

SUSTAINABLE MANUFACTURING STRATEGIES AND PRODUCTION EFFICIENCY OF MULTINATIONAL FIRMS IN NAIROBI, KENYA

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ABSTRACT: Purpose: The objectives of this study were to determine the sustainable manufacturing strategies commonly used by multinational firms in Nairobi and to establish the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi, Kenya. **Design/Research method:** This study used a descriptive research design. The target population consisted of 164 manufacturing firms. The quantitative data collected was analysed by the use of descriptive statistics using Statistical Package for Social Sciences (SPSS). A regression analysis was applied to determine the relationship between manufacturing strategy and production efficiency. **Finding:** The manufacturing multinational firms adopted total quality management, production planning & control and plant & equipment maintenance strategies which contribute a major part of the production efficiency of multinational firms in Nairobi. The study concludes that most of the manufacturing multinational firms re-evaluate the manufacturing strategies regularly to ensure that they are sustainable and relevant to facilitate efficiency in production. **Limitation:** The study was limited to sustainable manufacturing strategies. There is need to focus on other manufacturing strategies especially on how they influenced performance. **Implication:** This study recommends the adoption and implementation of manufacturing strategy as it will enable the manufacturing multinational firms optimize their production efficiency in terms of production cost per unit, product quality and product development time. The multinational firms should integrate their resources efficiently to enhance their operations and adopt the manufacturing models developed to align with their operations and target customers.

Keywords: Sustainable Manufacturing Strategies, Production Efficiency, Multinational Firms, Kenya.

1. INTRODUCTION

The overall goal of any company is its long-time survival and the ability to produce useful outputs. Therefore, at the heart of the success of an organization lies on its ability to strategically position itself to winning. The concept of strategy comes from the military, so usually it is said that it has been borrowed from the military and is used in the business. Strategy is that which the top management does and which is of great importance to the organization. Strategy refers to the basic directional decisions that are to the purposes and the missions. Strategy consists of the important actions necessary for the realization of these directions (Hallgren, 2007).

The term multinational corporation refers to all those business activities, which involves cross border transactions of goods, services, resources between two or more nations. Transaction of economic resources includes capital, skills and people. for International production of physical goods and services such as, transport, telecommunication, banking and food products (Buckley, 2009).

1.1. Research Problem

In the midst of changes in the global manufacturing scene, the global manufacturing scene has experienced rapid changes owing to their numerical dominance, dispersal across almost all industry sectors, and local market focus, manufacturing firms have a central role to play in meeting the supply needs of the citizens and organizations in general (Woldesenbet *et al.*, 2012). The manufacturing industry contributes a large share of the industrial sector in developed countries. According to (Emily *et al.*, 2016), U.S. manufacturing accounts for 35 percent of value added in all of the world's high technology production, and enjoys a trade surplus in revenues from royalties from production processes and technology. In addition, 57% of all U.S. exports are in manufactured goods. (Anton *et al.*, 2016) indicated that manufacturing output contributed £162 billion (10%) of the total UK economy in year 2016. According to World Bank (2016), manufacturing accounts for 14% of GDP in Kenya. Jain *et al.* (2018)

state that every manufacturing activity requires resource input in terms of workforce, materials, equipment and machines. For maximum effectiveness, this must be done in such a way that customers' demands are satisfied, but at the same time production activities are carried on in an economic manner. However, the problems experienced in production result in disturbances in the flow of products and materials (Ward *et al.*, 2007). In any business that produces a product or service production activity must be related to market demands as indicated by the continuous stream of customers' orders. Managers have no clear understanding of the manufacturing task facing the organization and these results into a mismatch between manufacturing strategy and the market requirements (Skinner, 1969). This consequently leads to longer lead times, longer manufacturing cycle times, delayed / cancelled orders and excess inventory.

There have been several studies linking manufacturing strategy to performance efficiency; however, most of the research has been confined to different contexts. (Nolwenn and Vanhems, 2012) analysed firms' efficiency in the Ivorian manufacturing sector and found that the emphasis on certain manufacturing priorities and decisions or practices and their internal understanding could be the basis for achieving sustainable advantages over competitors. Mohammad and Muhammad (2017) evaluated managerial efficiency of petrochemical firms in Saudi Arabia and found that manufacturing strategies are pursued by large manufacturing firms as a way of remaining afloat in the turbulent environment.

1.2. Research Focus

The manufacturing function plays a fundamental role in its pursuit of competitiveness. It is therefore critical to formulate an appropriate manufacturing strategy that will enable the manufacturing function to contribute to the company's long-term competitiveness (Kolinski, 2010). According to Krajewski *et al.* (2013), sustainable manufacturing strategy is a functional-level strategy and is a component of a firm's business-level strategy and specifies the means by which operations implements corporate strategy and helps to build a customer driven firm. Slack and Lewis (2011) indicated that sustainable manufacturing strategy is a plan for developing resources and configuring processes such that the resulting competencies maximize net present value. Miguel and Brito (2011) state that the competitive priorities framework can be thought as way to conceptualize and measure operational performance or even competitiveness.

Locally, Kioko and Were (2014) conducted a study on factors affecting efficiency of the procurement function at Supplies Branch in Nairobi and study found that procurement staff competencies, legal framework, institutional culture and Information Communication Technology (ICT) positively affect the efficiency of the procurement function in public institutions in Kenya. Musyimi (2012) studied the manufacturing strategy in small and medium scale enterprises in Kenya and revealed that the primary aim of a manufacturing strategy in SMEs is to ensure that all long-term manufacturing developments are congruent with the overall business strategy or competitive priorities of the firm. None of these studies examined the correlation between manufacturing strategy and production efficiency. It was against this backdrop that the study sought to answer the following research question: What is the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi?

The objectives of this study were: to determine the sustainable manufacturing strategies commonly used by multinational firms in Nairobi, Kenya; and to establish the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi, Kenya.

2. LITERATURE REVIEW

This literature review was undertaken to bring out the gaps and enhance knowledge related to the research problem. Accordingly, this chapter captures the major issues relating to the relationship between sustainable manufacturing strategies and production efficiency. The submissions and thoughts of various authors on exchange rates and economic growth are reviewed and discussed under theoretical literature review and empirical review.

There are various essential theories which highlight the exchange rates and economic growth. This study is grounded on Juran Trilogy and Theory of Constraints. The Theory of Constraints (TOC) is largely adopted, normally with the five-step process or with the rope-drum-buffer technique (Messinger and Narasimhan, 1995). The Theory of constraints was pioneered by Eli Goldratt. It identifies that organizations' resources are limited. It can be used to find the root of variables limiting the organization's performance. The theory states that every system, no matter how well it performs, has at least one constraint that limits its performance- this is the system's weakest link (Manktelow, 2015) Companies must identify these limitations and eliminate them to attain smooth operations. It is based on limitations of organizational and market variables (Librelato *et al.*, 2016).

2.1. Sustainable Manufacturing Strategies and Production Efficiency

Effective use of materials is one possible component of a sustainable manufacturing strategy. There are many such strategies used in practice, with confusion over what they are, what the differences among them may be and how they can be used by practitioners in design and manufacture to improve the sustainability of their product and processes. [Karim and Arif-Uz-Zaman \(2013\)](#) did a study on a methodology for effective implementation of lean strategies and its performance evaluation in manufacturing organizations. The research was applied to an Australian company manufacturing medium voltage switchgear products. The types of waste were identified through process mapping and time studies. They then developed an improved process map. They evaluated process efficiency and effectiveness by using an established continuous performance measurement (CPM) metric. From their findings, moving, holding and handling distance and time had drastically improved. The distance moved by the operators as well as holding and handling times had been reduced significantly by the proposed method and layout, efficiency and effectiveness of the new process had improved and waste cut from the process.

[Hong-Sen et al. \(2013\)](#) addressed the closely related problems of production planning and scheduling on mixed model automobile assembly lines. They proposed an integrated solution, in which a production plan that was feasible with respect to aggregate capacity constraint was developed and then a sequence that was feasible with respect to this plan was sought. They proposed three tabu-search-based algorithms that explore the solution spaces for both problems to different degrees to find a combination of a production plan and schedule that were feasible and that approximately optimized the objective function (involving the overproduction and underproduction of finished automobiles, the set up cost, the idle times of work cells on the line, the make span and the load deviations among work cells). Simulation was used to evaluate alternative schedules.

[Mula et al. \(2012\)](#), presented a new linear programming model for medium term production planning in a capacity constrained MRP, multi-product, multi-level and multi-period manufacturing environment. This paper provided three fuzzy models with flexibility in the objective function. The paper demonstrated the usefulness and significance of MRP modeling with flexible constraints under uncertainty in demand. Their model was tested using real data from an automobile seat manufacturer. This study seeks to investigate the relationship between manufacturing strategies and production efficiency of manufacturing firms in Kenya.

3. RESEARCH METHODS

This section discusses the various aspects of research methodology that were adopted in this study.

3.1. Research Design

This study used a descriptive research design. A descriptive design is a scientific method that involves observation and description of the subject's behaviour without influencing it in any way ([Cooper and Schindler, 2011](#)). This design enabled the researcher establish how the variables relate to each other ([Magutu et al., 2015](#); [Magutu et al., 2016](#); [Mose et al., 2013](#); [Mugenda and Mugenda, 2012](#)) and it also provided the researcher with the appropriate procedure for examining the relationship between manufacturing strategies and production efficiency of multinational firms in Kenya.

3.2. Populations of the Study

The study focused on multinational manufacturing firms in Kenya since they are highly involved in manufacturing strategies for production efficiency. According Kenya Investment Authority (2017), there were 214 Multinational companies operating in Kenya. The study focused on manufacturing firms with headquarters in Nairobi which are key players in the manufacturing sector whose production efficiency is of great importance to the management, employees, investors and the nation in general.

From the 164-food manufacturing MNCs the study selected 30% of the firms to conduct the study on the relationship between manufacturing strategies and production efficiency of multinational firms in Kenya. The sample captured 30% (48) of the manufacturing MNCs in the sampling frame to comprise the sample as advocated by [Gall et al. \(1996\)](#).

3.3. Data Collection

The study collected primary data using a questionnaire. The questionnaire method is considered appropriate for this study since it is an inexpensive method of data collection as it is administered collectively to a study population. It also offers great anonymity hence respondents are sure of confidentiality. The structure of the questionnaire included structured and semi-structured questions as this provided the flexibility for specific and unique responses to some of the questions. The questionnaires contained open ended and closed ended questions all briefly stated and well-focused in recognition of the busy schedule of the participants. The structured questions are normally closed ended with alternatives from which the respondent is expected to choose the most appropriate answer.

3.4. Data Analysis

The data collected was first cleaned, then sorted and coded using numerical numbers. The data was then entered in the SPSS software after which analysis was done. The quantitative data collected was analyzed by the use of descriptive statistics using Statistical Package for Social Sciences (SPSS) in terms of averages, minimum, maximum, means and standard deviations. The data was analyzed in accordance with the objectives of the study. SPSS (version 23.0) was used as a tool to analyze the data. The information was displayed by use of tables, figures. This was done by tallying up responses, computing percentages of variations in response as well as describing and interpreting the data in line with the study objectives.

Additionally, regression analysis was applied to determine the relationship between manufacturing strategies and production efficiency of multinational firms in Kenya. The regression model was as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \epsilon$$

Where Y = production efficiency, X_1 is total quality management, X_2 is lean manufacturing strategy, X_3 is production planning and control, X_4 is plant & equipment maintenance, X_5 is reduced set up time, X_6 is lot production, X_7 is employee involvement and empowerment and X_8 is push and pull production. Further, β_0 is a constant, $\beta_1, \beta_2, \beta_3$ and are regression coefficients and ϵ is an error term.

4. RESULTS AND DISCUSSIONS

4.1. Introduction

The purpose of this study was to establish the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi.

4.2. Response Rate

During data collection, the researchers administered a total of 48 questionnaires to the senior management (CEO, Managing Director or senior manager) working in the multinational manufacturing firms in Nairobi, Kenya. From the study, the researchers successfully received responses from 44 respondents. The received research instruments were complete and taken as valid for data analysis which translated to a response rate of 91.7%. According to [Kothari \(2004\)](#), a response rate of 50% or above is adequate for making conclusions and recommendations. This implies that the response rate of 91.7% is satisfactory and good for analysis, drawing conclusions and making recommendations. The response rate was improved by the use of drop and pick method, follow-up telephone calls to the respondents, personal visits and explanation of the purpose of the study and its usefulness to the organization. This was supplemented with a letter of introduction from the University of Nairobi.

4.3. Demographic Information

The general information breaks down the features of the study population. Several aspects were used to describe the respondents and the organization. To get the background information, the demographic data of the respondents was investigated in the first section of the questionnaire. The data comprised of respondents' gender, age bracket, highest level of education, duration worked in the organization and category of employee in the organizational structure.

4.4. Gender of the Respondents

The government of Kenya has a requirement on gender equality and a third representation on gender mainstreaming. The respondents were asked to indicate their gender. The subject of gender is considered fundamental in this study largely because it could help the researcher get a balanced view from

both genders. From the research findings, 54.5% of the respondents were male while 45.5% were female. These results show that the multinational manufacturing firms in Nairobi have both male and female staffs and views expressed in these findings can be taken as representative of the opinions of both genders.

4.5. Age Brackets of the Respondents

Management of firms more so senior management has for long been a preserve of certain age groups above the ages of 45. This bias is allegedly informed by the notion that younger people are more reckless and hence cannot be trusted with decision making. However, this seems not to be the case in multinational firms where management also consisted of personnel whose age bracket fell in the years below 35. The study sought to ascertain the composition of the respondents in terms of age brackets. This data was sought since the age bracket of the respondents plays a critical role in understanding the issues sought by the study.

Majority of the respondents (29.5%) were aged between 36 and 40 years. In addition, 29.5% of the respondents indicated that they were aged between 41 and 45 years, 22.7% of them were aged between 46 and 50 years, 11.4% were between 31 and 35 years old while 6.8% of the respondents were people whose ages fell between 26 and 30 years. These results demonstrated that the respondents were well distributed in terms of age hence different views across varying ages are accounted. This implies that they have a significant level of work experience- long enough to understand the adoption of manufacturing strategies in the MNCs. It also implies that firms are slowly entrusting senior management of their firms to the younger and more dynamic personnel.

4.6. Working Experience

In the recruitment of individuals to work in any category, prior work experience is a major success factor in selection of the best individual for the position. The paradox of this is that you need to first work before you can gain the requisite experience that employers look for in potential candidates. The respondents were requested to indicate the number of years that they had been working in the organization. Working experience is critical since it reviews the respondents' understanding of the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi. The results shown in Figure 2 reveal that 43.2% of the respondents had been working in the MNCs for a period of between 6 and 10 years, 25.0% of them had worked with their firms for between 11 and 15 years, 18.2% of the respondents had worked with the manufacturing MNCs for 16 to 20 years, while 13.6% of them indicated that they had been working with the MNCs for a period of less than 5 years. The results of the study were explained to mean that most participants had been working in the firm for a significant period. This therefore meant that they were sufficiently informed of the goings-ons in the firm.

4.7. Designation of the Respondents

Most organizations are centrally structured in such a way that decision making is a preserve of the senior management. This study sought to establish the distribution of the respondents in the various job levels in the organizational structures of the manufacturing MNCs so as to ascertain the respondents' impact on decisions affecting the firm's manufacturing strategy. From the research findings, 59.1% of the respondents indicated that they were assistant managers in the manufacturing MNCs in Nairobi, 34.1% of them were unit/departmental managers, while 6.8% of the respondents comprised of senior managers. These findings show that the respondents that participated in the study were mainly those involved in the formulation and implementation of the decisions concerned with sustainable manufacturing strategies and production efficiency of manufacturing multinational firms in Nairobi.

4.8. Level of Education

Education and skill levels is key in implementing any best practices in manufacturing sector and multinational companies consider it as one of the basic requirements to employment and possible consideration for managerial positions. The study therefore considered this question key in this study. The study results reveal that, 72.7% of the respondents had acquired bachelors' degrees, 20.5% of the respondents indicated that they had acquired master's degrees, while 6.8% of them had acquired college diplomas as the highest level of education. This result imply that majority of the respondents had at least a university degree level of education and hence understood the information sought by this study.

4.9. Number of Employees

Large enterprises, such as multinational companies, are believed to contribute significantly to the Country's GDP through their operations. As such the study sought to establish the number of employees in the MNCs in Nairobi. From the study, majority of the respondents (shown by 59.1%) unanimously recapped that their MNCs had between 301 and 500 employees, 25.0% of them indicated that their MNCs had between 501 and 700 employees, 11.4% of the respondents were drawn from manufacturing MNCs which employed 100 to 300 employees, while 4.5% of the respondents worked in MNCs with between 701 and 1000 employees. These results imply that the respondents worked in MNCs mainly comprising of a large number of employees hence, the findings in the study are representative of the real situation of the sustainable manufacturing strategies and production efficiency of MNCs in Nairobi.

4.10. Sustainable Manufacturing Strategies and Production Efficiency

The study sought to determine the sustainable manufacturing strategies commonly used by multinational firms in Nairobi. Accordingly, the respondents were requested to indicate the extent to which the manufacturing MNCs adopted sustainable manufacturing strategies in their operations. From the results 38.6% of the respondents reiterated that the manufacturing MNCs adopted sustainable manufacturing strategies in their operations to a great extent, 36.4% of them argued that their firms adopted sustainable manufacturing strategies in their operations to a moderate extent, 15.9% indicated to a very great extent and 9.10% of the respondents reported that the MNCs adopted sustainable manufacturing strategies in their operations to a little extent. According to these results, the MNCs in Nairobi considerably adopted sustainable manufacturing strategies in their operations. These results concur with [Chen and Li \(2013\)](#) who reported that manufacturing firms' strengths are developed and sustained by strategies considered as a pattern of choices made in order to achieve a full competitive ability of a business unit. It is therefore critical for MNCs to adopt manufacturing strategies that will enable the manufacturing function to contribute to the company's long-term competitiveness. Since some firms showed low level of adoption of manufacturing strategies, there is need to establish sustainable manufacturing strategies in cases where the strategies have not been greatly adopted.

The respondents were also required to indicate the frequency at which manufacturing MNCs review the sustainable manufacturing strategies implemented. From the results, 61.4% of the respondents indicated that MNCs review the sustainable manufacturing strategies implemented on a regular basis; 20.5% of them reiterated that their firms review the sustainable manufacturing strategies implemented frequently, while 18.2% of the respondents indicated that the MNCs review their sustainable manufacturing strategies occasionally. These results are an indication that most of the manufacturing multinational firms re-evaluate the manufacturing strategies regularly to ensure that they are sustainable and relevant to facilitate efficiency in production. These findings coincide with [Sliwczynski \(2011\)](#) who established that manufacturing strategies formulation process is continuously oriented to the creation of products/services that are valuable, rare and imperfectly imitable. Strategies are evolutionary tactics for organizations to keep up with the globalizing world. In this regard there is need for frequent review of the manufacturing strategies in the MNCs.

The respondents were also asked to indicate the extent to which their companies utilize various sustainable manufacturing strategies in their operations.

From the study, majority of the respondents reiterated that their companies adopted total quality management to a great extent as shown by a mean score of 3.8864, they also utilized production planning and control to a great extent as shown by a mean score of 3.5682 and plant and equipment maintenance to a great extent as shown by a mean score of 3.5000. In addition, the MNCs adopted employee involvement/empowerment, lot production, reduced set up time, lean manufacturing strategy as well as push and pull production to moderate extents as shown by mean scores of 3.4545, 3.4091, 3.3864, 3.3182 and 3.2093 respectively. Accordingly, manufacturing firms should seek the best practices that can fit in their operations and enhance their overall performance.

4.11. Effects of Sustainable Manufacturing Strategies on Production Efficiency

The respondents were required to rate the various aspects of production efficiency in their firms for the period between year 2013 and year 2017. The results are as shown in [Table 1](#).

Table 1. Rate the Production Efficiency in MNCs during Years 2013 to 2017

Production efficiency	2013	2014	2015	2016	2017	Mean	Std. Dev
Product development time (time-output ratio). Key: 1= very little, 2= little, 3= Average, 4= Much time, 5= Very much amount (a lot)	3.4318	3.3182	3.3182	3.2273	3.3182	3.3227	0.8311
Production cost per unit (cost per unit) Key: 1= very little, 2= little, 3= Average, 4= high cost, 5= Very high cost	3.4773	3.4773	3.7273	3.4091	3.2727	3.4727	0.7616
Product quality (level of quality) Key: 1= very low, 2= Low, 3= Moderate, 4= High, 5= Superior/very high	3.3409	3.7500	3.8409	3.3182	3.3409	3.3977	0.7964

Source: Research Data, 2018

Over the five-year period, majority of the responses showed that the product development time was average as shown by a mean score of 3.227. The minimum product development time was 3.2273 reported in year 2016 and the maximum was 3.4318 recorded in year 2013. Majority of the respondents recapped that the production cost per unit was average as shown by a mean score of 3.4727. The minimum production cost per unit was 3.2727 corresponding to year 2017 and the maximum was 3.4773 coinciding with years 2013 and 2014. In addition, most of the respondents indicated that the product quality over the five-year period averaged at a moderate mean score of 3.3977. The lowest product quality was 3.3182 as reported in year 2016 and the highest was 3.8409 corresponding to year 2015. From these results, it is clear that the MNCs have reported average production efficiency over the five-year period with the most characteristic aspect of production efficiency being production cost per unit, followed by product quality and finally product development time. The same views were echoed by [Jung et al. \(2011\)](#), who revealed that firms that produce at the lowest cost, lowest time and realize highest standard products in the industry enjoy the best profits. The sustainability of an organization lies in its capability to enhance its production through product development time, production cost per unit and product quality. Accordingly, firm resources and efforts ought to be concentrated on ensuring that there is efficiency, cost saving and quality improvement in all their endeavours.

The study further sought to establish the extent to which various aspects of sustainable manufacturing strategies affect production efficiency of multinational firms Kenya. From the study, majority of the respondents indicated that the adoption of lot production affects the production efficiency of multinational firms to a great extent as shown by a mean score of 3.9318. This was followed by push and pull production strategy which affects the production efficiency of multinational firms to a great extent as shown by a mean score of 3.8636. They also indicated that production planning and control affects production efficiency to a great extent as shown by a mean score of 3.8182, lean manufacturing strategy affects production efficiency to a great extent as shown by a mean score of 3.6136, total quality management affects production efficiency to a great extent as shown by a mean score of 3.5000 and reduced set up time affects production efficiency to a great extent as shown by a mean score of 3.5000. The respondents further reiterated that employee involvement and empowerment as well as plant & equipment maintenance affect the production efficiency of the MNCs to moderate extents as shown by mean scores of 3.4545 and 3.3864 respectively. These results imply that the manufacturing strategies employed by the manufacturing firms in Nairobi play a crucial role on their production efficiency. From these results, there is need to relook at the extent to which firms focus on specific manufacturing strategies that lead to their efficiency.

The respondents were required to indicate their level of agreement with various statements on the effects of sustainable manufacturing strategies on production efficiency of multinational firms Kenya. According to the results, most of the respondents agreed that automation and installation of technological systems ensures optimal production, the firm uses maximum and minimum methods where Stock levels are well known, workload control is primarily designed to enhance efficiency in food processing, IT investment is increasingly directed toward organizational transformation, quality control enhances service delivery in the companies, the companies conduct machine and equipment maintenance in the production section, quality management enhances production efficiency and effectiveness, the firms use an order quantity that minimizes total inventory holding and ordering costs, access to information system resources is critical for developing, the organization maintains its machines and equipment regularly as per need,

workload control is uniquely placed to meet their production requirements and the firm uses an approach where materials, parts and other goods are ordered only in quantities required to meet immediate production needs as shown by mean scores of 3.9535, 3.8837, 3.8605, 3.8372, 3.8372, 3.7907, 3.7907, 3.7209, 3.7209, 3.6047, 3.5814 and 3.5581 in that order. This shows that there are numerous benefits of manufacturing strategies on the production efficiency of the manufacturing MNCs in Nairobi. The manufacturing MNCs should pay attention to these benefits emanating from manufacturing strategies to increase chances on producing goods efficiently.

On the other hand, there was neutrality on that utilization of IT in manufacturing lowers the production costs in the companies, total quality management reduces lead time, quality control application saves cost in the firms, IT systems are essential for fine-tuning manufacturing coordination, through perpetual stock method the firms are able keep record of inventory with high turnover, IT has become a catalyst for manufacturing process and product change, the firms hold an additional amount of stock carried over the normal stocking level requirements as buffer against, uncertainty and the companies have sufficient experts who have adequate skills and knowledge on machine and equipment maintenance as shown by mean scores of 3.4884, 3.4884, 3.4186, 3.3721, 3.3488, 3.3256, 3.2791 and 3.2791 respectively. These results indicate that there are still some aspects of manufacturing strategies and the production efficiency of the manufacturing MNCs in Nairobi that still need to be addressed to realize optimal results in their operations. These results predict that the manufacturing MNCs need to enhance their utilization of IT, stocking levels, skills and knowledge management and equipment maintenance to ensure there is increased production efficiency.

4.12. Relationship between Sustainable Manufacturing Strategies and Production Efficiency of Multinational Manufacturing Firms in Nairobi

A linear regression analysis was conducted to predict the effects of manufacturing strategies and production efficiency of multinational firms in Kenya. The predictors included total quality management, lean manufacturing strategy, production planning and control, plant & equipment maintenance, reduced set up time, lot production, employee involvement and empowerment and push and pull production while the outcome is production efficiency.

The researcher extracted the model summary which portrays the coefficient of determination. Table 2 shows the results of the model summary.

Table 2. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.908 ^a	.825	.789	.0323

Source: Research Data, 2018

From the model summary, R²= 0.825 and adjusted R square 0.789 reveal that 82.5% change in production efficiency can be explained by the changes of all the predictor variables. It shows that the independent variables had a strong correlation with the dependent variable. On the other hand, 17.5% was explained by other factors that were not part of this study. The results imply that sustainable manufacturing strategies contribute a major part of the production efficiency of multinational firms in Nairobi.

The F-ratio in the ANOVA table tested whether the overall regression model was good and fit for the data. The results obtained are presented in Table 3.

Table 3. ANOVA Test Results

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	8.44	8	2.11	2.912	0.001
Residual	23.76	35	0.72		
Total	32.2	43			

Dependent variable: Production efficiency

Independent variables: Sustainable manufacturing strategies

Source: Research Data, 2018

The results indicate that F=2.912, and is significant since p=0.001 which is less than p value (p =0.05). The critical alpha value for F-test (8, 35, at 0.05) is 2.22 which is less than the computed F-value

(2.912). This therefore shows that the model is fit for finding out the relationship between the dependent and independent variables.

4.13. Discussion

The study found that the manufacturing MNCs adopted sustainable manufacturing strategies in their operations to a great extent as indicated by 38.6% of the respondents. [Chen and Li \(2013\)](#) reported that it is critical for MNCs to adopt manufacturing strategies that will enable the manufacturing function to contribute to the company's long-term competitiveness. 61.4% of the respondents indicated that MNCs review the sustainable manufacturing strategies implemented on a regular basis. Accordingly, [Sliwczynski \(2011\)](#) recapped that manufacturing strategies are evolutionary tactics for organizations to keep up with the globalizing world and thus there is need for frequent review of the manufacturing strategies in the MNCs.

The study found that the MNCs have reported average production efficiency over the five-year period with the most characteristic aspect of production efficiency being production cost per unit, followed by product quality and finally product development time. According to [Jung et al. \(2011\)](#), firms that produce at the lowest cost, lowest time and realize highest standard products in the industry enjoy the best profits. Thus the sustainability of an organization lies in its capability to enhance its production through product development time, production cost per unit and product quality. [Hassan et al. \(2012\)](#) established that quality management systems practices positively impact the performance

Total quality management, lean manufacturing strategy, production planning and control, plant & equipment maintenance, reduced set up time, lot production, employee involvement and empowerment and push and pull production. [Ramachandran and Alagumurthia \(2013\)](#) reiterated that lean manufacturing techniques have facilitated manufacturing plants to dramatically increase their competitive edge.

[Pophaley and Vyas \(2010\)](#) agreed that plant maintenance strategy is a long-term plan, covering all aspects of maintenance management which sets the direction of maintenance management and contains firm's action plans for achieving a desired future state for the maintenance function while [\(Varsha and Shriram, 2013\)](#) affirmed that setup time reduction is an approved way to improve manufacturing efficiency in batch production environments. However, the manufacturing MNCs need to enhance their utilization of IT, stocking levels, skills and knowledge management and equipment maintenance to ensure there is increased production efficiency.

5. CONCLUSIONS

The study concludes that the MNCs in Nairobi have adopted sustainable manufacturing strategies in their operations. The study established that most of the manufacturing multinational firms re-evaluate the manufacturing strategies regularly to ensure that they are sustainable and relevant to facilitate efficiency in production. The various sustainable manufacturing strategies adopted by the MNCs include total quality management, lean manufacturing strategy, production planning and control, plant & equipment maintenance, reduced set up time, lot production, employee involvement and empowerment and push & pull production. The study deduces that the MNCs have reported average production efficiency over the five-year period with the most characteristic aspect of production efficiency being production cost per unit, followed by product quality and finally product development time. The results showed that the manufacturing strategies employed by the manufacturing firms in Nairobi play a crucial role on their production efficiency.

6. RECOMMENDATIONS TO POLICY AND PRACTICE

This study recommends the adoption and implementation of manufacturing strategy as it will enable the manufacturing MNCs optimize their production efficiency in terms of production cost per unit, product quality and product development time. Through formulation and implementation of sustainable manufacturing strategies the firms would realize superior operational performance through having the ability to produce goods at low process, have superior quality, be reliable and dependable and ultimately have a competitive advantage.

The manufacturing firms in Nairobi and MNCs in particular need to re-evaluate their capabilities and orientation of their manufacturing strategies. They should benchmark from the best performers in their industry in order to borrow best practices on the best strategies to cut cost and improve on other capabilities. Moreover, more funds should be sourced in order to pursue a few or all strategies at the same time thus employing other models of competitive priorities.

In addition, multinational firms should integrate their resources efficiently to enhance their operations and also adopt the manufacturing models developed to align with their operations and target customers. This will be a modest attempt to cope with the complexity of production, increase customer requirements, and profitability efficient management of the operations management is a prerequisite.

This study focused primarily on the relationship between sustainable manufacturing strategies and production efficiency of multinational firms in Nairobi. From the study, a useful extension of this work could be to analyze uncertainties in manufacturing and production efficiency in various firms. Some of the uncertainties in the form of machine failures and demand forecast errors often exist in real life situations. As such, there is need to carry out another study with a focus on specific manufacturing strategies which were found to affect production efficiency yet there exist little documented researchers surrounding them. Such aspects would include lot production, push and pull production as well as reduced set up time. Further studies could be replicated in a different context and industrial setting to check whether the same results would be realized hence pave way for policy recommendations.

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