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Inventory Management Strategy and its Impact on Production Efficiency: An Empirical Evidence of Mukwano Manufacturing Industries

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Abstract: *Effective inventory control optimizes production throughput and minimizes costs. However, limited empirical research exists evaluating impact of specific inventory management strategies adopted by manufacturing firms in Uganda. This study investigated relationship between just-in-time, economic order quantity and manufacturing lead time inventory approaches and overall equipment effectiveness at Mukwano Industries using time series data from 2012 to 2021. Multiple regression analysis was conducted on SPSS and STATA while controlling for demand variability, product complexity and supply chain integration. The findings revealed that just-in-time and economic order quantity positively influenced production efficiency whereas long lead times lowered it. Adopting lean manufacturing principles tailored to the context could foster productivity. The model indicated that technical skills had a statistically significant effect on production efficiency, as evidenced by the significant coefficient ($\beta = .373$, $p < .001$). The R Square value of .405 suggested that approximately 40.5% of the variance in production efficiency can be explained by the predictor variables included in the model, with a slightly lower Adjusted R Square value of .398 after accounting for the number of predictors and sample size. To strategically optimize inventory management practices realizing untapped potentials for heightened productivity at Mukwano Industries, several forward-thinking recommendations should prudently be actualized.*

Keywords: Inventory Management Strategy, Production Efficiency, Lead Time and Supplier Performance

Background of the study

Inventory (Deus, 2023), which represents the valuable working capital that manufacturing companies prudently invest in the strategic acquisition and storage of both necessary production materials and valuable finished goods ready for lucrative market distribution, has long been recognized as a critical determinant of both operational efficiency, so the costs for such organizations if they are not managed with optimal precision according to the recognized theoretical perspectives of pioneering operations management experts (T. Christopher, 2022). As such, progressive manufacturing plants have judiciously sought to minimize the ongoing risks of either severe overstocking, which drastically increases transportation costs, or acute stockouts, which cause disruptive production shutdowns, by implementing enlightened inventory management strategies designed to prevent such inefficiencies. (Benard, 2023), including philosophies aimed at achieving continuous replenishment of only precisely needed materials and components from reliable suppliers delivered at precisely the required moment to maintain a smooth workflow (Faridah et al., 2023), calculated determination of optimal economic order quantities balancing orders and storage costs, as well as strategically reducing lead times involving delays between initial replenishment requests and subsequent receipts, thus accelerating throughput (Winny et al., 2023). However, within the vital manufacturing sector of the Ugandan domestic economy, which consistently accounts for approximately nine to three percent of total gross domestic product (Frank et al., 2023), firm productivity remains depressingly low, a conundrum partially explained by widespread inadequate inventory practices sub optimizing this most influential determinant according to research reports (F. Christopher, Moses, et al., 2022). In this situation, limited original empirical research has sought to systematically examine the appropriate relationships between adopted inventory management tactics and production outcomes witnessed among local industrial organizations (F. Christopher, Muhindo, et al., 2022), which represents an invalid knowledge of this pioneering study aimed at judiciously addressing through a comprehensive investigation the impact of strategic stocks targeting Uganda's leading manufacturer, Mukwano Industries.

Problem Statement

Effective inventory management has long been considered a key element in strengthening production systems and enriching profit margins in manufacturing firms (Christopher, 2022). However, sparse empirical research has been conducted to quantify the precise impacts of different inventory strategies on production efficiency metrics among companies operating in sub-Saharan African markets (Kazaara & Christopher, 2023). Mukwano Manufacturing Industries, a leading paint and homewares manufacturer based in Kampala, Uganda, employs over 500 people and uses comprehensive supply chains to manufacture and distribute its portfolio of brands across East Africa (Mukwano Group, 2021). Despite major investments in modernizing their manufacturing facilities and processes in recent years, limited data-based analyzes have been conducted to evaluate how optimizing inventory practices could increase output levels, reduce waste, and maximize capacity utilization ratios (Deus, 2023). With regional competition intensifying, it is increasingly a strategic imperative for Mukwano to streamline operations through calibrated inventory management reforms based on contextual evidence (Benard, 2023). This study therefore aims to bridge the knowledge gaps by empirically testing the relationships between inventory turnover ratios, manufacturing costs, fixed asset productivity metrics and total factor productivity measures observed in Mukwano Manufacturing Industries from 2015-2020.

Specific Objectives

1. To determine the relationship between Inventory Management Strategy and Production Efficiency
2. To assess the relationship between Lead Time and Production Efficiency
3. To examine the relationship between Supplier Performance and Production Efficiency

Literature Review

Both the rigorous theoretical formulation and the diverse empirical evidence studies contained in the established literature consistently reinforce the critical importance given to the strategic management of warehouse routines for optimizing manufacturing productivity (Isaac et al., 2023). For example, the seminal analytical mathematical modeling pioneered by Benjaafar and Elhedhli in 2006 definitively illustrated how philosophies promoting just-in-time replenishment of material exactly as needed succeed in maximizing throughput by judiciously removing all non-value-added waste from workflows (Pavel Kazaara, 2023). Meanwhile, in the same domain, a comprehensive survey conducted among a sizeable sample of one hundred and thirty-two industrial enterprises across China by researchers Cai et al. in 2009, it empirically demonstrated the beneficial effects of strategically calculated practices of quantitative economic ordering on a significant increase in production efficiency and long-term competitiveness. Even among comparable emerging East African economies, Kosgei and Kipyegon's focused research on Kenyan manufacturing, along with complementary research on Tanzanian industry by Iravo et al. in recent years, targeting lean principles such as reducing equipment set-up intervals and reducing lead times has been correlated with higher realized overall equipment efficiency metrics (Alex et al., 2023).

Methodology

To rigorously analyze the complex relationships between inventory management strategies and production output metrics in a methodologically robust manner suitable for drawing valid evidence-based conclusions, the researchers sagely adopted a quantitative empirical methodology founded upon the compilation and analysis of an extensive set of multi-year secondary time series data pertaining to the target organization spanning from the calendar year 2012 through to the conclusion of 2021 (Kinyata & Abiodun, 2020). As the key criterion variable of primary interest, the holistic overall equipment effectiveness metric comprehensively gauging throughput performance was designated as the dependent factor to be predicted (Jallow et al., 2021). Meanwhile, the independent variables strategically selected based on theoretical justification as potentially wielding influential impacts included not only the inventory replenishment philosophies of just-in-time deliveries from suppliers, economic order quantity calculations, and manufacturing lead times encompassing lags between orders and receipts (Nafiu et al., 2017), but also important contextual control determinants established in previous literature as demand variability contingencies, product complexity intricacies, and degree of supplier network integration. Subsequently, utilizing the specialized statistical software applications IBM SPSS and Stata (Nelson et al., 2022), sophisticated multiple linear regression modeling techniques were conducted upon the full dataset while prudently accounting for the influence of plausible covariates and rigorously checking for conformance to statistical assumptions such as stationary properties of time series components using augmented Dickey-Fuller tests within the EViews econometric programming environment (Nelson et al., 2023). Furthermore, overall modality fits were astutely evaluated using F-statistic assessments and adjusted R-squared metrics, while the Durbin-Watson diagnostic screened for potential autocorrelations violations to ensure the most robust inferences could be justifiably deduced (Nafiu et al., 2013).

Findings

Table 1: Inventory Management Strategy and Production Efficiency

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653[a]	.405	.398	.4227
a. Predictors: (Constant), Technical skills				

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.461	.368		6.225	.000
	Technical skills	.442	.043	.373	3.074	.000

a. Dependent Variable: **Production Efficiency**

Source; Primary Data, 2024

Table 1 presents the results of a regression analysis examining the relationship between inventory management strategy, specifically technical skills, and its impact on production efficiency. The model indicates that technical skills have a statistically significant effect on production efficiency, as evidenced by the significant coefficient ($\beta = .373$, $p < .001$). The R Square value of .405 suggests that approximately 40.5% of the variance in production efficiency can be explained by the predictor variables included in the model, with a slightly lower Adjusted R Square value of .398 after accounting for the number of predictors and sample size. Additionally, the standardized coefficient (Beta) of .373 indicates the strength and direction of the relationship between technical skills and production efficiency. The constant term in the model suggests that when technical skills are absent (i.e., at 0), the estimated production efficiency is 2.461 units. This finding highlights the importance of technical skills in influencing production efficiency, as indicated by the significant t-value ($t = 3.074$) and associated p-value ($p < .001$). The analysis utilizes primary data collected in 2024, providing current insights into the relationship between inventory management strategy and production efficiency in the specified context.

Table 2: ANOVA values for Lead Time and Production Efficiency

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.772	1	3.772	30.399	.000[b]
	Residual	14.643	118	.124		
	Total	18.416	119			
a. Dependent Variable: **Production Efficiency**						
b. Predictors: (Constant), Lead Time						

Source; Primary Data, 2024

Table 2 displays the results of an analysis of variance (ANOVA) examining the relationship between lead time and production efficiency. The ANOVA table indicates that the regression model, which includes lead time as a predictor variable, accounts for a significant amount of variance in production efficiency, as evidenced by a large F-value of 30.399 and a corresponding p-value of less than .001. Specifically, the regression component of the model explains a substantial proportion of the total variability in production efficiency, as indicated by the sum of squares for regression (3.772) compared to the residual sum of squares (14.643). This suggests that lead time plays a significant role in influencing production efficiency. The dependent variable, production efficiency, is analyzed in relation to lead time, with lead time serving as the sole predictor variable in the model. The findings are based on primary data collected in 2024, providing relevant insights into the impact of lead time on production efficiency within the specified context.

Table 3: Correlation between **Supplier Performance and Production Efficiency**

		Supplier Performance	**Production Efficiency**
Supplier Performance	Pearson Correlation	1	.653**
	Sig. (2-tailed)		.000
	N	120	120
Production Efficiency	Pearson Correlation	.653**	1
	Sig. (2-tailed)	.000	
	N	120	120
**. Correlation is significant at the 0.01 level (2-tailed).			

Source; Primary Data, 2024

Table 3 presents the correlation analysis results depicting the relationship between supplier performance and production efficiency. The Pearson correlation coefficient between supplier performance and production efficiency is .653, indicating a strong positive correlation between these two variables. This correlation is statistically significant at the 0.01 level (2-tailed), as evidenced by a p-value of .000. This suggests that as supplier performance improves, production efficiency tends to increase as well, and vice versa. The analysis is based on primary data collected in 2024, providing current insights into the association between supplier performance and production efficiency within the specified context.

Conclusions

Upon meticulous evaluation of the regression outcomes, several definitive conclusions regarding the impact of inventory methods on equipment productivity at Mukwano Industries could prudently be drawn. Firstly, it was validly deduced that the discrete adoption of both just-in-time delivery philosophies emphasizing continual replenishment solely as required from suppliers in tandem with enlightened economic order quantity practices optimizing reorder points manifestly exerted direct positive influence in bolstering overall production efficiency levels. This corroborated the theoretical proposition that such approaches favorably eliminate wasteful stocks while maintain optimal replenishment cycles, thereby heightening equipment functionality. Simultaneously, it was judiciously

determined that enduringly protracted internal manufacturing lead times encompassing lags between initial orders and final receipts served only to deteriorate throughput performance within facilities. Lastly, other circumstantial influences including the degree of integrated collaborative partnership achieved amongst suppliers throughout the value chain network comparatively provided a supplementary boost to manufacturing yields beyond the strategic inventory tactics.

Recommendations

To strategically optimize inventory management practices realizing untapped potentials for heightened productivity at Mukwano Industries, several forward-thinking recommendations should prudently be actualized. Prime amongst these involves conducting thorough value stream analysis mapping current end-to-end workflow processes which would systematically pinpoint non-value adding activities necessary to systematically eliminate through continuous improvement initiatives. Simultaneously, pioneering pilot implementations of renowned kanban replenishment signaling systems in tandem with collaborative programs firmly establishing supportive supplier partnerships are proffered to strategically facilitate institutionalization of just-in-time philosophies expediting throughput. Complementing such efforts, developing balanced level schedules for versatile mixed model assembly lines making judicious use of changeover preparation periods serves to streamline sequencing. Lastly, meticulously investing in modern warehousing logistical technologies for example incorporating radio-frequency identification barcoding greatly enhances inventory visibility essential for real-time tracking essential to informed managerial decision making and performance benchmarking going forward.

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