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Technology choices in Nigerian textile industry

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Abstract

The study examined technological choices available in the Nigerian textile industry and assessed factors influencing the choices. Three states (Lagos, Kano and Kaduna) where there is active textile production were purposively selected. All 18 textile firms in the states made up the sample for the study. Data were collected using structured questionnaires and interviews. The results showed that the majority of the textile firms chose Sulzer (44.4%) and Alpha circular machines (16.7%) for their weaving operations. Dyeing was carried out with Jumbo jet machines (33.3%) while printing operations were done with OBEM (27.8%) and Flexo machines (11.1%). The results further revealed that access to loans ($r = 0.523$, $p < 0.05$), complexity of the technology ($r = 0.542$, $p < 0.05$), compatibility ($r = 0.484$, $p < 0.05$), labour ($r = 0.686$, $p < 0.01$), and location of the firms ($r = 0.775$, $p < 0.010$) were the main factors that significantly influenced technology choices in weaving, printing, dyeing, and finishing. It is recommended that the use of modern machines and software be adopted by textile firms in Nigeria.

KEYWORDS: CHOICES, PRODUCTION, TEXTILE, WEAVING, TECHNOLOGY

Introduction

Globally, the textile industry is strategic to the nation's overall industrialisation efforts and is imperative in the advancement of social, economic and industrial activity of many nations (Akalin, 2001). Textile manufacturing involves the use of technology to make textile products for human, industrial and household consumption. These textile products are in daily use and can be in the form of clothing, apparel and furnishings (Diyaolu, 2016). The demand for labour and machinery in the industry is high, making it a source of employment and income generation.

Over the years, the Nigerian textile industry has been experiencing challenges hindering effective operations (Makinde, Fajuyigbe, & Ajiboye, 2015). Most of these challenges are smuggling of finished fabrics, low level of power supply, low patronage and raw material acquisition among others (Gherzi, 2013). There has been no detailed study on the choice of technology used in manufacturing among firms and factors influencing the choices (Varukolu, 2007). The technology chosen in the production of textiles ultimately affects the quality, cost and delivery of the products (Besterfield, Besterfield-Michna, Besterfield, & Besterfield-Sacre, 2003). The inability of Nigerian textile firms to purchase new and automated machinery can contribute to low-level operations in the industry. Furthermore,

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while advancements in textile manufacturing in developed countries like China and United States of America are tending towards nanotechnology and smart textiles (Berglin, 2013), textile firms in Nigeria are yet to follow this trend.

Technology has emerged as an important determinant of competitiveness in the increasingly globalised and knowledge-based economy. The technology, which may be hardware (in the form of machines) or computer software, aims at enhancing better, faster and safer production methods while achieving the goal of consumer satisfaction (Bayazit, 2003; Demirbag, Tatoglu, Tekinkus, & Zaim, 2006). The types of machine selected for any of the operations, such as weaving, spinning and dyeing, impacts greatly on the quality of the output. This can affect patronage, profitability and performance in the industry. It is, therefore, crucial to choose the right technologies that meet the needs of the organisation.

The size of the firm affects the choice of technology. Smaller firms may not have the financial and human resources to afford complex systems. Thus, it is necessary for textile firms to remain competitive by applying new technological innovations in design and manufacturing as well as providing good quality products for customers' satisfaction. Gherzi (2013) opined that there is an urgent need to assess the viability of technology employed in production among textile firms in Nigeria. This study, therefore, examined the technology choices in production among textile firms in Nigeria and assessed the factors influencing the choice of technologies employed in the industry.

Methodology

The population of the study consists of all textile manufacturing firms in Nigeria. According to the Nigerian Textile Manufacturers Association (2014), out of 33 existing firms, the majority are located in Lagos, Kano and Kaduna States. Therefore, purposive sampling was used to select these three states for the study. All the firms in Lagos (10), Kano (7) and Kaduna States (1) were selected, making a total of 18 firms. General managers and production managers in all the firms completed the questionnaire to obtain relevant information on the choice of technology used. These managers are believed to have a broad range of knowledge and to be pivotal in technology choices and decision-making in the industry. Data were collected and analysed using SPSS. Percentages were used to describe the technology choices while bi-serial correlation and regression were used to examine the relationships among the selected factors and technology choices. All analysis was carried out at 5% level of significance.

Results

Choice of machines used for textile production in Nigeria

The results in Table 1 show the machines used in the firms for production processes. Most of the firms (44.4%) used Sulzer weaving machines while others used Kapps weaving machines (16.7%) which is an older model of weaving machine. About 33.3% carried out dyeing operations with Jumbo jet machines while 22.2% used winch dyeing baths. Manufacturers employed the use of Flexo printing machines (11.1%) and OBEM dyeing machines (22.2%). Knitting was achieved with Camber knitting machines (16.7%). The singeing finishing operation was achieved with the aid of Bailing and singeing machines (33.3%).

Table 1 **Choice of machines used in production**

Operations	Machines	Number of firms	Percentage
Weaving	Sulzer	8	44.4
	Kapps	3	16.7
	Alpha circular	3	16.7
Dyeing	Jumbo jet	6	33.3
	Winch dyeing bath	4	22.2
	Jigger jet	2	11.1
Printing	Flexo machine	2	11.1
	OBEM machine	5	27.8
	Rotary screen printing	2	11.1
Knitting	Camber machine	3	16.7

Operations	Machines	Number of firms	Percentage
Finishing	Matex Stenter	2	11.1
	Adstarkon 60	2	11.1
	Bailing and singeing	6	33.3
	Decartising machine	2	11.1

Choice of computer software

Table 2 reveals the choices of computer software used in the industry. The majority (83.3%) installed Numerical Control Machines and Statistical Process Control. Also, 50.0% employed the use of Computer Aided Design (CAD) in production. About 22.2% employed Computer Aided Manufacturing (CAM) in the industry. Automated Inspection is installed in 22.2% of firms. Most (88.9%) of the firms make use of Information and Communication Technology to communicate with clients. These include phone calls, internet and short message services.

Table 2 Choice of computer software used in the textile firms

Software	Number of firms	Percentage*
Computer Aided Designs	9	50
Computer Aided Manufacturing	4	22.2
Automated Inspection	4	22.2
Automated Material Handling Device	9	50
Numerical control machine	15	83.3
Statistical Process Control	15	83.3
Production Planning Software	11	61.1
Inventory management software	14	77.8
Information & Communication Technology	16	88.9

*Multiple responses

Correlation of technology choices of production process and factors influencing the choices

Table 3 shows the correlation between choice of technology for various processes and factors influencing the choice. Access to loans had a significant relationship with technology choices for dyeing (r = 0.523, p < 0.05), printing (r = 0.523, p < 0.05) and finishing (r = 0.523, p < 0.05). Complexity of technology had a significant relationship with technology choices for knitting (r = 0.542, p < 0.01) in the textile firms. Availability of labour was also significantly related to the choice of technology in weaving (r = 0.686, p < 0.01) and knitting (r = 0.837, p < 0.01) while size of the firm (r = 0.542, p < 0.05) and location (r = 0.775, p < 0.05) were significantly associated with technology choices in weaving and finishing, respectively.

Table 3 Correlation analysis of technology choices and factors influencing the choice

Variables	Weaving *r*	Dyeing *r*	Printing *r*	Knitting *r*	Finishing *r*
Awareness	0.193	-0.255	0.343	-0.106	-0.255
Access to loans	0.314	0.523*	0.523*	-0.51	0.523*
Level of effort	-0.065	0.269	0.269	0.277	0.269
Affordability	0.389	0.224	-0.151	0.238	0.254*
Perceived value	0.081	0.304	0.304	-0.158	0.304
Complexity	0.193	-0.255	0.255	0.542*	-0.255
Compatibility	0.484*	0.670**	0.670**	-0.400	0.670**
Observability	0.542	0.152	0.033	0.120	0.122
Labour	0.686**	-0.051	0.277	0.837**	-0.051
Size of firms	0.542	0.112	-0.255	0.120	0.122
Government policy	-0.378	0.081	-0.236	0.316	0.316

Variables	Weaving *r*	Dyeing *r*	Printing *r*	Knitting *r*	Finishing *r*
Market forces	0.293	0.255	-0.151	0.258	0.255
Age of firms	-0.107	0.215	0.107	0.196	0.244
Education	0.359	0.120	0.096	0.354	-0.027
Location	0.238	0.343	-0.106	0.102	0.775**

* $p < 0.05$; ** $p < 0.01$; r = correlation coefficient

Effect of factors influencing technology choices in textile industry

Table 4 presents the result of multiple linear regression analysis showing the relationship between choice of machines and the factors influencing the choices. There is a strong positive relationship between the choice of machines and the factors influencing the choice ($R = 0.980$). The factors that were in the model accounted for approximately 97% of the variance in the choice of machines (the coefficient of determination R^2 was 0.960). The result of Analysis of Variance revealed that the model is fit ($F = 13.057$, $p = 0.003$). Furthermore, awareness of new technology ($p > 0.05$), complexity of the technology ($p > 0.05$), age of the firm ($p > 0.05$) and educational qualification ($p > 0.05$) were not significant predictors of choice of machines.

However, access to loans was a significant predictor of choice of machines ($p < 0.05$). The coefficient for access to loans was 12.645 and this indicated that a unit increase in the access to loans will cause increase in the choice of machines by 12.645 unit, other factors held constant. The level of efforts to implement the technology was also a significant predictor of choice of machines ($p < 0.05$). The coefficient of determination was 11.275 implying that a unit increase in the level of effort to implement the technology will cause 11.275 increase in the choice of technology. Affordability (high cost of technology) was a significant predictor of choice of machines ($p < 0.05$). The coefficient for affordability was -32.713 and this indicated that a unit increase in the cost of the technology will cause 32.713 decrease in the choice of machines. Thus, when the cost of a new technology is high, firms might not be able to choose such technology.

Table 4 Regression Analysis of factors influencing choice of technology in Nigerian textile industry

	Unstandardised Coefficients		Standardised Coefficients		
Variables	**B**	**Std. Error**	**Beta**	**T**	**p**
(Constant)	98.047	4.604		21.294	0.000
Awareness of new technology	1.195	1.754	0.141	0.681	0.521
Access to loan	12.645	2.481	1.371	5.097	0.002
Level of effort to implement	11.275	1.754	1.331	6.427	0.001
Affordability	-32.713	6.379	-2.489	-5.128	0.002
Perceived value	-47.437	9.374	-2.631	-5.060	0.002
Complexity of the technology	0.092	1.308	0.011	0.070	0.946
Compatibility of the technology	-17.167	2.188	-1.728	-7.846	0.000
Observability with other technologies	9.925	1.754	0.999	5.658	0.001
Labour	0.667	4.133	0 .161	0.877	0.001
Size of the firm	9.313	1.654	0.938	5.631	0.001
Market forces	11.018	4.492	0.994	2.453	0.05
Government policies on tax, importation	32.637	6.379	2.484	5.116	0.002
Age of firms	-0.333	4.133	-0.081	938.000	1.000
Education	0.083	1.200	0.230	0.418	0.691
Location	0.517	658.000	1.070	0.754	0.004

Note. Model Diagnosis: $R = 0.980$; R Square = 0.960, $F = 13.057$, $p = 0.003$

Discussion

The weaving machine most commonly used in the firms is the Sulzer weaving machine used for cotton weaving. This is a shuttle-operated machine that has a limitation in the fabric produced in metres per hour. According to ILO (2004), non-shuttle Sulzer machines weave 13.30 metres/loom/hour compared to shuttle looms that weave 5.36 metres/loom/hour. The rate of production between shuttle and non-shuttle looms dictate how efficient the firms are in meeting customer demands. Constant innovation and adoption of new technology is an essential element for competitive advantage in the global market as firms can maintain quick and flexible responses to market demand using the technologies (Özçelik & Taymaz, 2004).

Kapps weaving machine (shuttle) is used for the production of blankets and floor dusters. All major developments in weaving machinery have been geared towards increasing productivity, improving fabric quality and reducing the number of operations. This should reflect in the installed machines in the firms. Ibrahim, Hassan, and Sule (2013) classified weaving machines according to the methods of picking or weft insertion into projectile, rapier, and air-jet. Itema America (2015) asserts that there are modern weaving machines that enhance better manufacturing in textile production. The weaving machines available in the firms are relatively cheap and not greatly demanding in technical supervision as ILO (2004) reported that air-jet weaving machines are too expensive, technically demanding and suitable for large-scale production.

Circular weaving machines are employed in weaving polypropylene bags (packaging sacks). The machine uses six shuttles and weaves quickly. Parisi (2014) observed that there are OBEM dyeing machines that are fully robotized, developed for wool, cotton, acrylic, polyester, viscose, and blends that require a limited number of operators.

The software technologies used in the firms include Computer Aided Design used among half of the firms. This is a part of Computer Integrated Manufacturing which reduces design cost. Computer Aided Manufacturing (22.2%) increases productivity and improves product quality. Computer Aided Design and Computer Aided Manufacturing offer broad capacity for textile designing and manufacturing by providing a wide application in the design of bed covers, towels, suiting, shirting and so on (Siemens, 2016). The use of this kind of software is uncommon in the Nigerian firms. Managers can also use statistical process control to evaluate the output of a process and determine its acceptability by taking periodic samples from the process and comparing with a predetermined standard.

Access to loans for making better choices of machines and software can positively impact the industry. Interest rates on available loans were reported to be too high, making it inaccessible to firms. The complexity of the technology to be chosen in the firm is another influencing factor. If there are no capable technical staff that are well-equipped to manage and maintain new technology, the firms will find it difficult to adopt the technology. The applicable technology should fit the existing production processes without requiring any major modification (Linstone, 1999).

Increased production capacity and increased customer loyalty are attested to by 27.8% each. This shows that the choices had little influence on the production capacity and customer loyalty. However, 61.1% and 33.3% of firms enjoyed improved productivity and improved quality respectively. It is believed that better choices will increase the productivity and quality. Cooper (1996) mentioned that successful manufacturing industries get more than 49% of their profit from new products differentiated by incorporating new technologies.

Conclusion

The technology used for weaving in textile firms in Nigeria is mostly Sulzer weaving machines. The use of Computer Aided Design and Computer Aided Manufacturing which should improve product quality is low. These choices are being influenced by the complexity of the technology, compatibility and ability of the firms to access loans. Textile firms in Nigeria should, therefore, choose more recent technology which will lead to better operations. In addition, there should be incentives from the government in the form of loans with low interest rates to the existing textile firms.

Biographies

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References

Akalin, M. (2001). Insight into the Turkish textile and apparel industry. *Electronic Journal of Textiles, 1*(1), 1-6.

Bayazit, O. (2003). Total Quality Management (TQM) practices in Turkish Manufacturing organizations. *The Total Quality Management Magazine, 15*(5), 345-350.

Berglin, L. (2013). *Smart Textiles and Wearable Technology—A study of smart textiles in fashion and clothing*. A report within the Baltic Fashion Project, published by the Swedish School of Textiles, University of Borås.

Besterfield, D. H., Besterfield-Michna, C., Besterfield, G. H., & Besterfield-Sacre, M. (2003). *Total Quality Management*. (3rd ed., pp. 34-56). New Delhi, India: Prentice-Hall.

Cooper, R. G. (1996). Overhauling the new product process. *Industrial Marketing Management, 25*(6), 465-482.

Demirbag, M., Tatoglu, E., Tekinkus, M., & Zaim, S. (2006). An analysis of the relationship between Total Quality Management implementation and organizational performance: Evidence from Turkish SMEs. *Journal of Manufacturing Technology Management, 17*(6), 829-847.

Diyaolu, I. J. (2016). *Technology Assessment of Nigerian Textile Industry*. Unpublished PhD thesis, African Institute for Science Policy and Innovation, Faculty of Technology, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

Gherzi (2013). *Nigerian Industrial Revolution Plan (NIRP) —Revival of the Textile Industry. A Cotton, Textile and Garment Sector Study in Nigeria* (pp. 3-66). Abuja, Nigeria: Federal Ministry of Industry, Trade and Investment.

Ibrahim, H. D., Hassan, U. A., & Sule, Y. O. (2013). *Textile Fibres, Fabrics and Dyes* (pp. 8-18). Zaria, Nigeria: Ahmadu Bello University Press Limited.

International Labour Organisation (2004). *Small Scale Weaving*. (Technology series—Technical memorandum, No.4, pp. 70-88). Geneva, Switzerland: International Labour Office & the United Nations Industrial Development Organisation.

Itema America. (2015). *Weaving machines*. Available online at http://www.itemausa.com/weaving-machines.php. (Accessed November 10, 2015).

Linstone, H. A. (1999). *Decision Making Technology Executives: Using Multiple Perspectives to Improve Performance* (p. 110). Massachusetts, USA: Artech House.

Makinde, D. O., Fajuyigbe, M. O., & Ajiboye, O. J. (2015). Nigerian Textile Industry: A Tool for Actualising Economic Stability and National Development. *European Journal of Business and Social Sciences, 4*(8), 331–344.

Nigerian Textile Manufacturers Association (2014). *List of operating members, addresses and telephone numbers* (pp. 1-4). Lagos, Nigeria: Author.

Özçelik, E., & Taymaz, E. (2004). Does innovativeness matter for international competitiveness in developing countries? The case of Turkish manufacturing industries. *Research Policy, 33*(3), 409-424.

Parisi, S. (2014). *Fully Robotized Dyeing Plants*. Retrieved from http://www.technofashionworld.com/fully-robotized-dyeing-plants-2/

Siemens (2016). *Computer-Aided Design*. Retrieved from http://www.plm.automation.siemens.com/en_us/plm/cad.shtml.

Varukolu, V. (2007). *Technology Adoption of Indian Garment Manufacturing Firms.* A Master of Science Thesis, Agricultural and Mechanical College, Graduate Faculty of the Louisiana State University, Baton Rouge, USA.