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IMPACT OF MANUFACTURING TECHNOLOGY ON THE QUALITY OF SCHOOL UNIFORMS PRODUCED IN SMALL AND MEDIUM SCALE INDUSTRIES IN KUMASI, GHANA.

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ABSTRACT
Purpose: This study assessed manufacturing technologies small medium scale industries use to produce quality school uniforms in the Kumasi Metropolis in Ghana.
Design/Methodology/Approach: The study adopted a descriptive survey design with a qualitative approach. The instruments used for the data collection were interviews and observation guides. Since the data was qualitative, it was analysed using thematic content analysis.
Findings: The result showed that industrial sewing machines, overlocking machines, and cutting machines, among others, were the most common machines used to produce school uniforms. The technology used in producing school uniforms positively impacted the products, making the uniforms meet average standards for their clients.
Research Limitation: The study is limited by its geographical coverage and the number of small medium scale firms involved.
Practical Implication: Given the need for a technological support system for expertise and advanced machinery, small/medium-scale firms will be well-positioned to compete with well-resourced big manufacturing companies.
Social Implication: Empowering small/medium-scale industries can increase productivity and create more employment, higher economic returns, and more equitable industrial norms.
Originality/Value: The study offers a novel approach to assessing the impact of manufacturing technology on the quality of school uniforms produced in small and medium-scale industries in Kumasi, thereby contributing to unearthing the industry's challenges and gaps.

Keywords*: Empowering. manufacturing. quality. school uniform. technology*

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INTRODUCTION

Clothing plays a crucial role throughout every person's life since it is symbolic and identifies people and groups, defines different cultures and provides different meanings; it usually relates to the position and the usual way of living in the community (Tajuddin, 2018). Clothing shields individuals from colds, heat, and rain, makes them feel comfortably healthy, influences how others view the wearer and offer social well-being. One of man's three needs, clothing made of textile, is a basic necessity of life and is essential as shelter and food in conforming to human personal requirements and recognised as a human right under international law (Koch, 2023; Graham, 2023; Sing & Khare, 2020).

Clothes influence one's mood, ego and psyche, symbolising the body wearing them and a barometer of the person's delusions, grievances, or aspirations (Delebarre, 2022 & Hidalgo, 2007). Clothing plays a pivotal role in socialisation (Borah, 2011), and the preference for clothing varies significantly because of beliefs, desires, and attitudes. In many emerging economies, the textile and clothing (T&C) industry is an integral global value chain sector focusing on the manufacturing process, capital investment, job creation and trade activities (Yu & Zhao, 2022; Appiadu, Senayah & Biney-Aidoo, 2022 and Keane & Velde, 2008;). One of the oldest known, fastest, and most global industries is the T&C industry. Countries involved in export-oriented industrialisation, the typical 'starter' industry (Fernandez-Stark, Bamber & Couto, 2022 and Appiadu et al., 2022), which is labour-intensive, provide several opportunities comprising entry-level jobs for unqualified labour in emerging countries.

The T&C industry's high-tech structure has made it appropriate as the initial stage on the "industrialisation ladder" in developing countries. Some, such as Bangladesh, Sri Lanka, Vietnam, and Mauritius, have experienced a very high production growth rate in the sector and have since become middle-income countries (Yu & Zhao, 2022; Keane & Velde, 2008). Small and Medium scale industries in different countries form the backbone of most economies. Typically, the small and medium scale enterprises are vital for growth and job creation in most countries.

In emerging economies, they employ almost four-fifths, empowering the dynamics for a competitive environment in the shifting global economy (Madgavkar et al., 2024). A medium-scale industry employs more than fifty (50) workers (Berisha & Pula, 2015). Fashion design is the pragmatic art devoted to clothing and lifestyle accessories created within a specific time's cultural and social influences with built-in obsolescence, typically for one or two seasons, establishing the difference between it and costume design.

In Ghana, garment and textile manufacturing are dominated by small scale industries based on machinery and workforce strength. Companies with less than ten workers are considered small-scale enterprises by the Ghana Statistical Service (GSS), whereas those with more than ten are classified as medium-sized enterprises. The predominance of small-scale setups in Ghana's

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clothing and textiles industry is characterised by low productivity due to low educational background, source of skill acquisition, financial problems, and lack of machinery to enhance quality garment production. School uniforms have become the norm for small or medium-scale manufacturers to produce since students are compelled to wear school uniforms in the first and second-cycle institutions to have a standard uniform across such institutions. The school uniforms' production must be delivered on time to schools for onward distribution to students (school uniform, outing dress, house dress, prep wear, and ceremonial dress). These are time-bound; delivery deadlines must be met to distribute uniforms to students.

Poorly made school uniform makes the wearer look sloppy and unkempt. On the other hand, well-constructed, well-fitted, impressive and well-polished uniforms increase students' confidence and appearance level. Such a result of uniform construction must be supported with adequate machinery, technology, and staff. However, preliminary investigations and observations by the researchers suggest this is not often the case. Few schools are visited where uniforms are delivered early enough for students to wear. In contrast, others have their orders delayed by the manufacturers, and quality is sometimes compromised when they are finally delivered. Some have no interfacing, crests are turned upside down, some fastenings are not well sewn, stitches are not correctly made, and some are shapeless. Based on this concern, the study sought to investigate the technology employed by small- and medium-scale industries in the Kumasi Metropolis to construct these uniforms.

LITERATURE REVIEW

Computer-assisted cutting machines, pattern layouts, and other features, and, in many cases, patterns can be produced from prototypes, which can then be transferred electronically to automated cutting machines. These are connected to the production pre-assembly processes; however, the clothing industry's assembly (sewing) process is still labour-intensive, and the phase is most likely to increase the cost of clothing. The individual sewing tasks are coordinated consistently, and sophisticated sewing machines for the individual tasks have been created.

Designing a 3D object is inherently tricky, but it is becoming more appealing to designers who have done 2D flat pattern making. Three-dimensional tools are planned for garment design to enhance pattern generation efficiency and for a more appealing design presentation. Research has shown that 3D pattern making has several advantages over traditional 2D manual pattern manufacturing, including faster design generation and improved visualisation (Habib & Alam, 2024; Mousa, Ahmed & Ahmed, 2023). Three-dimensional modelling technologies use data from camera sensors or scanners and help generate 3-D models of the outer or inner surfaces of different items, such as objects, humans, scenes or animals (Verykokou & Ioannidis, 2023).

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Modern practical simulation tools require computer-aided design systems (CAD systems). These systems help create and visualise digital images of designers. They save time using virtual models, thereby eliminating the physical preparation of samples for production (Jhanji, 2018).

Technological developments in fashion manufacturing machines have reduced the time and expense of producing clothes. Onu (2020) and Krishna (2023) added that innovations in the automation of technologically advanced machinery in the clothing sector help to enhance garment production and bring efficiency into the system strategically. Computers provide the fashion industry with a powerful means of designing and producing garments. New computer-aided design (CAD) software systems such as TUKAcad make it easier for designers to efficiently create, modify and grade patterns digitally and generate markers. This helps to reduce waste and enhance productivity (Tukatech, 2023). Technology adaptation in textile factories, mostly small-scale industries, uses various machines in manufacturing processes, such as 3D body scanners and 3D body scanning.

Three-dimensional (3D) Body Scanner

This scanner technology creates a 3D model by scanning 360 degrees of the body surface using a variety of light sensors. The use of 3D body scanning and digitised images in the mass-personalisation of apparel enables the user to choose a garment with a design that matches his/her choices through the digitised image shown on the computer screen. It is possible to obtain individual measurements with greater accuracy and speed using this method. Standardised dimensions such as path, height, diameter, and the complete 3D data are included in the 3D scanned data. This latest technology shifts the facets of the textile business.

Types of 3D Body Scanning

Three-dimensional (3D) body scanning comes in different forms like Laser and White light body scanning. The technology comes in a way that makes its use flexible.

Laser Scanning

This 3D technology consists of laser rays-sensors of light that record the measurements by projecting them onto the human body. A laser beam scans the customer's body within a couple of minutes.

White Light Body Scanning:

This device uses a white light scanner and measurement extraction software. Hundreds of images are collected, and the program automatically generates precise measurements captured by an integrated camera reflecting light reaching the user's body. This technique is superior to laser technology, such that data collection takes a significantly short time and the entire surface components can be digitised.

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Cutting and Sewing Machines

Cutting machines can be automated or manually controlled to cut fabrics into various shapes. The most accurate and quickest are automatic knives, while a straight knife is required if the number of materials is low. Hand scissors are applicable for cutting single or even double folds, but they are time-consuming.

Manufacturing school uniforms means investing in automation and advanced machinery that improve efficiency, quality and productivity, which are essential in achieving good results in sewing uniforms (Weldmaster, 2024). The sewing machines for the lockstitch consist of a needle thread and a bobbin thread, which must coordinate in their functioning by interloping to form a stitch. Many machines are on the market today, each with attractive features and advantages. Sewing machines vary from the most basic, with only a simple lockstitch, to automated machines that use sophisticated computer technology to provide different functions, such as stitching, binding, ruffling, plating, darning, hemming, and even buttonholes and fastenings. In order to obtain quality goods, a good sewing machine is required. Textile Engineering (2024) suggested that the styles of sewing machines used in clothing manufacturing can be categorised as:

Basic Sewing Machine

This consists of a stand, table, electric motor, etc. It provides one type of stitch with numerous shapes that help the operator control the sewing speed, density, and presser foot position. Other accessories attacked for smooth and quicker operations include presser foot raise, back tack, thread trim, fullness, and others, which are pre-set and automatically operated. Examples of this group of machines are single-needle lockstitch, safety-stitching, blind stitching, single and two-thread chain stitch, and overlocking machines (Treasurie, 2023; Textile Engineering, 2024).

Simple automatics

These machines are controlled manually, but impressive cams usually control the components' sewing movements during the entire sewing operation. A simple automatic machine produces only one sewing formation. Varieties of simple automatic machines are label sewers, button sewers, bar tack machines and buttonholers (Treasurie, 2023). These machines' specialised natures make them perform entirely accurate sewing operations and are extremely fast (Textile Engineering, 2024).

Automated workstations

These use mechanical, electronic, and pneumatic power, implement advanced conveyor and clamp technology, and perform complex functions in addition to sewing.

Profile sewing systems, CNC sewing machines, and robots are such machines

Examples include patch pocket fittings on jeans and tops, sewing collars or flaps, long hem attachment, jetted pockets, tightening pants, and sequential buttonholing. Aside from launching

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and pulling the garment after stitching, the machine controls most handling and sewing (Treasurie, 2023).

High-speed sewing machines
These are industrial machines with various supplementary mechanisms.

The primary role is to minimise the operator's time for non-sewing tasks (Textile Engineering, 2024). Its activities include an automatic presser foot, thread wiper, thread cutter, bar tacking, stitch compression, automatic stop with an optical sensor, automatic start with an optical sensor, needle positioning, and edge trimmer, which are ancillary materials for industrial high-speed sewing machines.

Pressing Machines
Pressing devices are used in the production process's final stages, whether manual or automated. Due to various uniform styles, there are different pressing machines with particular pressing specifications. According to Mick (2015), using technologies such as digital printing and cutting operations revealed that these processes would greatly influence the manufacturer's inventory requirements.

Manual work may bring about effectiveness, slow down work and bring a few hands-on decks. Meanwhile, automation could improve the efficiency, precision, and speed at which work could be done. The use of technological devices to cut school uniforms and work on other parts of garments may reduce waste, delay, and burden of a few individuals and increase production. Investment in infrastructure and manufacturing plant-based machinery, equipment, and access to raw materials, suppliers, and skilled labour contributes to a strong manufacturing industry in other parts of the world is the order of the day (Conerly, 2014; Curtis, 2014). Although some equipment becomes obsolete over time, investment in improved and other technologies has taken place as a replacement, creating knowledge and capital in advanced or emerging economies of nations that are not necessarily replicated domestically (Curtis, 2014).

Integrating Printers and Cutters
The cut path must be matched to the printing process in cutting a helpful product using a digital cutting machine. This is not a trivial job because the printed materials must be passed between the printer and the cutter and must not be stacked or rolled in any form (Mick, 2015). Even a minor misalignment can cause an unacceptable defect, leading to the rejection of the entire product. This alignment (registration) is fundamental for the printing industry to match the cutting path with the printing process; it is also essential to align the overlap processes in overlapping colours. These registration marks shall be entered by the computer or the operator and used to align the cut course in the design (Mick, 2015).

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For precision, at least three or four registration marks are used for each cut picture (Mikkelsen Graphics Engineering, 2014). Once the print registration marks have been found, the computer will use the cut file registration marks to match the cut direction. Alignment is reasonably straightforward for stiffer materials where skewing is unlikely to occur, but where defects happen, these are overcome by changing the cut path based on registration (Aeronaut, 2014; Mikkelsen Graphics Engineering, 2014).

A technology incorporates printing and cutting into the same machine (Summa, 2015). In this case, a fluid rolling over a very shallow bed is fed into the picture using Inkjet technology. As the ink is applied, the material is accelerated. A study was conducted to find the pattern of fabric weaving and yarn colour identification and classification using the Deep ELM network (Khan, Han, Wang & Masood, 2016). The authors (Khan et al., 2016) established that a pattern of fabric weaving is typically recognised using methods that distinguish warp floats and weft floats.

Khan et al. (2016) present a biologically influenced method to invariantly recognise the fabric weave pattern (fabric texture) yarn colour from the colour image input. The descriptor of the fabric weave pattern in the new proposed model is based on the computer vision model HMAX (Khan et al., 2016). In the new proposed model, cost-effectiveness and efficiency would be the haul mark. One of the prime aims of school uniform production is to mark their targeted market for revenue maximisation.

Pattern Making

The pattern helps in sewing so that waste is reduced to a manageable level. Patterns are designed and cut out for sewing. According to Habib and Alams (2024), pattern drafting is a pattern-making method that relies on measurements taken from a shape or model to establish the necessary foundation (working patterns) or design patterns, and the draft of the basic pattern set is an example. The most common approach is to cut a flat pattern by a scale or a direct measuring device. It involves designing a block shape that suits the human body and modifying and manipulating it to produce the desired shape as determined by design.

Other cutting methods include moulage or draping on the stand and bespoke cutting and tailoring (Almond, 2010). Patterns are a simple blueprint for a garment: an outline of the front and back of a bodice and skirt and a sleeve from which any style pattern can be developed or generated. It forms a template for cutting fabric and sewn into a 3D garment (Techpacker, 2024; Joseph-Armstrong, 2010; Bhati, 2011). The zero-waste approach is not new (Saeidi & Wimberley, 2017). The McQuillan (2011) zero-waste policy suggests designing the zero-waste garment, and the developer must know the fabric and design factors. In the zero-waste scheme, textile width is still a critical factor (Rissanen, 2013). You cannot design zero-waste without understanding precisely how large the synthetic fabric is. There are various methods to tackle zero-waste fashion design through pattern formation, including tessellation and jigsaw puzzles of the fixed area and fabric

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width. New fashion construction processes yield a loss of 15 percent of the total fabric (Saeidi & Wimberley, 2017), leaving a "large ecological footprint."

Today's textile industry is moving towards using advanced technologies in fashion and design. Clothing companies are searching for new ways to save time in product creation and generally improve productivity in activities ranging from design to production between designers, suppliers, and retailers (Siersema, 2015). Two Dimension (2D) pattern-making programming was first released in the industry in the 1980s to increase speed and ease of flow and improve performance. Examples of two-dimensional graphics software packages customised for the fashion industry include Pattern Design Software (PDS) (OptiTex), Accumark (Gerber) and Master Pattern Design. (Packet Assembler/Disassembler - PAD system) (Sayem, Kennon & Clarke, 2010).

The application of the computer-aided design (CAD) method in the textile and apparel industry brought in a revolution in the designing and production of apparel to meet customers' demands and offer high-quality products that help maximise operation efficiencies and minimum manufacturing cost and time (Chaudhary, Kumar & Johri, 2020). An analysis of 140 out of 180 dressmakers in the Ho Municipality reveals that most dressmakers used 'free-hand' cutting when they arrived at clothing sections, restricting their potential to diffuse intricate designs (Obinnim & Pongo, 2015). It has been suggested that much waste will be produced using 'free-hand' cutting.

Manufacturing Technology on Clothes Production

Manufacturing and industry divisions apply materials and systems to turn raw materials into finished goods. The automotive industry is closely related to engineering and industrial design (Weldmaster, 2024). Manufacturing technology is a concept that may apply to just a few contemporary research, manufacturing, and engineering techniques that aid in industrial development and different production processes. In structure or physical configuration, the production processes vary. Per the physical scheme, classical production processes and modern manufacturing systems have gained tremendous popularity in the apparel industry; job shops, flow shops, and project shops are significant.

Lately, manufacturing comes with its associated technology all over the world. In developed countries like China, the US, and Germany, their garment production is heavily dependent on recent technologies. The use of technology makes the manufacturing of clothes easy and fashionable. Evidence indicates that changes and incorporation into global supply chains have increased China's exports exponentially, forcing Chinese clothing companies to move abroad (Zhang, Kong & Ramu, 2015). According to Zhang *et al.* (2015), global integration has motivated clothing firms to upgrade through learning, adoption, and innovation. Rasiah, Miao, and Kong (2013) indicated that the emergence of the garment industry caused by the authorities' decision to open up the system of transition, particularly industrial upgrading, requires an optimal institutional structure to facilitate the horizontal and functional upgrade of Chinese companies. Some East

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Asian economies like Hong Kong, South Korea, and Taiwan began with low-technology textile and apparel industries (CICC Research, CICC Global Institute, 2024) and were upgraded to higher value-added operations and higher-technology industries. Ghana has not vigorously developed and used manufacturing technology, as most industries subordinate their production to developed countries (Amissah & Stack, 2016).

METHODOLOGY

Research Design

The study was qualitative and used a descriptive survey. The descriptive survey design helped identify the types of technology and machinery small/medium-scale industries use to produce school uniforms in the Kumasi Metropolis, as indicated by the respondents.

Sampling Procedure

The study sample size was 15 participants. The census sampling procedure was used to sample all the school uniform manufacturing industries in the Kumasi Metropolis for the study. The criteria used to select the respondents were based on those who have been repairing the machines whenever they are breakdowns and were familiar with the industry.

Data Collection Instruments

The instruments for data collection were the interview and observation guides. The observation guide helped triangulate the data collected to make it more reliable. The observation checklist was designed to help collect data on the various types of machinery the designers employ. The observation helped to observe things that might otherwise be missed in the production stage of the school uniform.

Data Processing and Analysis

The qualitative data collected with the interview and observation guides were transcribed and given themes. The themes were used to analyse research questions using content analysis. Initially, all twenty SMSs in the Ashanti Region accepted to participate in the study. However, five SMSs decided to opt out of the study during the data collection stage.

RESULTS AND DISCUSSION

Demographic Characteristics of Participants

The result indicated that the male respondents were eight and the females seven. The age distribution of the participants cut across the age range from 25 years to 48 years. Only the age ranges from 31 – 36 years had three participants. The participants indicated varied educational levels. There were 2(13.0%) with Higher National Diploma (HND), 2(13.0%) with National

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Vocational Training Institute (NVTI), 1(7.0%) with Middle School Leaving Certificate, 6(40.0%) Junior High School levers and 2(13.0%) of them without any formal education.

Technological devices (machines) used in producing school uniforms

The various technologies (machines) employed by small medium scale establishments to produce school uniforms presented in Table 1 are responses from participants and observations made by the researchers in the field.

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Table 1: Machines used in producing school uniforms

	CODE OF SMS																
Industries	**SD**	**SFC**	**MC**	**HF**	**OTF**	**OF**	**FC**	**GC**	**IF**	**SF**	**MDD**	**WT**	**UF**	**SDS**	**LF**	**Frequency**	**Percent**
Industrial sewing machine	5	8	10	7	8	12	10	8	12	8	10	5	50	5	10	168	41.8
Treadle sewing machine	8	4	5	2	1	3	-	-	1	1	1	2	0	1	2	31	7.7
Embroidery sewing machine	0	0	1	1	2	1	1	1	0	0	0	1	2	0	1	11	2.7
Over-locking machine	1	1	2	1	1	1	1	1	1	1	1	2	2	1	1	18	4.4
Cutting machine	4	3	6	1	7	9	8	5	6	2	4	3	5	1	1	65	16.8
Button fixer/fixing	1	1	2	2	1	1	1	1	1	1	1	1	2	1	1	18	4.4
Button holing	1	1	2	2	1	2	1	2	1	1	1	1	2	1	1	20	4.9
Pressing iron	3	4	5	2	3	4	3	3	1	1	2	1	1	2	2	37	10.2
Scissors	3	3	2	1	1	3	1	1	1	1	3	1	2	3	2	28	6.9
Computer	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4	0.9
Computer aided design	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Total	**26**	**25**	**35**	**19**	**25**	**36**	**26**	**22**	**24**	**16**	**23**	**17**	**69**	**16**	**22**	**401**	**100.0**

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Table 1 indicated that most of the machines used by SMSs are straight-stitch industrial sewing machines, followed by cutting machines for cutting fabrics to be sewn. The least mentioned machine was scissors. Nine (9) participants indicated using an 'overlocking machine'. Researchers' observation revealed that the machines mentioned by participants are available at the firm and used during production.

Software Programmes Adopted by SMS in the Fashion Industry

The study aims to know the software programmes these SMS employ in their firms. The feedback revealed that eleven (11) of them do not use any software to assist in producing school uniforms, while three (3) indicated that they use computer-aided design in pattern making. However, the participants did not know the specific software used. A general observation by the researchers was that knowledge of the type of software used in the fashion industry is limited or non-existent among these local SMEs in the metropolis.

Cost implication for using Technology/Machine

The cost implication for using technological devices in software and modern machines to facilitate work in the production of school uniforms is considered very high and expensive to afford and operate by most participants. Two participants, 'OF and MDD", indicated that, 'even the industrial machines we are using are expensive to buy and maintain, how much more modern ones with many attachments that need *extra training to operate them. All are costly, and we cannot afford them now.*' LF, another participant, also expressed that 'software for pattern preparation and others being used in the industry is good, *but we cannot afford them, more or less look for expertise to train us or employ people to operate them. These are costs that some of us cannot bear, so it is better to keep doing what we know better for similar results.* These are indications that SMS in the Metropolis do not identify modern technologies as prime importance or cannot simply afford them.

Replacement of Technology by SMS

Technological advancement requires updating or replacing outdated methods and technology used in the industry. Hence, the study requires knowing the frequency of replacing technologies used in school uniform production. From the result, four (4) participants (SFC, UF, SD, HF) hardly made any changes to their machines being used over the years; OF, OTF, and LF participants indicated that, although replacing machinery in their firms is not frequent, they do that whenever the need arises. Another four (4) participants (GC, SF, MC, MDD) said 'when it is faulty or spoilt', they do the replacement. In contrast, one participant, 'WT', indicated that replacement in his firm is only possible when there is a total breakdown of the machines being used.

Concerning software used for production, only three (3) participants who indicated earlier that they use software said they replace or update the software they use when new ones are available or the existing one becomes obsolete.

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Use of Pattern to Produce School Uniforms

In finding out from the participants whether they work with any pattern technology software, all of them except one participant revealed they do not use the technology but have some idea of its importance in the industry. The participants, 'SFC', 'MC', 'OF', 'SF', 'WT', 'LF' and 'FC' said '*they know it is faster and convenient to use'* while two other participants, 'SDS' and 'OTF' said *'they learnt, it gives a professional outcome to finish product'.* Participant 'MDD', said, 'its uses speed up production and provide *greater results'.* The result indicated that most participants knew about the software for production purposes but admitted they did not own and use it mainly because of cost and accessibility.

Awareness of Design Technologies in the Apparel Industry

The responses from the participants about their awareness of both 2D and 3D design technologies in the apparel industry indicated that six (6) of the participants were at least aware of the existence of these design technologies in the industry, although five (5) of them (WT, OTF, GC, LF, FC) claim to have 2-Dimensional CAD tools, there is no evidence based on researchers' observation to verify that. One participant, 'UF', said, 'his firm has a 2D CAD sketch tool, *but there is no one to operate it'*. The rest of the participants indicated that they did not know of such technology in the industry, while some said they were not even interested in knowing about such technologies.

Use of Manual Patterns in the Apparel Industry

A 'yes' or 'no' response from the participants on the use of manual pattern design in the apparel industry had Participant 'FC' responded 'no' to the use of manual pattern design and stated that *'his firm uses 'CAD' for their designing of uniforms'*. Participants 'WT', 'LF' 'GC', 'OTF' and 'MC' said 'they use manual pattern design processes and admitted that the process is slow and might not be as attractive as using a related program*'*. Other participants, 'SFC' said *'there is no expertise to assist in the use or training of this designing programmes even if they have it'*; 'OF' indicated that '*the manual programme is not expensive as compared with modern systems like the use of CAD in pattern designing'*; 'UF', 'SD', 'MDD' and 'SF' said, *'they do not have any idea on how to use these technological programmes and believe they are expensive. Therefore, they consider manual pattern-making to be cost-effective for their businesses*.

Difference in 'Look' of Apparel by using Manual and Technology Production Processes

The responses on the 'look' of school uniforms designed manually or by use of technological-related processes, as indicated by some participants (FC, OF, IF, OTF, HF, UF, WT, GC, SF, MC) suggested that manually produced uniforms are not attractive, not presentable and generally low in quality while others (SDS, MDD, SFC, SD, LF) consider the finish products to be quite attractive. On the other hand, over three-fourths of the participants agreed that the end products of uniforms manufactured from technology-driven machines and software are more attractive, presentable and high-quality.

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Vol. 11, No. 1 (2025), pp.746-765
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Quality Output of Technologies Used in the Industry

In addressing quality output based on technologies used in uniform production by these SMS, results indicating views of more than half of the participants suggested that outdated Machines/Technology influence quality output, as some stated that 'the uniform produced are not of high quality, as stitches *are not often straight, precision and fit are questionable as well'.*

In the case of using modern machines in producing school uniforms, the responses from the same participants, in the case of feedback on the product (school uniform), were positive. For instance, participants 'FC' and 'MDD indicated that *'the school uniform produced using modern machines is genuinely 'nice' and for the technology, 'excellent"*. On a case-by-case basis, the participants indicated that school uniforms produced with technological devices provided the best results, except in a few cases.

Quality of School Uniform Produced by SMS Firms

The result on the quality of mass-produced school uniforms had varied views expressed by the participants who have been producing uniforms for schools in large quantities. The most popular view expressed by participants indicates that most uniforms they produced massively are of good quality. This was expressed by 'MDD', 'MC', 'OTF', 'HF' and 'OFT'. Another opinion expressed by 'IF', 'OF', and 'SFC' was that *'they are doing their best despite the limitation',* implying that some of the SMS still need to improve on what they do.

Main Driving Force in Producing Quality School Uniforms

The participants had made it clear that all the SMS had a driving force that made them pursue what they were doing currently. Participants 'SFC', 'HF', 'OTF' and 'SDS' revealed their driving force was that they *'sew to impress clients',* and other participants, 'WT' and 'UF', said *'they sew well to penetrate the larger market'*. Others indicate *'we sew to fit and also to attract other customers.*

The result on how SMS can pride itself on producing good school uniforms shows that all the participants have responded in the affirmative that they could boast of their products' acceptance rate in the market. The frequent reason some participants gave was 'we do quality sewing'. Other participants, too, expressed other views such as 'we sew to impress our customers', 'we make quality products', and *'we are proud of our products'.*

The response to whether school uniforms sewn in Ghana can last the test of time in terms of quality or otherwise shows that out of the 15 participants, only four (4) of them had alluded to the fact that the school uniforms they sew can last the test of time. Some facts that buttress this assertion include *'quality seams and stitches'* and *'ironing is done well'*. Another comment is *'some of us are doing a good job'*. On the other hand, eleven (11) participants also believed that the school uniform sewn cannot stand the test of time compared to international standards since the uniforms are not being sewn well. This was alluded to with the explanation that when there is too much work to be done within a short period, management sometimes sublet contracts to outhouse contractors whose deliveries are below standard. Others also occur

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within the firm, as a participant, 'MDD', noted that *'some of the uniforms do not have interfacing and some have their crest turned upside down'.*

Some participants, six (6), expressed misgiving that their school uniforms could not be compared to those produced by big industries and similar products outside the country. These participants, 'SFC', 'SD', 'FC', 'IF' and 'HF', revealed that the machines used by SMS 'were not up to standard, *and some of the workers do not sew well'*. This was why SMS could not produce quality products that could match those produced by big manufacturing industries in Ghana and beyond.

Discussion

The analysis of the result from the question which sought to find out the kind of technologies (machines/software) SMS used to produce school uniforms in the Kumasi Metropolis has revealed that straight stitching industrial sewing machines, overlocking machines, cutting machines, button fixing the machine, button holing machine and CAD for pattern technology were used to produce school uniforms. The type of machines a company have in the apparel industry aids in the quality of the final production. Manual cutting was identified as creating much waste in the fabric used (Saeidi & Wimberley, 2017; Obinnim & Pongo, 2015).

In this study, it was found that there is only one SME that uses scissors instead of a cutting machine. Waste from fabrics while using the manual machines would significantly affect the firm's profit margin. As found in this study, a cutting machine would greatly reduce waste. Therefore, this would help achieve zero waste (Rissanen, 2013). Some participants (5) did not have embroidery machines, meaning they would have to send their embroidery works outside their firm to be done. This can trigger delays or even get products missing, affecting quality. An industry with fifty straight-stitching industrial sewing machines has only two over-lock machines, meaning there will be much pressure on them at pick times.

The Findings on the Use of Technology in Designing and Production of School Uniforms

The Findings on the use of Technology in Designing School Uniform clearly showed that most of the industries surveyed use manual processes in designing their school uniforms, and this would create much waste and, in the long term, affect the cost of the finished product (Kassah et al., 2022; Rissanen, 2013).

The finding, however, is that some participants were unaware of technologies that exist in designing apparel, while some were not even ready to learn about such technologies. It was also revealed that most SMS were not using software to help with school uniform production (Kassah et al., 2022). Very few have been using it, which would not augur nicely with their production quality and the time to meet deadlines. The cost implication could deter them from using software for their production. The result clearly emphasises that software used in the apparel industry is quite expensive. The cost of acquiring such software and machinery is high initially, but its future benefits might be much higher when doing an effect analysis in the long term (Kassah et al., 2022). Using software and machines and new technology like 3D body scanners helps reduce time, error, and even fabric waste. The long-term effect on quality and

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speed of production to meet customer satisfaction would far outweigh the use of manual and non-computerised production systems.

The high cost of acquiring new technology might have informed the finding that the SMS replacement of machines and technology was exceedingly rare. The result confirmed that modern machines and technologies make the finished school uniform attractive and professional. The seams of the industrial sewing machines give good stitches that add to the quality of the finished school uniform. The implication of using outdated technology in producing school uniforms would be a reduced ordering for new consignments since the finished ones were not good quality. The situation that might arise is that the firm might miss out on growth, suffer technological stagnation, and customers would look elsewhere for their subsequent requests. Customers would be making new decisions to get the best for their purchasing power, meaning the firm will lose the trust of its existing customers (Stratpoint Technologies, 2024), and the end effect will be losing their old customers.

How Technology Contribute to Quality Output of School Uniforms

The contribution of technologies to producing quality school uniforms by these SMS indicated that most of the machines used in the cutting, pattern preparation, sewing and button fixing influence the output positively to a greater extent. A well-equipped modern industry with up-to-date software and machines in the fashion firm will produce better results than outdated ones. Using Grading software in pattern preparation saves time and energy when making manual patterns of different sizes. Pattern grading is suitable for mass production, where SMS must make garments that people of different body types can make, but these SMS do not grade their patterns.

Most respondents did not know or even hear of the latest sophisticated 3D body scanners. This indicates that most of the SMS that sewed for the public do not explore the latest technology in the manufacturing industries. They attributed this to lost technological knowledge of new developments, which the SMS admitted affects production by slowing down the output of their jobs. The output from outdated machines was less than that from modern machines or technologies (Techpacker, 2023; Joseph-Armstrong, 2010; Bhati, 2011).

Modern technology also calls for experts who can handle such machines. It would be a waste to procure such machines. The result revealed that the SMS produced good school uniforms despite a few lapses in the final products. An earlier study noted that SMS had rated themselves excellent in sewing (Koranteng, 2015). However, the current study did not support such a fact as the finding was not excellent but good on average. Results from finished products cannot only be attributed to modern or outdated technology or machines but are partly influenced by technocrats in the production line.

The participants believed they could not produce the best school uniform compared to the big industries within or outside the country. The uncompetitive nature of SMS in large manufacturing industries could lead to losing jobs or contracts with other companies, which may lead to the folding up of jobs for SMS. The big manufacturing companies would take up

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equally available contracts for which they can compete. Quality products usually sell faster since everyone wants the best. Earlier users of such a product would, therefore, recommend it to others. Producing quality school uniforms must start with planning and batch production, and the client, being the final consumer, must be factored into the overall production cycle. Without the consumer in mind, production should not even start. The product must be tailored to the way the customer wants it.

CONCLUSION

Manufacturing school uniforms by small/medium industries in the Kumasi Metropolitan Area had brought different experiences from their job training. The training and professional background of those working in the garment industries have helped them practise their trade less easily. Using different machines to sew school uniforms helps add a professional touch to the school uniforms that have been sewn. Cutting machines are to help reduce the waste of fabric during cutting. Due to financial constraints, the procurement of modern technologies by SMS industries in Kumasi was a great challenge to them.

Though the industries in the Metropolis have limited technologies for producing school uniforms, they can meet their clients' demands. The industries have been in business for these while other big manufacturing industries were doing their best. The expertise needed in the garment industry is mostly for designing and operating modern machines to produce quality products for their clients.

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