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Abstract

This study sought to determine the influence of lead time system on performance of manufacturing firms in Kenya. Increasing competitive pressures are forcing companies to increase their rates of innovation to shorten each product's duration in the market, thereby compressing each product's life cycle. 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 analyzed using descriptive and inferential statistics. The results of the data analysis were presented in charts and tables. The findings revealed that lead time system accounted for 7.6% of change in performance of manufacturing firms in Kenya. The results showed that organisational policy had no intervening effect on performance and lead time system. Lead time system significantly influences performance of manufacturing firms in Kenya. This study recommends that manufacturing firms should ensure that they are proactive in activities that reduce lead time.

Keywords: *Lead time system, Manufacturing firm, Performance, Kenya.*

1.0 Background of the Study

Determining an effective supply chain is an important component for improved performance (Dubois, 2003). 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.

Most of the manufacturing firms comprises of networks of distribution facilities that procure raw material, converts them into finished goods and distribute the finished goods to customers. The term 'multi-echelon' manufacturing and distribution networks are synonymous with such networks. The distribution locations in the supply chain are called "echelons". Usually the complexity of a supply chain is related to the number of echelons inside it. Supply chain networks having multiple layers of distribution locations are referred to as multi-echelon supply chains (Moinzadeh, 2002). Every firm desires to keep customer service and operations efficiency high, while keeping the cost of distribution low. Most firms are still using very basic methods for achieving this goal, such as utilizing a Days-of-Coverage ratio or a statistical safety-stock calculation for end-items. Multi-echelon distribution systems (MDS) bring major advances to answering the old question of where to distribute in the supply chain. Many firms have adapted this technology but it is still a big mystery to many others (Xu *et al.*, 2009).

One of the major challenges a company faces is matching its supply to consumers' demand. How efficiently a company addresses this challenge directly impacts the company's profitability. Working capital being of utmost importance for any company, it is important for companies to keep low levels of stock and sell them quickly. Supply chain systems today have multiple layers of suppliers and distributors. With each layer adding some safety stock considering service requirements, a significant amount of working capital is involved. Multi-echelon distribution systems approach involves taking a holistic approach toward the entire supply chain and considering the impact safety stock in each layer have at any given level in the supply chain. It answers where in the supply chain distribution locations should be placed and optimizing and updating buffer stock at all levels. By effectively modeling the entire supply chain from raw materials to manufacturing and finished goods, multi-echelon distribution creates what-if scenarios and explores alternate suppliers, transport links, lead times as well as locations. Levels of safety stocks and postponement strategies having lower cost implications are also verified in the process (Tsiakis, Shah & Pantelides, 2001).

Billington *et al.* (2004) have showed that savings realized by using the multi-echelon systems approach for Hewlett-Packard's Digital Camera and Inkjet Supplies business exceeded $130 million. Farasyn et al. (2011) have reported that the multi-echelon systems based models produced 7% of average inventory reduction at Procter & Gamble's business units. Wieland et al. (2012) have described a multi-echelon systems project at Intel and indicated that after its implementation, inventory levels were reduced more than 11% providing average service levels exceeding 90%. 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.

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. These studies however, have not examined performance of organisations in the context of multi-echelon systems.

1.1 Statement of the Problem

Customers want to receive ordered products as soon as possible (Christopher, 2011). Short delivery time is therefore of great importance to customers. A long lead time makes it harder for a firm to follow demand fluctuations in volume and product configuration (Ouyang, Wu & Ho, 2007; De Treville, Shapiro & Hameri, 2004). This has limited the availability of products in distribution systems of manufacturing firms in Kenya and therefore a cause for stock-outs and discontent for customers. 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. Olamade, Oyebisi and Olabode (2014) examined the effect of ICT integration on performance of organizations in Nigeria and found that ICT had enabled organizations to communicate, coordinate and learn effectively. It was also found that the role of ICT in communication and coordination of business processes had become critical for organizations. They depend on ICT for efficient knowledge acquisition, distributing information and knowledge management. The study presented contextual, conceptual and methodological gaps. It is amid these research gaps that this study sought to establish the influence of lead time system on performance of manufacturing firms in Kenya.

1.2 Objective of the Study

To determine the influence of lead time system on performance of manufacturing firms in Kenya.

1.3 Research Hypothesis

H_0. Lead time system has no significant influence on performance of manufacturing firms in Kenya.

H_1. Lead time system has a significant influence on performance of manufacturing firms in Kenya.

2.1 Literature Review

2.1.1 Quick Response Manufacturing Theory

In 1998, Rajan Suri proposed a new alternative and complementary approach to Lean Manufacturing called Quick Response Manufacturing (QRM). Such approach focuses its efforts on reducing the lead time in environments characterized by a high variety of products and customization. Quick Response Manufacturing is rooted in the concept of Time-based competition (TBC). Time-based competition is a broad-based competitive strategy emphasizing time as the major factor for achieving and maintaining a sustainable competitive advantage. It seeks to compress the time required to propose, develop, manufacture, market and deliver products. QRM therefore advocates a companywide focus on short lead times that include quick response to demand for existing products as well as new product and design changes (Suri, 2010a).

The theory has two core distinct features; the power of time and understanding and exploiting system dynamics. The power of time concerns the replacement of traditional productivity, cost and on-time delivery metrics using reduction of the lead time as the unique comprehensive performance measurement. Understanding and exploiting system dynamics entail recognizing the relationship between the variables that have an effect on the lead time and, therefore, giving better guidance to the improvement efforts for these variables to maximize their effects on the reduction of lead time (Suri, 2010b). The management of most manufacturing organisations is still based on economies of scale and a cost reduction mentality and thereby incurs a series of dysfunctional effects that is denominated in QRM as a Response Time Spiral (Suri, 2010a). With respect to suppliers, there is a standard practice in purchasing: because items with long lead times are often ordered in large batches, one should negotiate quantity discounts with suppliers due to the amounts being acquired. The problem with such belief is that it results in a Response Time Spiral for purchasing from suppliers.

This theory is suitable in explaining the influence of lead time on performance of manufacturing firms. Quick Response Manufacturing focuses on a different driving metric to improve manufacturing: lead time. Proponents of this philosophy believe that by reducing the time it takes to produce a product from order to delivery, total costs go down, and quality, delivery, and flexibility all improve. Products with very short lead times are simpler to manage, therefore overhead costs are low. Suri suggested that this singular focus on lead time is the right strategy for certain companies or certain markets. These companies are characterized by a high variety of different products that are produced in one manufacturing system, customers who demand highly customized products, and where demand is highly variable. The largest benefit with QRM is seen when the customers for these products value short lead times from a supplier over long lead times. Quick Response Manufacturing is a way to drive down lead times to both create a competitive advantage in the marketplace and improve the internal manufacturing operations.

2.1.2 Lead Time System

A challenge facing many firms in today's customer focused business environment is to create processes that facilitate responsiveness to customers' demands (Christopher, 2011). This can for instance be demands regarding product differentiation and pricing, which need to be considered in order to be competitive (Gunasekaran, Patel, & Tirtiroglu, 2001). In addition, short delivery time is widely recognized to be of great importance to customers, wanting to receive the ordered products as soon as possible (Ouyang, Wu, & Ho, 2007; Da Cunha, Agard & Kusiak, 2007). The

possibility to provide satisfactory levels of these three competitive dimensions (price, product differentiation and delivery time) is dependent on the lead time for fulfilling a customer order, and by that also the replenishment lead time for material from suppliers.

Cost and lead time are intimately connected to each other, both on the supplier side and on the purchasing side (Ray & Jewkes, 2004). On the purchasing side, lead time has a positive correlation with the required size of inventory and safety stock levels that is needed to prevent stock outs (Pahl, Voss & Woodruff, 2005; Vernimmen *et al.*, 2008). A longer lead time thus increases the safety stock costs, which are a result of tied-up capital, obsolescence, damaged goods and warehousing operations and facilities (Christopher, 2011). Increased safety stock levels also reduce the inventory turnover rate, incurring costs for bound capital as well as procrastinating product updates and by that inhibiting them from reaching the market.

In addition, a long lead time magnifies the bullwhip effect; leading to over- or under-production and inaccurate inventory levels (Chen, Drezner, Ryan, & Simchi-Levi, 2000; Lee, Padmanabhan, & Whang, 2004). A longer lead time also makes it harder to plan operational activities and impacts the cash flow in a negative way, by tying up capital in physical resources (Christopher, 2011). Furthermore, the amount of rush orders from suppliers will also increase with increased lead time, because a larger share of orders will fall outside of the time frame required for standard expediting, inflicting costs by performing express expediting. In conjunction to this, a long lead time causes difficulties in creating a responsive supply chain, obstructing the possibilities of rapidly responding to customers' demand.

The difficulty of forecasting the demanded quantities is positively related to lead time. In order to limit the total cost for the supplier's business, the supplier needs to consider the economies of, among other things, batch sizes, order quantities and storage of both raw material and finished goods. All these considerations affect the lead time since economies of scale usually is at hand; producing large batches due to set up times, ordering large quantities to attain less administration and to get better possibilities for efficient utilization of the chosen transport mode (Christopher, 2011). Altogether, a long lead time causes increased costs and delivery time, in the end affecting the customers' value benefit of a company's offerings. The flexibility to react to changes in customer demands is also affected (Gadde, Hakansson & Persson, 2010). Decreasing lead time, in a collaborative spirit in between actors will improve performance. More specifically, performance is to be improved by attending to problems affecting quality dimensions, such as lead time, and should be solved by identifying and eliminating the root causes of problems. Furthermore, the success of inter-firm efforts relies heavily on relational aspects such as trust and commitment. These are of course also important when conducting a similar effort within one company, but different perceptions and behaviours will be more noticeable, for instance due to misaligned goals and differences in corporate culture(Amemba, Nyaboke, Osoro & Mburu, 2013).

A firm has to consider which suppliers that are chosen to engage in joint improvement efforts; although a supplier initially has a positive attitude, relational aspects will have considerable effect on the success of the effort. Therefore, attention has to be paid to, for instance the supplier's approach to handle conflicts and how reliable the supplier is in committing to agreements. Closely related to choosing an appropriate supplier is of course also attracting the interest of the supplier. Attention has to be paid to in which ways the supplier's interest can be affected, making for instance social relations valuable to develop and the ability to provide examples of generic improvements necessary to retrieve. In the cases where a firm enjoys a high

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level of power to influence the supplier's decision, it is important to not force the supplier into an engagement by abusing this power. Rather a more constructive approach should be sought for, since the success of the project relies on genuine interest and commitment from both parties (Christopher, 2011).

Closely related to the relational aspects is the issue of misaligned goals; although the actors in a supply chain need to cooperate, they are still separate entities with self-interests to fulfil. This affects the acceptance and implementation of solutions, thus making goal alignment a very important and presumably challenging issue to alleviate. Furthermore, the issue of inter-firm transparency could be further investigated. For instance, what benefits and drawbacks that comes with transparency and how it can be attained. It would seem likely that transparency is closely related to sharing information across company borders, orally as well as in script. With this comes the interesting issue of how such information flows should be managed in order to be effective and efficient while still paying attention to politically sensitive issues such as ownership (Gadde, Hakansson & Persson, 2010).

2.2 Conceptual Framework

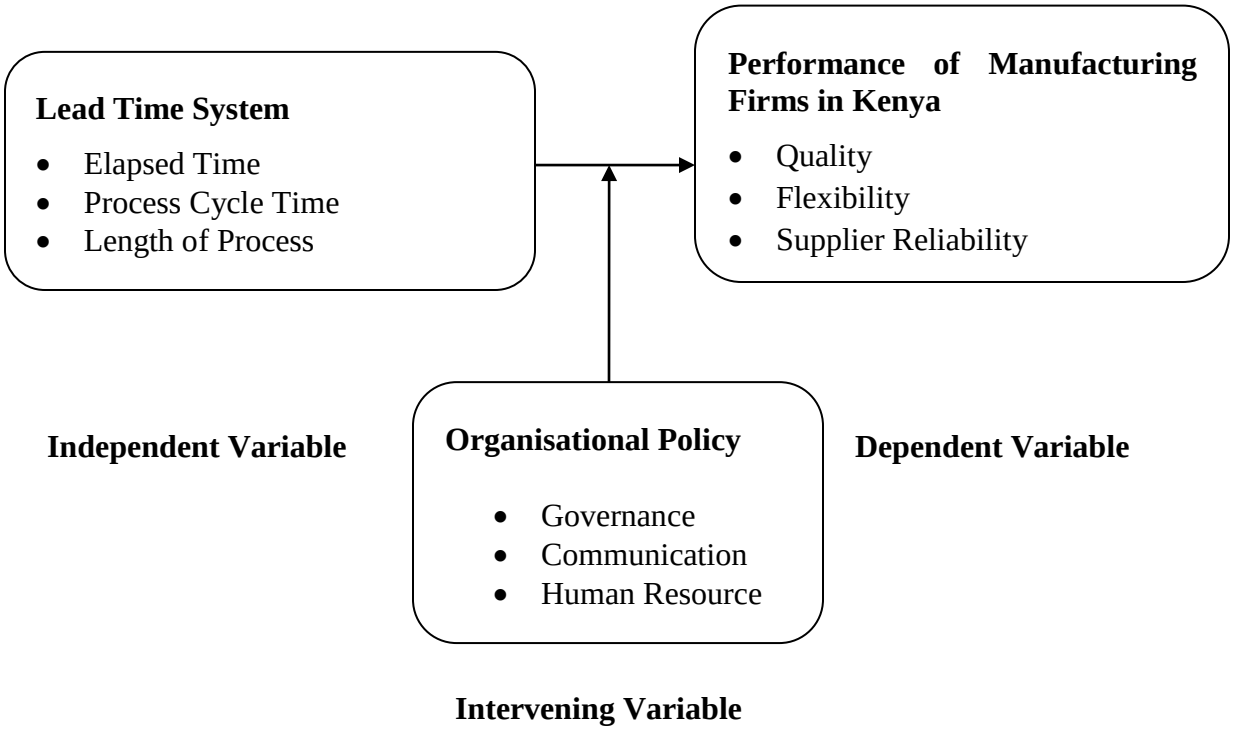

Figure 1: Conceptual Framework

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;

$$n = N(cv^2)/Cv^2 + (N-1)e^2$$

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)

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

= 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.

After collecting data from the respondents through the 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. The collected data was analysed using SPSS 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

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'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; lead time system 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: Lead time 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 Results and Discussion

Table 3: Lead Time System

Lead time activities	Mean	Std. Dev
There is responsiveness to customers' demands in regard to product differentiation	3.90	.539
There is responsiveness to customers' demands in regard to pricing	4.70	.459
There is responsiveness to customers' demands in regard to short delivery time	3.49	1.361
There is high order processing rate	4.41	.667
There is high order fulfilment rate	3.90	.539
Inventory replenishment	3.80	1.470
Sufficient delivery speed	3.80	1.470
Adequate delivery to location (on-time in-full)	4.11	.837
Delivery planning is adequate	4.11	.707

The results show that to a large extent there is responsiveness to customers' demands in regard to pricing (M=4.70, SD=.459), there is high order processing rate (M=4.41, SD=.667), adequate delivery to location (on-time in-full) (M=4.11, SD=.837) and delivery planning is adequate (M=4.11, SD=.707). The results also show that to a moderate extent there is responsiveness to customers' demands in regard to product differentiation (M=3.90, SD=.539), there is responsiveness to customers' demands in regard to short delivery time (M=3.49, SD=1.361), there is a high order fulfilment rate (M=3.90, SD=.539), inventory replenishment (M=3.80, SD=1.470) and sufficient delivery speed (M=3.80, SD=1.470). The results show three competitive dimensions that lead time addresses. They include price, product and delivery time. Lead time has an impact on pricing as longer lead time increases costs while shorter lead time diminishes costs (Ray & Jewkes, 2004; Pahl, Voss & Woodruff, 2005; Vernimmen *et al.*, 2008).

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Hypothesis Test Results

The hypothesis sought to test influence of distribution control system on performance of manufacturing firms. Hypothesis: H_0: Lead time has no significant influence on performance of manufacturing firms in Kenya. A simple linear regression analysis was conducted using the following model;

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

Where:

Y = performance of manufacturing firms

β_0 = Constant (Co-efficient of intercept)

β = Regression co-efficient of X.

X = Lead time 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

Lead time system was regressed against performance. The regression results are shown in Table 4.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.276[a]	.076	.065	3.04842

a. Predictors: (Constant), Lead Time System

The results of regression analysis of lead time against performance show that lead time system can explain 7.6% of change in performance of manufacturing firms in Kenya as indicated by the value of R^2 (0.076).

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	60.630	1	60.630	6.524	.013[b]
	Residual	734.136	79	9.293		
	Total	794.765	80			

a. Dependent Variable: Performance
b. Predictors: (Constant), Lead Time System

The ANOVA test results in Table 5 show that the model used was fit for the regression analysis (F=6.524, p=0.013). The results are therefore valid and can be used to make conclusions.

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Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	48.741	1.934		25.200	.000
	Lead Time System	-.134	.053	-.276	-2.554	.013

a. Dependent Variable: Performance

Results in coefficients table have shown that the contribution of lead time was -0.134 for every unit change in performance of manufacturing firms in Kenya. The regression analysis results show that H_1: $\beta_4 \neq 0$ (β=-.134) and $p < 0.05$ (p=0.013). We therefore reject the null hypothesis that lead time has no significant influence on performance of manufacturing firms in Kenya.

5.0 Conclusions

The study sought to determine the influence of lead time as an element of multi-echelon distribution systems on the performance of manufacturing firms in Kenya. It concluded that lead time system significantly and negatively influences the performance of manufacturing firms in Kenya. Improvement in the continuity of supplies with reduced lead times system will lead to improvement in cooperation and will also enhance cooperation and communications with reduced duplication of efforts, reduction in material costs and improvement in quality control.

6.0 Recommendations

Based on the findings and conclusions, the study recommends to the managements and stakeholders of manufacturing firms in Kenya that they should ensure that they are proactive in activities that reduces lead time systems as revealed in the study. This can be achieved through ensuring that there is responsiveness to customers' demands regarding pricing, there is high order processing rate and adequate delivery to location (on-time in-full). Manufacturing firms should also ensure that delivery planning is adequate and there is responsiveness to customers' demands regarding product differentiation as well as responsiveness to customers' demands regarding short delivery time. In addition, manufacturing firms should facilitate high order fulfilment rate, inventory replenishment and sufficient delivery speed. In addition, it is recommended to the scholars and academicians that they should conduct further research to determine other ways in which lead time system is capable of influencing performance of other organizations other than manufacturing firms.

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