



## Inventory Management Practices and Operational Performance of Manufacturing Firms in Ghana

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### Authors' contributions

*This work was carried out in collaboration among all authors. Author RKO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HMF and GK managed the analyses of the study. Authors JA and FOA managed the literature searches. All authors read and approved the final manuscript.*

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### ABSTRACT

**Aims:** The study examined the effect of different inventory management practices on the operational performance of manufacturing firms in Ghana.

**Study Design:** The study adopted the descriptive survey design.

**Place and Duration of Study:** The study was conducted among manufacturing firms within the Accra, Tema and Kumasi metropolises in Ghana between November 2019 and February 2020.

**Methodology:** The study randomly sampled 152 Procurement and Operations managers and officers from 246 registered manufacturing firms with the Association of Ghana Industries. The manufacturing firms are specifically located within the Accra, Tema and Kumasi metropolises. The study gathered primary data using structured questionnaires of which analysis was done using both

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descriptive and inferential statistical tools including mean, standard deviation and ordinary least square regression.

**Results:** Using 114 valid responses, the study found manufacturing firms in Ghana to have high preference for Strategic Supplier Partnership (M=3.63) and Activity Based Costing (M=3.56), whereas they had least preference for Just In Time (M=3.06). The ordinary least square regression analysis showed that all the different inventory management practices: strategic supplier partnership ( $P=.000$ ), activity based costing ( $P=.025$ ), vendor managed inventory ( $P=.008$ ), economic order quantity ( $P=.19$ ), material resource planning ( $P=.000$ ) and just in time ( $P=.009$ ) are significantly and positively associated with operational performance.

**Conclusion:** The study concluded that inventory management practices especially strategic supplier partnership plays tremendous roles in improving the operational performance levels of manufacturing firms in a developing economy notably Ghana.

*Keywords: Inventory management; activity based costing, economic order quantity; just-in-time; strategic supplier partnership; vendor managed inventory; material resource planning; operational performance.*

## 1. INTRODUCTION

Manufacturing sectors continue to contribute significantly to economic developments of both developed [1,2] and developing economies [3,4]. Manufacturing sectors have traditionally provided employment opportunities, innovativeness and revenues to government through Gross Domestic Products and taxes [5,6]. Developing economies such as Mexico, Taiwan, Brazil and India have witnessed their manufacturing sectors contributing, on average, about 15 percent to 35 percent and 30 percent to 45 percent to GDP and job creation respectively [1,2]. They also play key roles in transforming idle resources into beneficial products. The manufacturing sector's core mandate is to convert inventories comprising raw materials, components or parts and work-in-progress into end products to satisfy end users' needs [7].

Arguably, manufacturing firms can never operate without relying on inventories which constitute about 70 percent of total current assets [7,8]. This is a clear indication of the immense importance of inventories to achieving the performance and competitiveness goals of manufacturing firms. Studies by [9,10] revealed that the increasingly competitive and dynamic nature of manufacturing environments have called on firms to adopt comprehensive and innovative ways to manage their inventories. Thus, manufacturing firms in developing economies can only survive unhealthy competitions while continuously meeting fluctuating customer demands by ensuring proper inventory management [11,12]. Inventory management is regarded as the policies and procedures which determine and regulate a

firm's inventory [13,14]. It is also associated with identification, acquisition, planning, storage, packaging, transporting of inventories to meet customer satisfaction levels. [15] revealed that the activities of inventory management vary by firm, industry and or sector.

Additionally, inventory management strengthens internal controls to ensure optimal and quality inventory while providing value to customers [7,15]. It basically reduces unnecessary inventory wastages, shortages, thefts, production costs while ensuring sales growth, customer satisfaction, competitiveness and eventually survival of manufacturing firms. Proper inventory management enables manufacturing firms to mitigate risk by hedging against fluctuations arising from major risk-related issues such as economic, financial, market, weather and/or demand. It also serves as a buffer to handle uncertainties and process out variations [7,16]. It also strikes a clear balance between too little and too much inventory; thus, ensure optimum inventory levels at all times [17]. It avoids overstocking or understocking by determining current and future inventory requirements. [18] further argued that effective inventory management ensures inventory visibility in both upstream and downstream nodes in supply chains.

However, poorly managed inventories could potentially lock up about 70 percent of a firm's total current assets which could consequently affect their operational and overall performance levels [12,15]. It could also create huge gaps in internal controls leading to financial risks: theft and fraud schemes [19] while exposing manufacturing firms to production and delivery

delays, countless faulty products and unnecessary product shortages [13,20,21]. It could also expose these firms to inventory shrinkages (expiries, contaminations, thefts, damages), improper storage practices, frequent material wastages, product shortages, high customer dissatisfaction, low quality products, lack of flexibility, employee dissatisfaction and lack of competitive advantages. In view of this, for the concept of inventory management to be properly understood, the study relied on the theory of constraints and strategic choice theory respectively. According to the theory of constraints, for instance, manufacturing firms are predominantly exposed to inventory constraints arising from thefts, expiries, shortages and long lead times which could obstruct their entire systems [22,23]. Manufacturing firms can only overcome their inventory constraints while improving performance levels by adapting to relevant inventory management practices [24,25,26].

Moreover, these are clear indications that, managing inventories can never be effectively done in the absence of inventory management practices which are concerned with balancing demand and supply by controlling and monitoring manufacturing and purchasing orders so as to ensure uninterrupted material flow and value-adding activities [27,28]. Inventory management practices have largely been found to include economic order quantity (EOQ), just in time (JIT) replenishment, vendor managed inventory, strategic supplier partnerships, material replenishment planning (MRP), Pareto analysis, among others [7,14,28]. These practices have largely been found to improve operational performance in areas of product quality, operational speed, flexibility, dependability while minimising overall production costs [13,15,17].

Similarly, in developing economies notably Ghana, manufacturing firms have been found to rely on these practices during inventory management [6,29]; however, it remains unknown the most-preferred practices adopted by the firms. Also, none of the previous studies in Ghana have clearly revealed the extent to which the different inventory management practices influence the operational performance levels of the manufacturing firms. For instance, previous studies by [29,30] revealed key inventory management practices used by Ghanaian manufacturing firms to include Pareto analysis, Economic Order Quantity (EOQ), Just In Time (JIT) replenishment, Vendor Managed Inventory (VMI) and more recently, Strategic Supplier

Partnerships (SSPs). They further stressed that inventory management practices are key determinants of firms' financial performances thus cannot be overemphasised. Similarly, [6,30] found inventory management to improve performance levels of Ghanaian manufacturing firms, but it still remains unclear the contributions of each of the practices to operational performance of the manufacturing firms.

Furthermore, a report by Shippers Council of Eastern Africa (SCEA) in 2016 revealed that the African continent has performed poorly in inventory as against other continents. More precisely, the report revealed five least inventory performers to include Rwanda (2.04), Namibia (2.02), Sierra Leone (1.97), Eritrea (1.70) and Somalia (1.34) respectively; indicating that Africa is performing abysmally in inventory management practices. Poor inventory performance arguably continues to have severe rippling effects on the overall performance of the manufacturing sectors and their overall contributions to economic developments of African countries. A 2016 report by the United Nations Industrial Development Organisation (UNIDO) emphasised that the significance of manufacturing sectors to developing economies has diminished drastically over the last 25 years. In Ghana, a developing economy, for instance, the sector's economic growth has consistently declined over the years with average contributions of a meagre 5.5% and 8.2% to GDP and job creation respectively; indications of a stagnated and dying sector [2]. A Ghana Statistical Service report in 2018 disclosed that the sector's contributions to Ghana's GDP has declined by about 50.55 percent between 2007 (9.1%) and 2017 (4.5%). Arguably, the sector would continuously experience declining performances if irrelevant practices are adopted during inventory management.

It is, therefore, against this background that the study examined inventory management practices and operational performance of manufacturing firms in Ghana. The study also specifically assessed the inventory management practices most preferred and used by manufacturing firms in Ghana. It also investigated the effect of different inventory management practices on the operational performance of the manufacturing firms.

### 1.1 Hypothesis Development

The paper develops hypothesis to test the relationship between the key inventory

management practices and operational performance.

### **1.1.1 Strategic supplier partnership and operational performance**

The concept of strategic supplier partnership (SSP) is increasing in scope and recognition as suppliers have been found to play tremendous roles in modern supply chains [31,32]. Inventory is increasing in complexity requiring firms to partner strategically with key suppliers to avoid unnecessary stock outs, production delays and employees' low productivity levels. In times of global supply uncertainties, for instance, focal firms likely to obtain needed inventories to operate ahead of competitors due to SSP. As such, creating strong and long-lasting ties with key suppliers have been found to promote operational performance levels of both actors in the chain [3,31,33,34]. These studies have concluded that SSP promotes operational performance of firms in various developing economies other than Ghana by improving product quality, operational and delivery speed, operational dependability and flexibility while minimising production costs without compromising customer satisfaction. Therefore, the study hypothesises that: H1: Strategic Supplier Partnership significantly improve operational performance of manufacturing firms.

### **1.1.2 Economic order quantity and operational performance**

Economic order quantity (EOQ) has largely been adopted to manage inventories in manufacturing firms globally [35,36]. It has been found effective for solving trade-offs between holding and ordering inventory and their implications on total costs. EOQ has traditionally emphasised on keeping optimum inventory levels at all times to avoid inventory shortages or stock outs during production which ultimately affect customer delivery and operational performance levels. This practice assumes that, during a specific period, lead time is fixed, instant receipt of orders, fixed charges on inventory orders while customer demands are known and constant [35,37,38]. Meeting these assumptions help firms to properly handle inventories which promote operational speed, flexibility, dependability and product quality [36,39]. Also, [38] added that EOQ aims at reducing total inventory costs (i.e. ordering costs, holding costs, storage costs and inventory costs) to improve overall firm success and competitiveness. The study, therefore,

hypothesises that; H2: Economic Order Quantity significantly improves operational performance of manufacturing firms.

### **1.1.3 Activity based costing and operational performance**

The Activity-Based Costing (ABC) was introduced by Cooper and Kaplan to address shortfalls in the traditional volume-based costing approach [40]. The ABC system uses several allocation basis and cost drivers to allocate inventory overhead costs to final products [41,42]. It has been found to have the capabilities of producing better costs analysis through costs identification and classifications leading to improved firm competitiveness [43]. ABC specifically classifies inventory based on monetary value and annual usage. It divides inventory into three key classes: A, B and C; enabling firms to concentrate on more valuable items [44]. These classifications have been found to help firms' control overall inventory costs thereby improving their overall costs structure, survival and competitiveness. Previous studies have concluded that ABC results in better firm performance in areas of operational flexibility, dependability, customer satisfaction and product quality [45,46,48,49,50]. Similarly, [44] concluded that ABC to significantly improves product quality while minimising production costs. On this background, the study hypothesises that; H3: Activity Based Costing significantly improves operational performance of manufacturing firms.

### **1.1.4 Vendor managed inventory and operational performance**

Vendor managed inventory (VMI) is characterised by establishing strategic alliance with key suppliers through integrated technology, top management support, customised replenishment logic, information sharing and network application [47,51]. Through strategic alliance, suppliers are permitted to keep inventories on focal firm's behalf which helps the latter to eliminate or reduce safety stock. Precisely, firms' upstream actors (i.e. suppliers) take responsibilities for decisions regarding the amounts and timing of inventory replenishments; leading to reduced stock-outs and inventory-carrying costs. VMI and firm performance have, therefore, been discussed in existing literature [51,52,53]. For instance, [54] found VMI to reduce lead times, lost sales and demand uncertainties resulting from inventory shortages. Similarly, [51] found VMI to minimise inventory

costs and defective items while improving customer service and firm competitiveness. Also, [55] and [56] concluded that quality control, a dimension of VMI, promotes firm performance; arguably through improved product quality and meeting customer requirements. Similarly, VMI has been found to reduce uncertainties in customer demands, frequency and number of stockouts and inventory levels while promoting production planning, flexibility, distribution and speed [57,58,59,60]. The study, therefore, hypothesises that; H4: Vendor managed inventory significantly improves operational performance of manufacturing firms.

#### **1.1.5 Just in time and operational performance**

Just in time (JIT) practice has been embraced in our 21<sup>st</sup> century to help businesses cut operational costs while offering competitive prices, provide first class customer service to survive and develop [61]. JIT originated in Japan and implemented by Toyota and other Japanese manufacturing firms with great success in eliminating production waste. This practice has proven capable of effectively cutting production costs and wastes while improving productivity, quality and efficiency of manufacturing firms in both developed and developing economies [62,63,64]. According to [65], JIT lays much emphasis on the production of items just when needed, neither earlier nor later. It works efficiently when there are clear agreements with suppliers for short cycle deliveries [66]. It has largely been found to improve operational performance in areas of operational flexibility, dependability, speed while minimising inventory-related costs [65,67,68,69]. Other studies similarly found JIT to positively influence operational performance in terms of timely deliveries, waste elimination, increased productivity while improving demand management [70,71,72]. The study hypothesised that; H5: Just In Time significantly improves operational performance of manufacturing firms.

#### **1.1.6 Material resource planning and operational performance**

Material Resource Planning (MRP) as an inventory management practice relies on computer software applications to managing inventories. It specifically breaks down inventory requirements into precise periods to maintain optimum inventory levels to attain continuous production [73,74]. It is designed to answer what

is needed, when it is needed and how much is needed. MRP assists in planning capacity needs and allocating production times in order to achieve customer satisfaction. This practice has also been found to assist in managing inventories to meet production requirements such as production speed, dependability and flexibility [75,76]. Thus, MRP has been associated with operational performance by playing key roles in preventing inventory obsolescence, stock outs, excess stock levels while improving material flow, customer satisfaction and product quality [74,77,78]. The study, therefore, hypothesises that; H6: Material Resource Planning significantly improves operational performance of manufacturing firms.

## **2. LITERATURE REVIEW**

The section presents the theoretical, conceptual reviews and conceptual framework of the study.

### **2.1 Theory of Constraints (TOC)**

The theory of constraints (TOC) was developed by Eliyahu Goldratt as a management philosophy aimed at identifying constraints that limits a system from attaining expected performance levels [22]. The theory assumes that every firm has at least one constraint (limiting factor) which inhibits its entire system from achieving expected targets [79]. A constraint is anything that hinders a firm from achieving its goals [80]. It is the key limiting factor to obtaining firm's goals thus regarded as the weakest link in a system [26]. The theory further assumes that firms can only overcome their constraints by providing a clear, systematic, strategic and comprehensive focus. According to [23], TOC is a management philosophy that focuses on continuous system improvement by tackling any constraint through total quality management and effective processing flows.

Arguably, manufacturing firms are predominantly exposed to various constraints notably inventory constraints which contribute largely to unnecessarily lengthy lead times, poor material orders, large amount of unfulfilled and emergency orders, poor customer satisfaction and consequently poor performance levels [27]. The theory, therefore, suggests that firms can only overcome their inventory woes by adopting the most appropriate practices to managing inventories in order to address bottleneck issues while ensuring inventory controls and production scheduling. Also, [81] further opine that the

theory acts effectively by eliminating any constraint while increasing value addition without disrupting the firm's production flow. Thus, TOC underpins the study as it helps manufacturing firms appreciate the concept of inventory constraint and how it can be overcome through proper practices such as JIT, SSP, MRP, EOQ, VMI, Pareto Analysis (ABC) among others.

## 2.2 Strategic Choice Theory

The strategic choice theory (SCT) reveals the link between choices of top management and organisational performance coupled with the interaction of both internal and external organisation [82]. According to [83], the theory underlies the relevance of key management decisions to improving organisational performance levels. SCT also suggests that the quality of a manager's decision or choice is largely dependent on various environmental elements including purchasing, supply and inventory management. Simply put, the theory argues that management with the decision-making powers need to make relevant decisions regarding inventory investment, inventory optimality in order to have significant positive effects on performance outcomes. Also, [83] positioned that SCT perceives management as downstream decision makers who direct decisions while making changes to organisational processes, structures and systems. Thus, they need to make relevant decisions to protect organisational culture, resources including inventory in order to promote positive performance levels.

Moreover, [84] developed a strategic choice model which shows the interdependence among an organisation, actions, its environment and overall performance targets. The model is aimed at ensuring high performance standards in a bid to promote efficiencies where resources are limited or constrained. The theory, therefore, posits that management needs to make relevant and effective choices during inventory management in order to overcome potential inventory issues. Thus, management's choices of inventory management practices should be relevant to their business activities; adopting irrelevant practices could eventually threaten the profitability, operationalisation, overall performance and survival levels of a firm. Therefore, the strategic choice theory underpins the study because it shows the association between top management choices and performance levels of organisations. Thus, any

decision made by management concerning inventory management practices could have positive or negative effects on their firms' overall performance levels.

## 2.3 Inventory Management Practices

The success of any business organisation, particularly manufacturing, primarily relies on the inventory practices they adopt to manage their inventories [85,86,87]. Inventory management practices (IMP) refer to the various practices of firms to ensure that inventories are kept at optimum levels to provide maximum service levels at minimum costs [18,88]. They are primarily concerned with balancing demand and supply by controlling and monitoring manufacturing and purchasing orders so as to ensure uninterrupted material flow and value-adding activities. Inventory management practices ensure that manufacturing firms are able to effectively and efficiently manage their inventories [12,29].

Previous studies have revealed different inventory management practices (IMP) of manufacturing firms to include: Just in Time (JIT), Vendor Managed Inventory (VMI), Economic Order Quantity (EOQ), Economic Batch Quantity (EBQ), Activity Based Costing (ABC), Material Requirement Planning (MRP) and Material Resource Planning (MRP) [17,29,87,89,90,91]. However, some scholars have agreed that, some of these practices are more crucial and thus adopted by manufacturing firms in both developed and developing countries [89,90;91]. A study by [89], for instance, found EOQ as a traditional and commonly used strategy for minimising inventory of firms in most developed countries. In contrary, [92] found lean production also known as JIT as the most preferred IMP used by manufacturing firms in the USA.

Also, a study on Indian manufacturing firms revealed ABC classification, JIT and outsourcing as the key inventory practices used [93]. Similarly, [94] found ABC as a key inventory practice, whereas [95] found JIT as a practice used by US manufacturing firms to manage inventory. Manufacturing firms in Africa have been also found to adopt similar practices to managing their inventories. For instance, [96] found dominant practices adopted by Kenyan manufacturers to include VMI, SSP, JIT and ABC practices. A study by [3] on Sugar manufacturing companies in the Western Kenya Sugar Belt

revealed that these firms adopt lean inventory (JIT), SSP and information technology (IT) for managing inventories. In Ethiopia, [39] found JIT, VMI, ABC and forecasting as the most popular IMPs adopted by manufacturing firms in Arsi Zone.

In a similar vein, [97] found that majority of manufacturing firms in Melaka rely on EOQ to address their inventory weaknesses. In contrast, [10]’s study on flour milling firms in Lagos identified dominant IMPs to include ABC, supplier involvement (SI) and Thumb rule (TR) as the most dominant practices used by the flour milling firms. On the other hand, [98] and [99] found JIT as the most widely used strategies for managing inventories of manufacturing firms. In Ghana, a study by [100] revealed that, within the health service sector, inventory practices such as lean inventory (JIT), SSP and information technology are mostly used. A study on listed manufacturing firms by [6] revealed major inventory practices to consist of SSP, Pareto ABC and JIT respectively.

**2.4 Conceptual Framework**

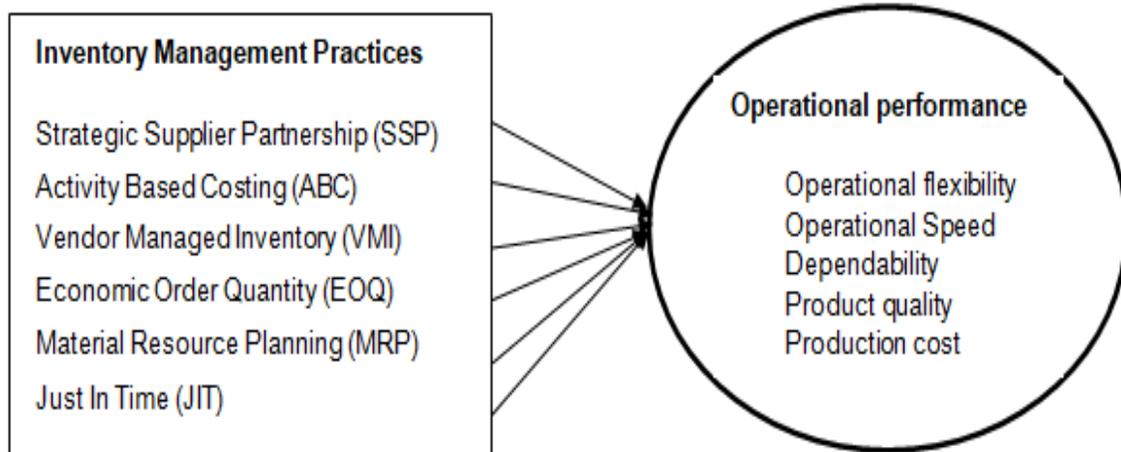
The conceptual framework was designed to bring forth a pictorial or diagrammatic view of the study’s dependent and independent variables. The independent variables are variables that predict the amount of variation in the dependent variable. Thus, the value of the dependent variable depends on any change in the independent variable. This study’s independent variable was represented by the different

inventory management practices comprising Strategic Supplier Partnership (SSP), Activity Based Costing (ABC), Vendor Managed Inventory (VMI), Economic Order Quantity (EOQ), Material Resource Planning (MRP) and Just In Time (JIT), while the dependent variable focused on operational performance measured in terms of operational flexibility, speed, dependability, product quality and production cost. Fig. 1 presents the conceptual framework of the study.

From Fig. 1, operational performance is dependent on the inventory management practices of the manufacturing firms. As such, any change, positive or negative, in inventory management practice is likely to cause a change in firm performance in the same vein. Therefore, this framework was very important as it clearly revealed the effect that inventory management practices could have on the operational performances of manufacturing firms. This will help inform policies and practices of the manufacturing firms in a bid to improve their operational and overall performance levels.

**3. MATERIALS AND METHODS**

This section of the paper presents the material and methods used in the study. It specifically discussed important elements such as research design and approach, population and sample size, data collection instrument, validity and reliability of data collection instrument and data processing and analysis.



**Fig. 1. Conceptual framework of the relationship between inventory management practices and operational performance**

### 3.1 Research Design and Approach

The study adopted the quantitative approach and descriptive survey design. The approach is suitable for analysing cause and effect relationships between variables under investigation [101]. It is also relevant for obtaining factual data to draw objective conclusions for better generalisation across an entire population. The design also has an advantage of producing good amount of responses from a wide range of people. It seeks to identify, describe and interpret trends which aid in investigating an occurring event. This design allows the collection of data through surveys or structured questionnaires [102,103]. It also allows the use of descriptive and inferential statistical tools which involve a great amount of numerical and narrative data to describe key issues [101,104,105].

### 3.2 Population and Sample Size

The study's target population consisted of 246 procurement and operations managers and officers of manufacturing firms located within the Accra, Tema and Kumasi metropolises in Ghana. The study focused on these three metropolises because of the concentration of manufacturing firms there. According to [106] report, about 75 percent of manufacturing firms in the country are concentrated in these three metropolises. Using the [107] sampling technique, the study sampled 152 members from the target population and further adopted the simple random sampling technique for selecting members. This technique is easy to use, fast, less expensive and relevant for a quantitative study of this nature.

### 3.3 Data Collection Instrument

Primary data collection instrument specifically the structured questionnaire was employed to collect data from respondents. Moreover, [108] revealed that, with a structured questionnaire, each person is asked to respond to the same set of questions in a predetermined order. Structured questionnaire is suitable for obtaining objective responses allowing for quantitative analysis [108]. It is also effective for collecting numerical data for both descriptive and inferential statistics to generate better conclusions for generalising findings across the entire population. The questionnaire contained 40 question items aimed at achieving the study's research objectives. More precisely, the six (6) key inventory management practices had five (5) question items each, whereas operational performance

had 10 question items. All the question items were adapted from previous studies. For instance, question items on SSP were adapted from [31,109]; ABC [48;110]; MRP [75,78]; EOQ [38,111]; JIT [71,112] and VMI [53,55] and operational performance [65,113].

The data was self-administered to a key representative of each of the manufacturing firms within the three major metropolises in Ghana. Prior to this exercise, a formal request form was sent to the various firms' understudy to obtain formal permission of the respondents. After obtaining permissions, the researchers allocated one month for the exercise due to the respondents' busy schedules coupled with difficulties locating some of the firms. Regular visits were paid to each firm until the exercise was complete.

### 3.4 Validity and Reliability of Data Collection Instrument

Previous studies by [114,115] suggested that validity focuses on checking the quality of all the question items by ruling out contradictions and possible unclear or ambiguous statements. This was achieved through peer and expert reviews. On the other hand, reliability focuses on extent to which a data collection instrument measures what it is actually intended to measure [108,115]. It also ensures that research instrument can be replicated by other researchers using similar population characteristics. It is determined by conducting a Cronbach Alpha test to check for internal consistency reliability. The rule of thumb is that, a Cronbach Alpha is acceptable if it has a value of 0.7 or more [116]. As such, the study achieved reliability since the pre-tested questionnaire had an alpha of 0.848 > 0.70 after pretesting the drafted questionnaire using 30 key personnel in manufacturing firms within the Sekondi-Takoradi metropolis of Ghana.

### 3.5 Data Processing and Analysis

The data obtained were processed using IBM SPSS Statistics version 26 software. This version was released in April 2019 and it offers advanced statistical and text analysis, integrates with big data, open source extensibility [117]. This software is flexible, scalable, accessible, easy to use and supports hypothesis testing. It is also suitable for projects with differing complexity, sizes which helps organisations and researchers to improve efficiency, obtain new opportunities while minimising associated risks. The processed data was subsequently analysed using both descriptive: means and standard deviations, and

inferential tools specifically ordinary least squares regression. The first research objective, for instance, analysed the responses using mean and standard deviations, whereas the second objective relied on the regression analysis for testing cause and effect relationship between inventory management practices and operational performance. Based on six independent variables, the study deduced the following regression equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon$$

Where: Y = Operational Performance;  $\beta_0$  = Constant;  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$  and  $\beta_6$  = regression coefficients;  $X_1$  = Strategic Supplier Partnership (SSP);  $X_2$  = Activity Based Costing (ABC);  $X_3$  = Vendor Managed Inventory (VMI);  $X_4$  = Economic Order Quantity (EOQ);  $X_5$  = Material Resource Planning (MRP);  $X_6$  = Just In Time (JIT);  $\varepsilon$  = Error Term

#### 4. RESULTS AND DISCUSSION

This section presented the results and discussion of the study in relation to its research objectives and hypothesis. It specifically presented the study's results on the preference for inventory management practices and also how the selected practices affect the operational performance levels of the manufacturing firms under consideration. The results were presented in tables based on both descriptive and inferential analysis and discussed with support of relevant literature. Key findings of the study were also revealed in this section and justified.

##### 4.1 Preference for Inventory Management Practices

From the descriptive statistics in Table 1, the study revealed that the manufacturing firms studied have high preference for Strategic Supplier Partnership (SSP) (M=3.63; SD=1.305) and Activity Based Costing (ABC) (M=3.56; SD=1.276); thus, 1<sup>st</sup> and 2<sup>nd</sup> respectively. From the Table, the other inventory management

practices including Vendor Managed Inventory (VMI), Economic Order Quantity (EOQ), Material Resource Planning (MRP) and Just In Time (JIT) had low preferences with mean scores of 3.35, 3.32, 3.24 and 3.06; with standard deviation scores of 1.241, 1.194, 1.372 and 1.422 respectively. These practices also ranked 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> respectively. However, with all the practices having mean scores above 3.0 indicate that they are all adopted by manufacturing firms in Ghana during inventory management.

These results imply that during inventory management, manufacturing firms develop strong, mutually collaborative and long-lasting relationships with third parties notably key suppliers [31,110,118]. This helps them to obtain vital resources in areas of expertise, financial assistance, and even exposure to new and innovative ways of successfully managing inventories. According to [3,118], through strategic partnerships and collaborations, manufacturing firms are also able to exchange ideas with their key partners while acquiring sensitive and highly expensive facilities and technologies which promote inventory management and invariably operational performances of the firms studied.

The study's result also implies that, manufacturing firms in Ghana prefer to also manage their inventories by periodically categorising their inventories in order of importance and value. As such, highly valued (core) inventories are given special control, security and financial support as compared to less valued inventories [41,42,43,50]. Recategorization enables manufacturing firms to determine highly valuable items where poor inventory management could have negative repercussions on the firms' operational performances [94,111]. Similarly, [96] concluded that ABC practice leads to cost identification and classifications which enable manufacturing firms to better understand their costs structures to enhance competitiveness.

**Table 1. Preference for inventory management practices**

Inventory Management Practices	Rank	Mean	Std. Deviation
Strategic Supplier Partnership (SSP)	1 <sup>st</sup>	3.63	1.305
Activity Based Costing (ABC)	2 <sup>nd</sup>	3.56	1.276
Vendor Managed Inventory (VMI)	3 <sup>rd</sup>	3.35	1.241
Economic Order Quantity (EOQ)	4 <sup>th</sup>	3.32	1.194
Material Resource Planning (MRP)	5 <sup>th</sup>	3.24	1.372
Just In Time (JIT)	6 <sup>th</sup>	3.06	1.422

However, the JIT was the least preferred inventory management practice and this could be because, it is primarily effective when manufacturing firms have highly responsive supply chains capable of meeting demands as and when needed. Arguably, such resilient supply chains are lacking within manufacturing sectors of developing economies including Ghana as compared to the advanced economies; making it difficult for firms to prefer this practice. Regardless, JIT is based on some primary elements: keep only the needed inventory, ensure quality with zero defects and minimise lead times through reductions in set-up times, lot sizes and queue lengths [61,62,64,119]. However, manufacturing firms in most developing economies struggle to embrace this practice basically due their over-reliance on obsolete technology, whereas JIT requires sophisticated technology.

#### 4.2 Inventory Management Practices and Operational Performance

The study also employed the Ordinary Least Square Regression analysis to examine the effect of different inventory management practices comprising SSP, ABC, VMI, EOQ, MRP and JIT on the operational performance (OP) of the manufacturing firms studied. The

results of the analysis were discussed in three sections: Model Summary, ANOVA and Coefficients. The results were presented in Tables 2, 3 and 4 respectively.

From Table 2 the study had an Adjusted R<sup>2</sup> of 0.371 which inferred that variation in operational performance of the manufacturing firms studied is caused by changes in the different inventory management practices. Thus, inventory practices comprising MRP, EOQ, ABC, SSP, JIT and VMI cause about 37.1 percent of change in operational performance of Ghana's manufacturing firms. This result was confirmed by [6,29] who found inventory management practices to contribute to determining the operational performances of manufacturing firms in Ghana. The result indicates that other variables notably sustainable procurement practices, inventory management efficiency, supply chain risk management, total quality management, supply chain agility and resilience could also contribute to promoting operational performance levels. These variables have been found to play key roles in contributing to product quality, operational flexibility, efficiency while reducing production costs. Thus, these variables combined could contribute the other 62.9% to promoting operational performance.

**Table 2. Model summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.636 <sup>a</sup>	.404	.371	2.95028

*Predictors: (Constant), MRP, EOQ, ABC, SSP, JIT, VMI*

**Table 3. ANOVAa**

Model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	632.593	6	105.432	12.113	.000 <sup>b</sup>
	Residual	931.346	107	8.704		
	Total	1563.939	113			

*Dependent Variable: OP*

*Predictors: (Constant), MRP, EOQ, ABC, SSP, JIT, VMI*

**Table 4. Co-efficientsa**

Model		Unstandardized coefficients		Standardized coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	10.245	1.125		9.102	.000
	SSP practice	.755	.248	.485	5.874	.000
	ABC practice	.613	.269	.210	2.276	.025
	VMI practice	.707	.261	.248	2.709	.008
	EOQ practice	.686	.287	.220	2.388	.019
	MRP practice	.730	.296	.453	4.149	.000
	JIT practice	.636	.240	.243	2.653	.009

*Dependent Variable: Operational performance*

*Predictors: (Constant), MRP, EOQ, ABC, SSP, JIT, VMI*

Table 3 presented the result on ANOVA<sup>a</sup> which provides the test significance for R and R<sup>2</sup> using F-statistic. The F statistic is the Regression Mean Square (MSR) divided by the residual mean square (MSE) and as such, if the significance value of the F statistic is small (i.e. < 0.05), then the independent variables do good jobs in explaining the variation in the dependent variable. In this analysis, the Sig. value (P) is well below .005 (i.e.  $P = .000 < .05$ ). Also, the calculated F (12.113) was greater than the critical value of  $F = 2.345$ . Thus, the different inventory management practices have significant relationships with operational performance of the manufacturing firms in Ghana. This finding is in line with previous studies by [69,98,120,121] who found positive relationships between inventory management practices (IMP) and performance of manufacturing firms in developing economies including Kenya, Nigeria and Ethiopia.

The established regression model for the study using the standardized coefficients was:

$$Y = 10.245 + .485X_1 + .210X_2 + .248X_3 + .220X_4 + .453X_5 + .243X_6$$

The result from Table 4 reveals that operational performance of the firms studied will be 10.245 if all other factors remain constant. Based on the standardized coefficient results, the study showed that a unit increase in SSP practice ( $P=.000<.05$ ) will cause a 0.485 units increase in operational performance if all other factors remain constant. Also, units increase in ABC ( $P=.025<.05$ ), VMI ( $P=.008<.05$ ), EOQ ( $P=.019<.05$ ), MRP ( $P=.000<.05$ ) and JIT ( $P=.009<.05$ ) practices would lead to increase in operational performances by .210, .248, .220, .453 and .243 respectively. These are clear indications that all the inventory management practices individually contribute significantly to improving the operational performance levels of the manufacturing firms in Ghana especially those within the Accra, Tema and Kumasi metropolises.

Among the different inventory management practices, SSP had the major and highest significant effect on operational performance ( $r=.485$ ); followed by MRP ( $r=.453$ ), VMI ( $r=.248$ ), JIT ( $r=.243$ ), EOQ ( $r=.220$ ) and ABC ( $r=.210$ ) respectively. This means that, developing strategic partnership with one's suppliers enable them to obtain relevant resources in order to meet firms' production needs in order to promote customer satisfaction

and invariably operational performances in areas of product quality, operational flexibility, speed, dependability while minimising production costs. The study's findings were in line with previous studies by [67,68,98,122] who found positive relationships between inventory management practices (IMP) and performance of manufacturing firms in some developing economies. Also, [39] conducted a study on the impact of inventory management practices (IMP) on the performance and competitiveness of micro manufacturing firms in Ethiopia. The study found that inventory management has a positive effect on performance of the firms' understudy. A similar study by [123] found inventory management practices to significantly improve performance levels of manufacturing firms in Kenya.

## 5. CONCLUSION

The study aimed at examining the effect of inventory management practices on the operational performance of manufacturing firms with in Ghana focusing on those within the Accra, Tema and Kumasi metropolises. The study also specifically assessed the most preferred inventory management practice adopted by the manufacturing firms. Based on the findings, the study concluded that the Strategic Supplier Partnership and Activity Based Costing practices are commonly used and most preferred inventory management practices by manufacturing firms in Ghana. The study also concluded that the Just In Time practice was rarely used and least preferred inventory management practice adopted by manufacturing firms in the country. As such, the SSP and ABC practices are highly likely to drastically minimise the firms' material management costs, while improving product quality, production speed, dependability, production cost and flexibility. The results have been largely supported by previous empirical studies which indicated that firms that prioritise on developing strong partnerships and periodically categorising their inventories are able to ensure better inventory management and achieve expected operational performance targets.

The study also found all the different inventory management practices including SSP, ABC, JIT, MRP, VMI and EOQ to be significantly associated with promoting operational performance levels of the Ghana's manufacturing firms. Thus, a unit increase in any of the practices would lead to significant and positive

unit increase in operational performance of the firm's studied. As such, ensuring proper inventory management plays important roles in improving product quality, operational speed, dependability, flexibility while minimising the production costs of the manufacturing firms studied. The study's finding has also been largely supported by both empirical evidence and qualitative analysis. The study, therefore, concluded that inventory management practices play tremendous roles in improving the operational performance levels of manufacturing firms in a developing economy notably Ghana.

The study also had some implications on the theory of constraints. This is because, the study extends existing knowledge within the limits of critically bounding assumptions in terms of inventory management practices and operational performance so far as the theory of constraints is concerned. More specifically, the study justifies the need for manufacturing firms to adopt specific inventory practices or approaches to addressing inventory constraints. As suggested by the theory, firms, regardless of size and nature, are exposed to inventory constraints which can only be addressed by adopting relevant inventory management practices notably SSP, ABC and VMI. Thus, the theory of constraints could be reviewed to include inventory management practices notably SSP, ABC and VMI to assist manufacturing firms and researchers alike to address any inventory-related constraints. The theory should further be developed to emphasise the contributions of inventory practices to promoting operational performance levels of manufacturing firms and other firms alike.

On the strengths of the research findings and conclusions made, the study recommends that: management of manufacturing firms in Ghana should massively invest in the Strategic Supplier Partnership practice whenever they intend to properly manage their inventories. This could be achieved by strategically partnering and integrating key suppliers into the firms' inventory management functions and activities. The partnership should be built on complete information sharing, effective communication, resource exchange and establishment of long-term agreements (contracts) between the parties.

Also, relevant policy makers including government, Association of Ghana Industries (AGI), National Board for Small Scale Industries (NBSSI) and Ministry of Finance should

collaborate with various financial agencies and bodies to provide adequate financial assistance to the manufacturing firms in Ghana. These assistances could come in the form of tax waivers, subsidies and flexible loan repayment terms in order to minimise the financial burden on these firms. These assistances would also invariably help reduce the impact of the huge costs associated with managing inventories, thus, encouraging the firms to adopt the necessary practices to inventory management amid financial constraints.

Finally, manufacturing firms in developing economies notably Ghana should continue to consider inventory management as part of their strategic and comprehensive business plans. Inventory has been found to account for over 70 percent of total manufacturing assets; thus, require proper attention and focus. Considering inventory management as a key aspect of manufacturing firms' strategic plans would enable the firms to apportion adequate resources aimed at adopting and developing relevant practices to promote operational and overall performance levels. Manufacturing firms in developing economies including Ghana should primarily invest more into supplier development and partnership as it was found to have the most influence on their operational performance levels in areas of product quality, operational flexibility, dependability, speed and production costs.

The paper also had some limitations; specifically, primary data was obtained through structured (close-ended) questionnaire restricting the respondents' opinions to only issues within it. Thus, respondents were allowed to make suggestions within the confines of the questionnaire. Also, the study's key findings and conclusions were limited to manufacturing firms within selected metropolises in Ghana. Further, the study was limited to only the operational performance dimension of the firms' overall performance levels. Arguably, inventory management efficiency depends on smoothness of supply chain processes, management of technologies, processes and tools, fluctuating customer demands, among others. However, these factors were excluded in the study as it majorly focused on inventory management practices. On this background, the study suggests that further research could adopt the mixed approach to allow the use of both questionnaire and interview. This would enable the study to obtain improved findings, conclusions and recommendations. Also, further

research could conduct a country-wide study or include manufacturing firms in order developing economies to improve generalisation of findings across a larger population. Further research could also focus on other performance dimensions notably financial, market and sustainable performance to help address existing literature gaps. Further research could also include information on the size, billing, time of existence and number of employees (separated by scales) of manufacturing firms participating in the study. This would certainly enrich the results presented. The study is limited to inventory management practices, thus potential researchers could also investigate the extent to which other variables including supply chain risk management, inventory management efficiency, logistics management, sustainable procurement practices, total quality management, supply chain agility affect the operational performance dimensions of manufacturing firms in developing economies.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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