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Abstract

This study aimed to investigate the influence of demand forecasting systems on the performance of manufacturing firms in Kenya. Without proper management, increasing product turnover will increase design and manufacturing costs. This study employed a descriptive survey research design to accomplish its goals since it has enough provision for the protection of bias and maximized reliability. The target population comprised of managers in manufacturing firms that are members of the Kenya Association of Manufacturers (KAM). KAM therefore provided the sampling frame for this study. As at 2017, KAM had a membership of 903 manufacturing firms. A sample of 90 respondents was drawn from this population. Primary data was collected using a semi-structured questionnaire which was self-administered. Data obtained was processed and analysed using descriptive and inferential statistics. The findings from the data analysis were visually represented through tables. The study revealed that demand forecasting system explained 7.6% of the change in performance of manufacturing firms in Kenya. The study concluded that demand forecasting system significantly influence performance of manufacturing firms in Kenya. This study recommends that manufacturing firms should use quantitative methods, qualitative methods, causal methods and time series for demand forecasting.

Keywords: *Manufacturing, Performance, Demand, Forecasting, firm, Kenya.*

1.0 Introduction

Competition among firms has resulted in firms developing a supply chain that can respond quickly to customers' need. In the current business environment, a firm has to reduce costs while improving its customer service level to remain competitive, which also helps maintain profit margins. Supply chain management is divided into two levels: strategic and operational. The strategic level primarily is about the cost-effective location of facilities (plants and distribution

centers), the flow of products throughout the entire supply chain system, and the assignment in each echelon (Da Cunha *et al.*, 2007; Xu *et al.*, 2009). The operational level is about the safety stock of each product in each facility, the replenishment size, frequency, transportation, and lead time, and the customer service level. Determining an effective supply chain is an important component for improved performance. In addition, the decisions regarding in which facilities the product should be made and how to serve customers are very critical (Dubois, 2003).

Manufacturing is an important sector in Kenya's economy since it makes a substantial contribution to the country's economic development (Snyder, 2006). With solid growth continuing in the manufacturing industry, Kenya is poised to be among the fastest-growing economies in East Africa, according to the World Bank Group's economic analysis for the country (World Bank, 2016). However, as a share of GDP, Kenya's manufacturing firms has been stagnant in recent years. Low overall productivity and large productivity differences in firms across subsectors point to lack of competition. Manufacturing firms in Kenya are characterized by elongated or overextended chains of retailers (Snyder, 2006) which, in turn, mean long chains of transactions between chain members and consumers. Unavailability of integrated distribution management has affected productivity at manufacturing firms leading to reduced profits.

Although a number of studies have been done on the concept and context of management practices in Kenya, there is limited information within the context of manufacturing industry. Okanda, Namusonge and Waiganjo (2016) investigated the influence of supply planning practice on the performance of the unit of vaccines and immunizations in the Ministry of health, Kenya and found out that supply planning practices such as optimum distribution procurement, determination of health requirements of health facilities at every node, aggregate determination requirements and joint coordination with suppliers if adopted by the unit of vaccines and immunizations will increase the performance positively. Arani *et al.* (2016) investigated the influence of strategic sourcing on resilience in manufacturing firms in Kenya. Okello and Were (2014) explored the influence of management practices on performance of the selected NSE listed food manufacturing companies in Nairobi Kenya and the study revealed that product development process, distribution management, lead time, technology and innovation have a significant influence on the performance of food manufacturing companies in Kenya. Amemba *et al.* (2013) did a study on elements of green supply chain management and established green supply chain management leads to enhanced production efficiency and reduced wastage culminating in improved performance of the organisation. These studies however, have not examined performance of organisations in the context of multi-echelon systems.

1.1 Statement of the Problem

Manufacturing firms use safety stock to protect against increased supply risk, longer lead times or faster service requirements (Tang & Musa, 2011). It, therefore, requires effective demand forecasting. In Kenya today, manufacturing firms experience increased stock-outs due to challenges in managing safety stocks. The difficulties in managing safety stocks in a multi-echelon distribution system make it necessary for the use of technology or ICT (Lotfi, Sahran & Zadeh, 2013). There is a problem of bullwhip for manufacturing firms in Kenya as small changes in end item demand amplify order oscillations as one moves up in the supply chain. This problem shows lack of integration and coordination of actions across different distribution locations.

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Previous studies have attempted to highlight problems in distribution systems and their performance. KAM (2013) attributed customer dissatisfaction New KCC downstream chain to a poor distribution system that reduced firm profits by 48%. For example; Mathuva (2013) conducted a study on influence of distribution systems on performance of an organization and found that a good distribution system can improve organisational effectiveness. The study presented conceptual gap since it used distribution systems as the only variable. Albarune and Habib (2015) in their study demonstrated forecasting practices in supply chain management (SCM) in various areas, particularly life science and retail chain using secondary data and found that the limitation and few practical solutions on forecasting were useful in the business organization. The study presented contextual, conceptual and methodological gaps. It is amid these research gaps that this study sought to establish the influence of demand forecasting system on performance of manufacturing firms in Kenya.

1.2 Research Objective

To determine the influence of demand forecasting system on performance of manufacturing firms in Kenya.

1.3 Research Hypotheses

H_0: Demand forecasting system has no significant influence on performance of manufacturing firms in Kenya.

H_1: Demand forecasting system has a significant influence on performance of manufacturing firms in Kenya.

2.0 Literature Review

2.1 Theoretical Review

Theory of Constraints

The theory of constraints is a management philosophy that seeks to increase manufacturing throughput efficiency or system performance measured by sales through the identification of those processes that are constraining the manufacturing system (Nan, 2011). Theory of constraints is based on the principle that a chain is only as strong as the weakest link or constraint and to elevate and manage the constraint as necessary. The difficulties in the theory of constraints are: long lead times, large number of unfulfilled orders or they are executed with much extra effort (overtimes), high level of unnecessary inventories or lack of relevant inventories and wrong materials orders among others. These are the bottlenecks manufacturing firms are likely to face especially in a multi-echelon supply chain and they must employ the right systems to enhance their operations so they can meet the projected performance.

The theory is founded on the belief that an organisation that maximizes the output of every machine will not perform as well as one that ensures of the flow of materials and value created through its operational performance. Theory of constraints emphasizes focus on effectively managing the capacity and capability of these constraints if they are to improve the performance of their organisation. This can be achieved by tea processing firms applying appropriate multi-echelon distribution systems. Firms have struggled to invest in the technology and organizational structures needed to achieve to-date systems synchronization that enable coordinated distribution flows (Fawcett & Magnan, 2002). The theory of constraints methodology proposes that performance is dependent on the systems applying by manufacturing firms. Theory of constraints

is a methodology whose basis is applied to production for the minimization of the distribution. In reality, it is difficult for a manufacturing firm to forecast with precision the consumption of its specific product at a specific region with sometime prior to production and supply of the same product.

In the perspective of the Theory of Constraints, performance measurements are based on the principles of throughput, distribution dollar days and operating expenses (Umble, Umble & Murakami, 2006). They are based on a simple relationship that highlights role of multi-echelon distribution systems on progress toward performance. The proof of effectiveness for any distribution control system is the degree to which it improves operational performance of business firms. For manufacturing firms to ensure that the bottlenecks on their operations run smoothly they have to embrace the use of multi-echelon distribution systems that can facilitate operational efficiency. This may result in the acquisition of additional capacity or new technology that lift or break the constraints. This theory explains demand forecasting context in a multi-echelon distribution system. Safety stock is distributed across different distribution locations with different customer needs which make demand forecasting difficult. Firms have quantitative, qualitative, casual and time series methods for demand forecasting at their disposal. The method or combination of methods used largely depends on the situation. Demand forecasting methods also have their weaknesses which might prevent manufacturing firms from acting proactively in customer demand anticipation (Xu *et al.*, 2001).

2.2 Empirical Review

Demand management is the supply chain management process that balances the customers' requirements with the capabilities of the supply chain. Management can match supply with demand proactively and execute the plan with minimal disruptions, with the right management process (Croxton *et al.*, 2002). Demand management is a part of the supply chain management and it's truly important part because demand from the final customer is the force that drives the activities in the supply chain (Helms *et al.*, 2000).

Forecasting is a prediction or an estimation of an actual value in a future time period or for another situation. It is a form of statement that reveals future value of interest for a specific time period that is used as prime output in decision process of management (Stevenson, 2006). The main point of forecasting is to support a company acting proactively in customer demand anticipation. More specifically, the goal of forecasting is to determine, analyse and estimate a probable future customer demand in order to enable a company to bring its capacity on par with it. That allows goods and service providers to meet their customers' needs at minimal cost. Forecasting is a fundamental step of demand management that optimizes the customer satisfaction through capabilities of supply chain. It has an impact on fulfillment of the customer requirements, reducing risk and in measurement of process improvement (Asmus, Cauley & Maroney, 2006).

Demand forecasting system is used to determine the number of products or services that will be purchased by consumers in the future. Numerous methods can be used when integrating demand forecasting into any business. Most demand forecasting methods fall under four basic categories or methods. These categories include, but are not limited to: quantitative, qualitative, time series methods, and casual methods (Datta *et al.*, 2007). Quantitative forecasting methods take numbers or quantities sold in the past to forecast how much will be sold in the near future. This is usually a forecast that will provide numbers for the next sales year. Some examples of quantitative

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forecasting methods include last period demand, multiplicative seasonal indexes, and simple and weighted moving averages. Each of these use quantities sold in different types of mathematical formulas to determine how many products or services will be sold at the same times in the future year's sales that is being predicted (Stevenson, 2006).

In time series methods information is typically composed of historical demand data. Time series main purposes are based on the hypothesis that in future will happen the same improvement than in past. That hypothesis and historical data can calculate for future demand forecast with different functions (Arnold *et al.*, 2008). Demand forecasting typically does use strategies in the time series method to forecast the demand of products and services. The time series method can be split up into two different types of methods. These include frequency domain methods and time domain methods. Even though the frequency domain method is classified as a time series method, it is not based on time, but on frequency of the occurrence happening or a product being bought. Time domain will show quantities purchases with respect to time (Cheng & Wu, 2005). Time series manage demand with different factors.

Like any process and done work in companies also the demand forecasting needs to be measured. With forecasting organisation wants to do business better and that means lowering the marketing and operations costs with better customer service. So that process ability need to be measured (Mentzer & Moon, 2005). Measuring forecast accuracy serves two main purposes. First, managers can use error analysis to determine whether the current forecasting methods predict the systematic component of demand accurately. Secondly, managers' estimate forecast error because any contingency plan must account for such an error (Chopra & Meindl, 2001).

2.3 Conceptual Framework

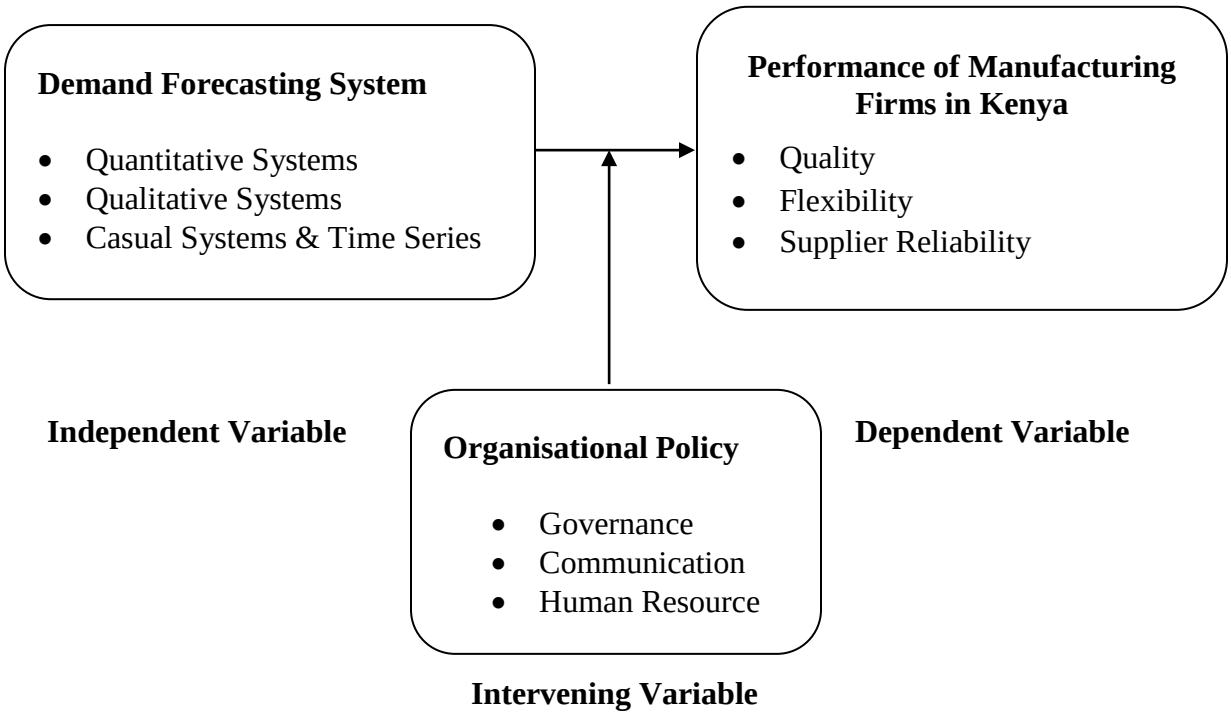

Figure 1: Conceptual Framework

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3.0 Research Methodology

This study used a descriptive survey research design. Creswell (2013) asserts that a descriptive research design is used when data are collected to describe persons, organisations, settings or phenomena. The design also has enough provision for protection of bias and maximized reliability (Kothari, 2004). It was appropriate for this study because it allowed the collection of information for independent and dependent variables using questionnaires (Orodho, 2003).The study population was 903 manufacturing firms. A list that contains the number of all 903 manufacturing firms was sourced from the Kenya Association of Manufacturers (KAM, 2017). This study used stratified random sampling. A sampling frame of this study comprised of 903 manufacturing firms who are members of Kenya Association of Manufacturers categorized in fourteen (14) different sub-sectors that characterizes manufacturing industry in Kenya. However, consultancy services sub-sector was excluded from this study as multi-echelon distribution systems do not apply in the services sector.

To obtain the desired sample size for the study with the population of 903, Nassiuma (2000) formula was used as shown; $\boldsymbol{n = N (cv^2)/Cv^2 + (N-1)\, e^2}$

Where,

n= sample size

N = population (903)

Cv= coefficient of variation (take 0.5)

e= tolerance of desired level of confidence (take 0.05 at 95% confidence level)

$\mathbf{n = 903\ (0.5^2)/\ \{0.5^2 + (903\text{-}1)\ 0.05^2\} = 225.75/\ 2.505}$

= 90.11 (rounded off to 90 respondents)

The sample size was 90.

This study used the questionnaires in collecting the primary data while secondary data was obtained from journals, textbooks, Internet and Kenya Association of Manufacturers magazines. A semi-structured questionnaire containing both open-ended and close-ended questions was used to collect primary data for this study. The questionnaires method was preferred as it is economical in terms of time and cost as compared to other methods. The researcher obtained necessary authorization and clearance from relevant authority before commencing the study. The researcher also obtained authorization letter from NACOSTI and an introduction letter from the University. A cover letter was attached to each questionnaire to assure the participants that the information given was anonymous and confidential. The questionnaires were distributed using drop-and-pick later method to the respondents. This enabled the respondents to have ample time to fill the questionnaires and at the same time ensure high response rate. According to Kothari (2004), a self-administered questionnaire elicits self-report on people's opinion, attitudes, beliefs and values. After collecting data from the respondents using a questionnaire, data was then checked for completeness, consistency and reliability. The next step involved coding the responses in the coding sheets by transcribing the data from questionnaire by assigning characters the numerical symbols. This was followed by screening and cleaning of data to make sure there are no errors. After this, data was transferred to SPSS for analysis.

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The collected data was analysed using SPSS (Statistical Package for Social Science) version 20 as an aid. Descriptive statistics were used to examine the characteristics of the population. It enabled the researcher to meaningfully describe a distribution of scores using statistics that depends on the type of variables in the study and the scale of measurement. Mugenda and Mugenda (2003) assert that descriptive statistics enable the researcher to describe distribution of scores. Variable aggregation was undertaken in facilitation of further statistical analysis. The researcher applied "Collapsing Response" method in analyzing responses from a Likert scale measurement. This was done by adding the 'strongly agree' responses with the 'agree' responses and also adding the 'disagree' responses with 'strongly disagree' (Gwavuya, 2011). Regression analysis was used to examine the presence of a linear relationship between two variables; demand forecasting and performance of manufacturing firms in Kenya. The following regression model was used:

$Y = \beta_0 + \beta X + \acute{\varepsilon}$

Where,

Y= Performance of manufacturing firms in Kenya

X: Demand Forecasting System

β_0 is the constant or intercept while β is the corresponding coefficients for the respective independent variable while ε is the error term.

4.0 Findings and Discussion

The study collected 81 questionnaires from the 90 questionnaires administred. This translates into an overall response rate of 90%. Sectors in which 100% response rate was achieved include energy, electricals and electronics, metal and allied, paper and board, timber, wood and furniture. Fresh produce, as well as leather and footwear sectors did not have any response. The chemical and allied sector had a response rate of 93.8% while food and beverage sector had 94.7%. Building mining and construction had a response rate of 80% while motor and accessories had a response rate of 85.7%. The pharmaceuticals and medical equipment had a response rate of 80% while plastics and rubber had 87.5%. Textiles and apparels had a response rate of 75%. Majority of firms (53.1%) are locally owned while 30.9% have both local and foreign ownership. Sixteen (16%) of the manufacturing firms have foreign ownership. majority of firms market their products in both domestic and foreign markets.

Descriptive Statistics for Demand Forecasting System and Performance

Table 1: Quantitative System

Quantitative System	Mean	Std. Dev
Last period demand	4.37	.782
Multiplicative seasonal indexes	3.94	.242
Simple and weighted moving averages	3.73	.822

The results in Table 1 show that the quantitative method used to a large extent by manufacturing firms for demand forecasting system is last period demand (M=4.37, SD=.782). Multiplicative seasonal indexes (M=3.94, SD=.242) and simple and weighted moving averages (M=3.73, SD=.822) were also moderately used by manufacturing firms for demand forecasting.

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Quantitative method is among the four main methods of demand forecasting system as outlined by Datta *et al.* (2007).

Table 2: Qualitative System

Qualitative Systems	Mean	Std. Dev
Delphi method	2.83	1.292
Historical life cycles of similar products	4.57	.498
Market research	3.99	.783

The results show that the qualitative systems used to a large extent by manufacturing firms for demand forecasting was past life cycles of similar products (M=4.57, SD=.498). Manufacturing firms moderately used market research (M=3.99, SD=.783) for demand forecasting system while Delphi method was only used to a little extent (M=2.83, SD=1.292). As expected, when used, the qualitative method the second of the four primary methods in demand forecasting show its influence on the performance of manufacturing firms (Stevenson, 2006; Asmus, Cauley & Maroney, 2006; Datta *et al.*, 2007).

Table 3: Causal Methods

Causal System	Mean	Std. Dev
Holidays	3.43	1.589
Seasons	3.93	.667

The findings show that manufacturing firms moderately used causal systems for demand forecasting. The results show that manufacturing firms moderately used holidays (M=3.43, SD=1.589) and seasons (M=3.93, SD=.667) for demand forecasting system. The causal method is the third of the four main methods of demand forecasting as outlined by Datta *et al.* (2007).

Table 4: Time Series

Time series	Mean	Std. Dev
Frequency domain method	4.25	.751
Time domain method	3.89	1.012

The results show that time series method used to a large extent by manufacturing firms for demand forecasting was frequency domain method (M=4.25, SD=.751) while time domain method was moderately used (M=3.89, SD=1.012). Time series is the last of the four main methods of demand forecasting as outlined by Datta *et al.* (2007).

Table 5: Achievements of Demand Forecasting System

Achievements of demand forecasting	Mean	Std. Dev
Customer satisfaction	4.89	.316
Fulfilment of the customer requirements	4.49	.503
Reducing risk	4.20	.401
Process improvement	4.70	.459

The results show that demand forecasting to a large extent achieved the four goals. The findings show that demand forecasting to a large extent achieved customer satisfaction goals (M=4.89, SD=.316) while it equally to a large extent achieved the goals of the fulfillment of the customer

requirements (M=4.49, SD=.503). The findings also show that to a large extent demand forecasting achieved goals of reducing risk (M=4.20, SD=.401) and process improvement (M=4.70, SD=.459). These findings are in line with Asmus, Cauley and Maroney (2006) who expected a company to align its production capacity with estimated customer demand to not only ensure that the company meets customer requirements effectively but also optimise its customer satisfaction.

Hypothesis Test Results

The hypothesis sought to test the influence of demand forecasting on the performance of manufacturing firms. Hypothesis H_0: Demand forecasting systems have no significant influence on the performance of manufacturing firms in Kenya. Simple linear regression was conducted using the following model;

$$Y= \beta_0 + \beta X + \acute{\varepsilon}$$

Where:

Y = performance of manufacturing firms

β_0 = Constant (Coefficient of intercept)

β_1 = Regression coefficient of X.

X_1 = Demand forecasting System,

$\acute{\varepsilon}$ = Error Term

$H_0: \beta = 0$ vs $H_1: \beta \neq 0$

Reject H_0 if $p < 0.05$, otherwise fail to reject the H_0

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.276[a]	.076	.065	3.04815

a. Predictors: (Constant), Demand forecasting system

The results of the regression analysis show that demand forecasting system contributed to change in performance by 7.6% as indicated by the value of R^2 (.076).

Table 7: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	60.760	1	60.760	6.540	.012[b]
	Residual	734.005	80	9.291		
Total		794.765	81			

a. Dependent Variable: Performance
b. Predictors: (Constant), Demand forecasting system

The results of the ANOVA test in table 7 show that the model was fit for the regression analysis (F=6.540, p=0.012) and therefore results are valid as they did not occur by chance.

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Table 8: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	30.353	5.299		5.728	.000
	Demand forecasting System	.236	.092	.276	2.557	.012

a. Dependent Variable: Performance

Y= 30.353 + 0.236X

X= Demand Forecasting Systems

Results of coefficients table show that the contribution of demand forecasting to the change in performance was 0.236 and it was statistically significant (p=0.012). According to the regression results as shown in tables 6, 7 and 8, H1: $\beta \neq 0$ (β=0.236) and $p < 0.05$ (p=0.012). The null hypothesis was hence rejected that; demand forecasting system has no significant influence on the performance of manufacturing firms in Kenya. The study therefore adopted the alternative hypothesis that demand forecasting system has significant influence on the performance of manufacturing firms in Kenya.

5.0 Conclusions

The study sought to establish the influence of demand forecasting systems as an element of multi-echelon distribution systems on the performance of manufacturing firms in Kenya. The study concluded that demand forecasting significantly influences the performance of manufacturing firms in Kenya. Demand forecasting systems are a fundamental step in demand management that optimises the customer satisfaction through capabilities of the supply chain. It has a significant impact on the fulfillment of the customer requirements, reducing risk and in the measurement of process improvement. However, it has its limitations and few practical solutions in a business organization. The most critical aspect of demand forecasting is the character of data flow, and the type of cooperation between the links in the whole supply chain is essential.

6.0 Recommendations

This study recommends to stakeholders of the manufacturing firms that they should adopt quantitative systems, qualitative systems, causal systems and time series for demand forecasting systems. This will not only optimise the customer satisfaction through capabilities of the supply chain have a positive impact on the fulfillment of the customer requirements, reducing risk and in the measurement of process improvement. The study also recommends to the scholars and academicians that they should carry out more studies in the same field using different variables so as to compare the findings with those of the current study. To the public and private organizations, they should strive to adopt demanding forecasting systems since it has been established that it influences the performance of an organization. The study further recommends to the managements of state corporations and government agencies that, they support the manufacturing firms in the country as they strive to achieve excellence in their performance. Finally, the government and other policy makers should come up with policies making it possible for the manufacturing firms to access grants and loans to be able to implement the strategies they seek to incorporate in their manufacturing for better performance.

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