques rather than contemporary marketing and advertising mediums for marketing their products. This is one area that appears to be a shortfall relative to the operations of the SMTEs. This probably may be due to low technical skills and awareness about technological advancement in marketing, which is one of the major barriers to a knowledge-based modern economy. In this contemporary environment, a little effort in innovative activities significantly affects the performances of respective SMEs. In view of this, SMTEs should seek more knowledge regarding innovative contemporary marketing strategies to boost sales. Ghanaian SMTEs must continuously integrate external technological resources with robust technological processes to provide frequent on-the-job training to employees, attract and hire talented experts, upgrade their machines and equipment, invest in Research and Development, and apply innovative technology to enhance their operations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Diaconu, M. (2011) Technological Innovation: Concept, Process, Typology and Implications in the Economy. *Theoretical and Applied Economics*, **10**, 127-144.

[2] Ulhøi, J.P. and Gattiker, U.E. (2000) The Nature of Technological Paradigms: A Conceptual Framework. In: Dorf, R.C., Ed., *The Technology Management Handbook*, Springer, Berlin, 21-93.

[3] Mutlu, B. and Er, A. (2003) Design Innovation: Historical and Theoretical Perspectives on Product Innovation by Design. *Proceedings of the* 5*th European Academy of Design Conference*, Barcelona, 28-30 April 2003, 1-22.

[4] Chen, J., Yin, X. and Mei, L. (2018) Holistic Innovation: An Emerging Innovation Paradigm. *International Journal of Innovation Studies*, **2**, 1-13.
https://doi.org/10.1016/j.ijis.2018.02.001

[5] MOTI (2016) Medium Term Expenditure Framework (MTEF) Programme Based Budget Estimates for 2014 Ministry of Transport. 29.

[6] Mcsherry, M. (2017) The Diffusion of Innovation in Low-Income Countries Impact Case Study. https://degrp.odi.org/boosting-innovation-in-ghana

[7] Avevor, E.E. (2016) Challenges Faced by SMEs When Accessing Fund from Financial Institutions in Ghana. University of Applied Sciences, 65.

[8] UNCTAD (2018) Science, Technology and Innovation for Enterprise Development. *Trade and Development Board Investment*, *Enterprise and Development Commission* 10*th Session*, Geneva, 3-7 December 2018, 1-16.
https://unctad.org/meetings/en/SessionalDocuments/ciid39_en.pdf

[9] OECD (2017) Enhancing the Contributions of SMEs in a Global and Digitalised Economy. *Meeting of the OECD Council at Ministerial Level*, Vol. 1, 7-8.

[10] Altuntas, S., Cinar, O. and Kaynak, S. (2018) Relationships among Advanced Manu-

facturing Technology, Innovation, Export, and Firm Performance; Empirical Evidence from Turkish Manufacturing Companies. *Kybernetes*, **47**, 1-24.
https://doi.org/10.1108/K-10-2017-0380

[11] Bogdanovic, M.M. and Bogojevic, N. (2020) Advantages of Using New Technology in Textile and Fashion Design. In: Mitrovic, N., Mladenovic, G. and Mitrovic, A., Eds., *International Conference of Experimental and Numerical Investigations and New Technologies*, Springer, Cham, 294-309.
https://doi.org/10.1007/978-3-030-58362-0_17

[12] Mondal, K. (2018) Recent Advances in Soft E-Textiles. *Inventions*, **3**, 23.
https://doi.org/10.3390/inventions3020023

[13] Yuldoshev, N., Tursunov, B. and Qozoqov, S. (2018) Use of Artificial Intelligence Methods in Operational Planning of Textile Production. *Journal of Process Management and New Technologies*, **6**, 41-51. https://doi.org/10.5937/jouproman1802041Y

[14] Singh, D. (2019) Implementation of Technology Innovation in SMEs in India: Case Study in Select Firms from Northern Region. *Journal of Science and Technology Policy Management*, **10**, 769-792. https://doi.org/10.1108/JSTPM-06-2018-0065

[15] Wu, J.J. and Atkinson, R.D. (2017) How Technology-Based Start-Ups Support US Economic Growth. Information Technology and Innovation Foundation ITIF.
https://doi.org/10.2139/ssrn.3079624

[16] Taneja, S., Pryor, M. and Hayek, M. (2016) Leaping Innovation Barriers to Small Business Longevity. *Journal of Business Strategy*, **37**, 44-51.
https://doi.org/10.1108/JBS-12-2014-0145

[17] Zucchella, A. and Siano, A. (2014) Internationalization and Innovation as Resources for SME Growth in Foreign Markets: A Focus on Textile and Clothing Firms in the Campania Region. *International Studies of Management and Organization*, **44**, 21-41.
https://doi.org/10.2753/IMO0020-8825440102

[18] Luo, J., Olechowski, A.L. and Magee, C.L. (2014) Technology-Based Design and Sustainable Economic Growth. *Technovation*, **34**, 663-677.
https://doi.org/10.1016/j.technovation.2012.06.005

[19] De Vaus, D. (2001) Research Design in Social Research. Sage, London.
https://doi.org/10.4135/9781446263495

[20] Glass, G.V. and Hopkins, K.D. (1984) Statistical Methods in Education and Psychology. Prentice Hall, Englewood Cliffs.

[21] Rahi, S., Alnaser, F.M. and Abd Ghani, M. (2019) Designing Survey Research: Recommendation for Questionnaire Development, Calculating Sample Size and Selecting Research Paradigms. *Economic and Social Development: Book of Proceedings*, Belgrade, 23-24 May 2019, 1157-1169.

[22] Yamane, T. (1967) Statistics: An Introductory Analysis. 2nd Edition, Harper and Row, New York.

[23] Gaweseb, C.G. (2015) Marketing Communication Methods Used by Namibian Clothing and Textile SMEs: A Case Study of SMEs Operating from Katutura and Khomasdal Incubation Centers. Doctoral Dissertation, University of South Africa, Pretoria.