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The Impact Of Lean Manufacturing On Operational Performance Through Vendor-Managed Inventory And Supply Chain Practices

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Abstract: This study investigates the impact of lean manufacturing on operational performance through vendor-managed inventory and supply chain practices as the mediating variable. The study used the population of the manufacturing company domiciled in east Java, Indonesia. Data collection used a questionnaire designed with a five-point Likert scale. The study sample is 111 manufacturing companies from 5420 manufacturing companies domiciled in East Java. Data analysis used partial least square (PLS) technique using smarPLS software version 3.3. The result indicated that nine hypotheses developed were supported in this study. Lean manufacturing affects vendor-managed inventory, supply chain practices, and operational performance. Vendor-managed inventory and supply chain practices directly affect operational performance. Lean manufacturing indirectly improves operational performance through the mediating role of vendor-managed inventory and supply chain practices. This research provides a managerial implication on how to improve the operational performance in supply chain management. This study also could contribute to the current supply chain management theory.

Keywords: lean manufacturing, vendor-managed inventory, supply chain practices, operational performance.

INTRODUCTION

The Covid-9 pandemic has changed people's lives in all aspects, especially health and business. In the business aspect, the Covid-19 pandemic has disrupted supply and demand and created high business uncertainty. This evidence can be seen from the Purchase Manager Index (PMI). According to a survey conducted by IHS Market, demonstrated data Purchasing Managers Index (PMI) Indonesian Manufacturing for April 2020 fell sharply to a level of 27.5, lower than March, which was at 45.3. The pandemic also impacted Indonesia's manufacturing industry's performance, which contracted at its lowest point in history. In April, the Indonesian PMI Index drop was recorded as the lowest in the nine-year survey period. Indonesia's PMI index was recorded as the lowest in ASEAN under Myanmar, with an index score of 29.0 and Singapore 29.3 (Ekarina, 2020). PMI indicators could reflect the PMI measurement's operational performance: cost, time to market, new product introduction, flexibility, and delivery. Thus, a decrease in the PMI index indicates a decline in manufacturing operational performance. As shown in Figure 1, however, the Manufacturing PMI index increased in the past June to December 2020. This improvement shows that manufacturing companies have recovered their operational performance during the Covid-19 pandemic. This information is not clear what has been done by the company in recovering their performance. The Covid-19 pandemic has created higher uncertainty and, consequently, a higher risk as well. In the business sector, the uncertainty causes the risk of the inability to cope with demand changes. The company will lose opportunities to sell products when they do not have enough products to sell.

On the other hand, the excessive stock will result in big losses because they have to be write-off the excess stock unsold. It has been noticed that the manufacturing companies have been trying to stay in operation and doing business during the pandemic while sticking to the health protocol, a government policy. The essential question that arises is what strategy the company should adopt to keep in operation and doing the business while dealing with the Covid-19 pandemic. The principal response to the question is the company should be able to cope with any uncertainty in supply and demand caused by the pandemic. Every company needs to adopt a strategy that can follow the uncertain patterns of supply and demand responsively and flexibly. Manufacturing companies need to carry out a production system that can quickly adjust to demand. It is also necessary to collaborate with suppliers and partners in a supply chain so that they are expected to support the company and serve fluctuated demand in the pursuit of improved company performance.

Previous studies have shown several production management concepts that can improve company performance effectively during dynamic market demand. Lean manufacturing is a production system concept oriented to agility by reducing waste and inventory. Research by (Shah & Ward 2012) shows that lean manufacturing can improve a company's operational performance. Research by Tarigan (2018) described that operational

performance depends on how the company achieves cost, quality, and delivery. Lean manufacturing increases each member's competitive advantage in the supply chain by reducing non-value added activities, which results in lower costs, quicker response, and better product quality. The adoption of lean manufacturing more than just delivery method by just in time (JIT) but on the contrary, should be based on the understanding that true operational efficiency comes from the financial benefits derived from reduced inventory costs that can be achieved with a refined storage system to provide a good mechanism to respond to changes in the market itself quickly.

Other studies have also shown that the implementation of a vendor-managed inventory (VMI) system run by manufacturing companies can provide distribution in improving the company's operational performance. VMI is a form of collaboration between manufacturing companies and their suppliers. Suppliers in this concept manage their stock to support manufacturing needs, and suppliers are an integral part of the manufacturing company's production system. VMI is considered capable of providing solutions to complexities and disruptions in the supply chain itself, especially in the inventory section (Spear, 2011). Panic buying that occurred at the beginning of the pandemic made inventory management unable to predict demand well. However, the management has experienced overcoming the problem by implementing VMI, a continuous replenishment collaboration managed by external parties, namely suppliers. Companies must have suppliers that do not only come from a certain geographic location to minimize the risk if an area is problematic because the policies of each local government are also, of course, different in responding to this pandemic condition so that manufacturing companies have readiness in production and distribution networks in order to meet demand quickly (Fadiyah, 2020).

Besides that, in a pandemic situation like this, all parties' collaboration in the supply chain is needed. The main actors, but the role of supporting actors, are also needed and must be involved. Changes or actions taken by one member of the supply chain will impact other supply chain members (Safitri, 2020). Vanpouck et al. (2014) see that the decline in operational performance is inseparable from the current supply chain, which is facing a dynamic market due to rapid changes in competition in the same industry and high levels of uncertainty due to changing people's lifestyle due to the new normal. Therefore, companies must develop and utilize their main resources to improve competitive capabilities such as low cost and high quality to prevent competitors' duplication by implementing supply chain practices (Dutta et al., 2013). Collaborative partnerships in the supply chain are considered an important strategic component to help companies achieve mutually compatible and competitive goals (Tarigan et al., 2019). This advantage certainly cannot be achieved by the company alone but together with its supply chain members (Wittmann et al., 2012).

In its development, Lean Manufacturing evolved from the application of operational practices directly to the market and further expanded to supply chains in many organizations (Hines et al., 2014). The company's external partners must support lean manufacturing. Collaboration with external parties other than suppliers must also be well built by implementing best practices in the supply chain, often referred to as supply chain practices. The business competition encourages companies to optimize shorter time and lower costs. Lean manufacturing must be expanded to include external partners to identify and reduce waste in internal and external processes. Guimarães, Carvalho & Maia (2013) also researched the logistics director, operating staff, hospital CEO, Pharmacy director, chief nurses in the health industry. The results show a positive relationship between lean manufacturing and Vendor managed inventory, where lean manufacturing encourages companies to collaborate with suppliers in the form of VMI.

Based on the results of previous research described above, it appears that operational performance in the context of supply chain management can be improved by implementing lean manufacturing, vendor-managed inventory, supply chain practices. However, previous research shows that the researchers concern solely about the direct influence of these variables on operational performance. This study creates a model dealing with those four variables simultaneously to examine the relationship of these four variables simultaneously in a single model to investigate the impact of lean manufacturing on operational performance through vendor-managed inventory and supply chain practices as the mediating variable. This study's novelty lies in the simultaneous examination of the model to improve operational performance by adopting vendor-managed inventory and supply chain practices. Besides, this research was conducted in the Covid-19 pandemic in the region of East Java, Indonesia. This research can also provide insight for industry managers on improving operational performance in the supply chain management context. This study also could contribute to the current research in supply chain management theory.

2.1 Supply Chain Management

The supply chain consists of all activities and processes related to the flow of goods and information from the raw material stage to the final stage, which consumers accept, the integration of activities and processes among members of the supply chain is called supply chain management (Handfield & Nichols, 2011). Supply chain management is used to manage the flow of information, products, and services across a network of customers, companies, and supply chain partners (Russell & Taylor, 2011; Tarigan et al., 2019). Supply chain management is also defined as a series of approaches used to integrate suppliers, manufacturers, warehouses, and stores

efficiently so that the merchandise produced can be distributed in the right amount, to the right location, and at the right time to minimize costs and meet consumer expectations (Simchi-levi & Kaminsky, 2011).

2.2 Lean Manufacturing

Lean manufacturing is defined as a system that uses inventory (such as raw material requirements) following customer demand, an indicator used by Jabbour et al. (2013) to measure lean manufacturing in research conducted in the automotive industry in Brazil, namely, Multifunctional involvement in the process, continuous improvement, 5S, total productive maintenance, kanban, JIT (just in time), stock reduction, and kaizen circles. Lean manufacturing, according to Dora et al. (2013), is the process of identifying, eliminating waste, and reducing activities that do not provide added value in the supply chain process by using the right tools and techniques, while the indicator used by Dora et al. (2013) in measuring lean manufacturing in the food industry is commitment. Of top management, culture, compartmentalization, teamwork, nature of the process, and the product's nature. According to Manzouri et al. (2014), Lean manufacturing is defined as a systematic approach to identify and eliminate activities that do not provide added value or waste through a continuous improvement process. The indicators used to measure lean manufacturing in the manufacturing industry, namely productivity, efficiency improvement, customer service improvement, manufacturing cost reduction, waste reduction, profitability reduction, and lean manufacturing. In this study, the theory used is the theory proposed by Manzouri et al. (2014), which has some similarities from several of the concepts described above that lean manufacturing is a systematic approach to identify and eliminate activities that do not provide value-added or waste through a continuous improvement process. Of the several indicators used in previous studies, the relevant indicators used in the sample in this study were those used by Jabbour et al. (2013), who used nine indicators to measure lean manufacturing in the manufacturing industry, namely Multifunctional involvement in the process, continuous improvement, 5S, total productive maintenance, kanban, JIT, stock reduction and kaizen circles.

2.3 Supply Chain Practices

Supply chain practices have been defined as a systematic process of measuring supply chain operations' effectiveness and efficiency (Anand & Grover, 2015). The measurement of supply chain practices encourages collaborative integration among supply chain members in certain industries. Monitoring supply chain practices effectively helps companies ensure that they are on the right supply chain path, helping to establish financial stability and service excellence (Whalen, 2012). Measuring supply chain practices is very important to ensure continuous improvement in the supply chain process (Tarigan et al., 2019). Supply Chain Practices, according to Blome et al. (2014), is a company's potential ability to form partnerships with strategic suppliers, build customer relationships, and the ability to share information, vision, goals, and risks. By conceptualizing the seven main concepts not only for the company's internal operations but also for the company and its suppliers as well as its main customers to utilize resources effectively and efficiently, while the indicators used by Blome et al. (2014) are used to measure supply chain practices in the manufacturing industry in Europe, namely supply-side sustainability collaboration, demand-side sustainability collaboration, sustainability production, sustainability performance, market performance, and misalignment. Li et al. (2016) defines supply chain practices as a series of organizations' activities to manage an effective supply chain. These indicators are used by Li et al. (2016) to measure supply chain practices in the manufacturing industry, namely, Strategic supplier partnerships (SSP), customer relationships, levels of information sharing, quality of information sharing, and postponement. In this study, the theory used is the theory proposed by Anand & Grover (2015), which has some similarities from several of the concepts described above that supply chain practices is a systematic process to measure the effectiveness and efficiency of supply chain operations. The indicators used in this study are those proposed by Li et al. (2016) that there are five indicators to measure Supply Chain Practices, namely Strategic supplier partnership (SSP), customer relationship, level of information sharing, quality of information sharing and postponement because they are relevant to the research sample to be tested.

2.4 Vendor Managed Inventory

Vendor-managed inventory, known as continuous replenishment or supplier-managed inventory, is one of the most widely used partnership initiatives to encourage collaboration and information sharing among trading partners (Angulo et al., 2014). Vendor-managed inventory is a supply chain initiative where the Vendor decides the right inventory level of each product and the right inventory policy to maintain that level. In some VMI agreement models, charging involves a cross-docking or direct process store delivery (DSD) to reduce storage costs in warehouses between vendors and retailers (Bowersox et al., 2011). According to Zammori et al. (2011), the VMI agreement's standard structure marks the starting point for the relationship of submitting continuous filling decisions to vendors. Binding laws also govern VMI agreement between manufacturing and Vendor begins by realizing and agreeing to all the terms to know what is expected from the relationship. According to Flavin (2012), Vendor-Managed inventory is a means of optimizing supply chain performance where suppliers have access to customer inventory data and are responsible for maintaining the level of inventory required by

customers. This collaboration encourages collaboration and information sharing among supply chain members (Angulo et al., 2014; Tarigan et al., 2019), continuously monitored to continuously improve performance (Hines et al., 2014). According to Angulo et al. (2014), Vendor Managed inventory is a sustainable filling managed by suppliers, a partnership initiative capable of encouraging collaboration and sharing of information among trading partners. Claassen et al. (2011) have identified that the success of manufacturing companies that have implemented system has a vendor-managed inventory IT-based impact on improving the quality of information, the quality of buyer and supplier relationships, the level of information sharing between buyers and suppliers. Vendor managed inventory is measured using several indicators, namely information quality, information exchange, relationship quality, perceived industrial vending system success, costs benefits, service benefits, and inventory benefits In this study, the theory used is the theory proposed by Angulo et al. (2014), which has some similarities from several concepts described above that Vendor managed inventory is sustainable filling that can encourage collaboration and information sharing among partners. Trade. From several indicators that have been used in previous research, the indicators used in this study are those proposed by Claassen et al. (2011) that there are seven indicators to measure Vendor managed inventory, namely. Information quality, information exchange, relationship quality, perceived industrial vending system success, cost benefits, service benefits, and inventory benefits are relevant to the research sample.

2.5 Operational Performance

Operational performance is about the company's operational efficiency, which can help explain its competitiveness and profitability in the market (Tarigan, 2018). Operational performance is a change in thinking in a company that starts from thinking about competitive advantage and then converting it to strategic organizational capabilities. These measures can be evaluated by short-term measures, including quality, cost, delivery, and flexibility (Bhaird et al., 2011). Operational performance is a multidimensional concept that includes financial performance and market performance (Richard et al., 2011). D'souza & William (2011) suggest that cost and quality are part of the operational performance dimension. Further research by Vokurka et al., (2012) describes the operational performance dimensions, including price/cost, quality, responsiveness, and time to market. According to Jayalath et al. (2011), operational performance dimensions are price, quality, responsiveness, flexibility, time to market, and product innovation. In this study, the theory used is the theory put forward by Kotabe et al. (2013), which has several similarities from several of the concepts described above. Operational performance is a combination of company performance, including product development efficiency, process improvement, quality suitability. And low waiting times. This study used indicators proposed by Day and DeSarbo (2012) that there are five indicators to measure operational performance, namely Cost, Productivity, New Product, Flexibility, and Delivery, because they are relevant for measuring research samples in the manufacturing industry as used by Jabbour et al. (2013) in the automotive manufacturing industry in Brazil.

2.6 Conceptual Relationship

2.6.1.Relationship between Lean Manufacturing and Operational Performance The application of lean manufacturing carried out by GE is conducting kaizen circles where the company invites several participants who know the existing topic and participants from outside who can bring fresh thoughts. The application of kaizen is done virtually by this company and produces good input. It clearly shows the company's shortcomings in consumers' eyes, the reasons customers choose our products, and what kind of performance we are in consumers' eyes. This is very influential on internal improvements within the GE company itself, where usually kaizen is done face-to-face and is now practiced virtually due to the pandemic conditions, COVID-19but the application of kaizen can still be optimized properly by the company (GE Indonesia, 2020). Another research conducted by Droge et al. (2012) on the automotive industry supply aimed at top 150 independently first-tier suppliers at general motors, Ford, and Chrysler companies also provides strong evidence that the implementation of lean manufacturing results in improved operational performance in terms of inventory management. Process control, information flow, human factors, and flexibility. Based on the description above, the first hypothesis can be formulated as follows:

H_1: Lean Manufacturing directly affects Operational Performance

2.6.2.Relationship between Lean Manufacturing and Vendor Managed Inventory Nissan developed closer partnerships with suppliers, involving them in information regarding R&D and production plans. Through this collaboration, Nissan has turned its worst supplier into its best supplier (Skott, 2017). The implementation of lean Manufacturing in Nissan's supply chain affected internal parties and external parties. Increased information sharing about customer demand and supplier delivery helps companies optimize their production and delivery. Research conducted by Guimarães et al. (2013) on logistics directors, operating staff, hospital CEOs, Pharmacy directors, and chief nurses in the health industry shows a positive relationship between lean manufacturing Vendor managed inventory where lean manufacturing encourages the company. It is necessary to collaborate

with VMI suppliers to reduce activities that do not provide added value in the hospital treatment process, reduce costs incurred by hospitals in the supply chain and increase the ability to overcome obstacles that occur along the supply chain. Based on the description above, the second hypothesis can be formulated as follows:
H_2: Lean Manufacturing directly affects the Vendor Managed Inventory

2.6.3.The relationship between Lean Manufacturing and Supply Chain Practices Lean manufacturing evolved from applying operational practices directly to the market and then extended to many organizations' chains supply (Hines et al., 2014). Due to increased business competition by optimizing shorter times and lower costs, lean manufacturing should be expanded to include external partners to identify and reduce waste in internal and external processes. Therefore (Shah & Ward, 2012) recommend that a lean manufacturing system reduce waste by reducing internal and external variability along the supply chain. Lean manufacturing must shift from the old thinking, which is oriented towards short-term profit, the ability to negotiate with trading partners and dependence on trading partners to thinking of long-term partnerships with supply chain members who are constantly trying to reduce waste or activities that do not provide added value along the supply chain. Research conducted by Vanichchincai (2019) on the manufacturing industry in Thailand shows that the application of lean manufacturing has a significant effect on supply chain practices where lean manufacturing refers to efficient communication and transactions between suppliers and customers through more efficient delivery of raw materials from suppliers. Based on the description above, the third hypothesis can be formulated as follows:
H_3: Lean Manufacturing directly affects Supply Chain Practices

2.6.4.Relationship between Vendor Managed Inventory and Supply Chain Practices
The supply chain is defined as an integrated philosophy managed by all distribution channel flow activities from suppliers to customers (Cooper & Ellram, 2013). Another opinion states that the supply chain is looking at external consumers, managing all the processes necessary to provide customers value according to customer desires (Monczka & Morgan, 2011). According to Vokurka and Lummus (2011), the supply chain is about all activities involved in delivering products to customers from raw materials, manufacturing, assembly, warehousing, inventory tracking, order entry and order management, distribution, delivery to customers, and information systems. Integrate and monitor all of these activities. The company must increase its depth in every aspect of its operations, such as efficient delivery management, consistent time, comprehensive replenishment planning. It becomes very important for companies to manage their entire supply network to optimize overall performance (Vokurka & Lummus, 2011). Research conducted by Blackhurst, Craighead and Handfield (2012) in Industrial Electronics Manufacturing Services (EMS) shows the application of Vendor managed inventory in the electronics manufacturing company capable of helping suppliers do forecasting demand for electronics company with better, so the cost between the two mantra supply chain is reduced 23 percent and the production acceleration increased by 34 percent. Based on the description above, the fourth hypothesis can be formulated as follows:
H_4: Vendor Managed Inventory directly affects Supply Chain Practice

2.6.5.Relationship between Vendor Managed Inventory and Operational Performance
Effective competitive strategy is very important. Urgent. This strategy should be customer-centered and contain value-added processes that involve customers, suppliers, new product development, and order fulfillment. By focusing on these relationships, customer needs can be met, and the company has a competitive advantage over its competitors. Companies can run a system vendor-managed inventory where suppliers are responsible for customer inventory and replenish items when supplies are low. Managed inventory vendors can improve and streamline the core process of order fulfillment, streamline the order fulfillment process, save time and operating costs, allow companies to focus on continuous improvement and service to customers (Cai & Yang, 2014). Sari (2012) conducted a study on the performance improvements achieved by Vendor managed inventory (VMI) through various supply chain scenarios characterized by uncertainty in demand and waiting time, which were also explored extensively. The study results indicate a substantial decrease in VMI's performance increase due to the increased uncertainty in customer demand. The second finding shows that when the external supplier's production capacity decreases, the profits derived from VMI also decrease. These findings suggest that the VMI program's success depends not only on the internal dynamics of VMI but also on other external factors. The third finding shows that VMI affects lead time where VMI provides a level of performance improvement at ratio lead time a constant. Based on the above, it can be formulated as follows the fifth hypothesis
H_5: Vendor managed inventory directly affect the operational performance.

2.6.6.The relationship between Supply Chain Practices and Operational Performance The practice of supply chain management applied to 209 manufacturing companies in China has a significant influence on its operational performance in achieving a competitive advantage in chain development (Hong & Jeong, 2018). Monitoring effective supply chain practices helps companies ensure that they are on the right supply chain path,

helping to establish financial stability and service excellence (Whalen, 2012). Research conducted by Abdallah et al. (2016) on manufacturing companies in Turkey shows the influence of supply chain practices on company operational performance where the company can improve its employees' performance to bring good results in their operational performance.
H6: Supply chain practices directly affects operational performance.

RESEARCH METHOD

The research method used in this research is explanatory quantitative research methods. Quantitative research uses data such as numbers and statistical data analysis (Sugiyono, 2011). The population in this study were manufacturing companies located in East Java. Based on data obtained from the Central Statistics Agency of East Java, it is found that there are 5024 manufacturing companies in East Java. After calculating the sample using the Conrach formula, the minimum number of samples in this study is 67. After calculating the sample using the formula, it is found that the minimum number of samples in this study is a minimum number of 67 samples. This study's questionnaire uses a Likert scale of 1-5. The number 1 states strongly disagree, and the number 5 states strongly agree. The questionnaires distributed were 125 questionnaires, but only 111 questionnaires could be processed because some respondents did not meet the sample criteria because they did not have a minimum supervisory position in a manufacturing company domiciled in East Java. The company number data is obtained through the manufacturingindo.com website. The researcher explains the reasons for conducting research and the benefits of research for the company. Then a google forms link will be given through WhatsApp social media. The distribution of questionnaires in this study was carried out within three weeks. Respondents in this study have a minimum supervisory position so that they are expected to understand the operational conditions of the manufacturing company where they work because they have responsibilities associated with this research.

4. RESULT

4.1 Item Measurement Validity and Reliability

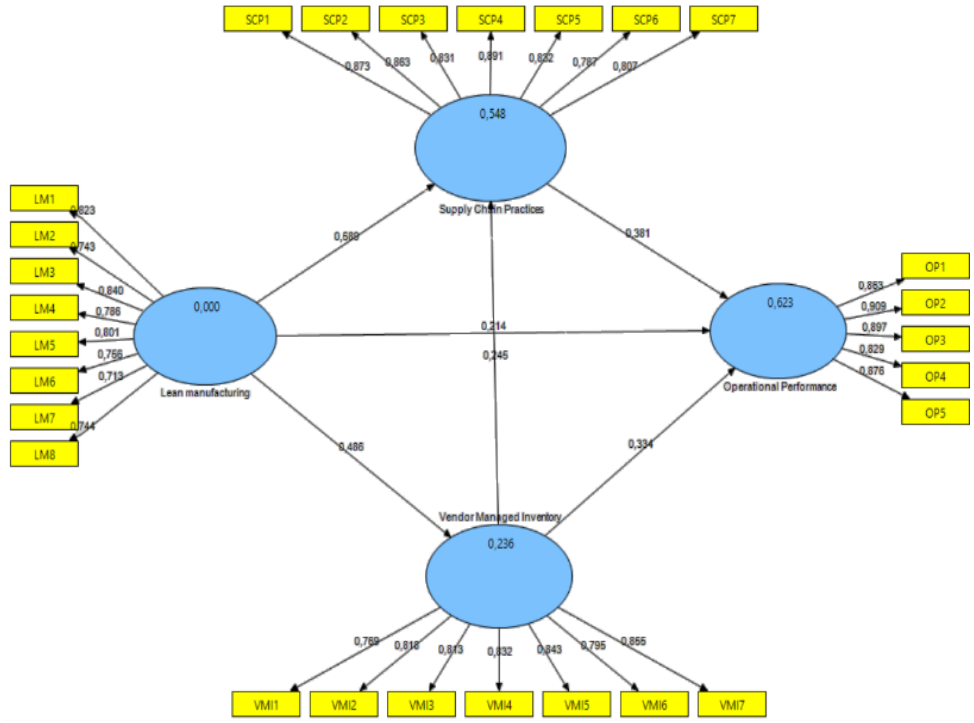

Fig.3:Research Model with the result

The convergent validity test results can be seen through the value of each item's outer loadings, as in Figure 3. For outer loading criteria, the indicator is considered valid for convergent validity when the outer loading value is > 0.70. Discriminant Validity looks at the cross-loading value and Fornell Larcker criteria. Cross loading itself is to compare the loading value between latent variables in each measurement item. Each item between latent variables cannot be highly correlated. The value of cross-loading on each item in a variable must be greater than the item's value on another variable.

Tabel 1. Indicator cross loading value

Indikator	Lean Manufacturing	Operational Performance	Supply Chain Practices	VMI
LM1	**0,8231**	0,5465	0,5374	0,4419
LM2	**0,7434**	0,4654	0,5520	0,3818
LM3	**0,8397**	0,5677	0,7182	0,4447
LM4	**0,7855**	0,5390	0,5363	0,4690
LM5	**0,8007**	0,5705	0,6368	0,2651
LM6	**0,7562**	0,4356	0,4488	0,3225
LM7	**0,7133**	0,3899	0,4405	0,3055
LM8	**0,7439**	0,4607	0,4674	0,3632
OP1	0,5372	**0,8633**	0,6157	0,5026
OP2	0,6497	**0,9087**	0,7059	0,5780
OP3	0,5937	**0,8965**	0,6795	0,6282
OP4	0,3917	**0,8290**	0,4579	0,4930
OP5	0,6127	**0,8756**	0,6078	0,5827
SCP1	0,6012	0,6027	**0,8730**	0,4344
SCP2	0,6341	0,5961	**0,8629**	0,4810
SCP3	0,6283	0,6103	**0,8310**	0,4765
SCP4	0,6448	0,6384	**0,8907**	0,5441
SCP5	0,5173	0,5619	**0,8324**	0,3740
SCP6	0,4924	0,5757	**0,7868**	0,3793
SCP7	0,6321	0,5914	**0,8067**	0,4188
VMI1	0,4752	0,5095	0,4722	**0,7694**
VMI2	0,3937	0,5389	0,3863	**0,8184**
VMI3	0,4139	0,4999	0,4060	**0,8134**
VMI4	0,3194	0,4709	0,3642	**0,8322**
VMI5	0,4471	0,6055	0,5362	**0,8433**
VMI6	0,3225	0,5449	0,4307	**0,7948**
VMI7	0,3840	0,4723	0,4137	**0,8550**

Table 4.2, the numbers printed in bold, indicate the value of the item correlated with its variable must be greater than with other variables. The indicators have met the terms of discriminant validity because they have the largest cross-loading value on their variable compared to other variables. A reliability test is used to measure the accuracy and consistency of a measuring instrument in making measurements. To test the reliability, you can see the value of Cronbach's alpha and composite reliability. The variable must have a Cronbach's Alpha value greater than 0.70 and a composite reliability value greater than 0.7 to meet the reliability test.

Tabel 2. Cronbach's Alpha and Composite Reliability

Variable	**Cronbach's Alpha**	**Composite Reliability**
Lean Manufacturing	0,905	0,923
Supply Chain Practices	0,930	0,944
Vendor Managed Inventory	0,917	0,934
Operational Performance	0,923	0,942

Table 4.3 shows that each variable in this study has met the reliability test because it has a Cronbach's Alpha and Composite Reliability value greater than 0.7. It can be said that it has good consistency in measuring the variables in this study. Table 3 shows that most of the respondents represent companies from the basic and chemical industry sector as much as 39.6% and followed by the food and beverage sector as much as 20.7%, textile 19.8%, automotive 11.7%, and household 8.15. As expected, this composition of respondents indicates that this study's sample has represented the manufacturing industry in general.

Table 3. Respondents profile by industry

Industry	**Frequency**	**Percentage (%)**
Food and Beverage	23	20,7
Automotive	13	11,7
Textile	22	19,8
Basic and Chemical	44	39,6

Household	9	8,1
TOTAL	**111**	**100**

4.2.Hypothesis Testing

Hypothesis testing used a significance level of 95%, which means that it has a critical t-statistic value of 1.96. The research hypothesis is supported by the data when the t-statistic value is greater than 1.96, or the p-value is less than 0.05 ($\alpha = 5\%$).

Tabel 4. Hypothesis Test result (Direct Effect)

Relationship	Path Coefficient	T Statistics	P Values
LM-> OP (H1)	0.214	2.001	0.037
LM -> VMI (H2)	0.486	6.527	0.000
LM -> SCP (H3)	0.589	7.413	0.000
VMI-> SCP (H4)	0.244	2.999	0,001
VMI-> OP (H5)	0.333	3.407	0.000
SCP -> OP (H6)	0.380	3.693	0.000

Table 4 shows the hypothesis testing result. Since all the t statistic values are greater than 1.96, it implies that those research hypotheses are supported. The first hypothesis has a statistical t-value of 2,001 with a positive coefficient value of 0.214. Lean manufacturing (LM) affects operational performance (OP). The second hypothesis states that lean manufacturing (LM) influences the vendor-managed inventory (VMI), supported by the statistical t-value of 6.527 and the path coefficient of 0.486. Furthermore, the third hypothesis states that lean manufacturing (LM) affects supply chain practices (SCP), is supported by the data with a statistical t-value of 7.413 and a path coefficient of 0.589. Similarly, the fourth hypothesis testing shows a statistical t-value of 2.999 and a path coefficient of 0.244, which means that vendor-managed inventory (VMI) influences the supply chain practices (SCP). The fifth hypothesis that vendor-managed inventory (VMI) affects operational performance (OP) is also accepted with a statistical t-value of 3.407 and a path coefficient of 0.333. The last hypothesis on the direct effect that SCP affects OP as expected is supported with a statistical t-value of 3.693 and a path coefficient of 0.380.

DISCUSSION

This study's main purpose is to examine the impact of lean manufacturing on operational performance through the mediating role of vendor-managed inventory and supply chain practices. Data analysis has provided the test result for discussion. The first hypothesis states that lean manufacturing improves the firm performance of the manufacturing company. The results of this study are in line with previous studies, which show that the application of lean manufacturing systems in the company can improve operation performance (Droge, Jayaram & amp; Vickery, 2012; Fullerton & amp; Wempe, 2011; Hofer & amp; Eroglu, 2012; Sánchez & amp; Pérez, 2011). One of the indicators of lean manufacturing is implementing 5S. The implementation of 5S enables the manufacturing process to be more efficient and, in the end, result in lower production cost, lower cycle time, quicker response to the customer request.

The second hypothesis state that lean manufacturing support vendor-managed inventory implementation. Lean manufacturing encourages the management to establish collaboration with its supplier in the form of vendor-managed inventory. The results support previous studies stating that implementing a vendor-managed inventory system can improve operational performance (Cai & amp; Yang, 2014; Guimarães, Carvalho & amp; Maia, 2013; Skott,2017). Implementing lean manufacturing requires establishing a special team to solve problems (denoted as indicator LM8) enables the company to anticipate the upcoming problem and encourages the team to collaborate with the supplier. This collaboration is realized in the form of vendor-managed inventory. This collaboration allows the company to cope with any change in market demand.

The third hypothesis state that lean manufacturing affects supply chain practices. This study's results are also in line with previous studies, proving that lean manufacturing by manufacturing companies can enhance supply chain practices (Agus & amp; Hajinoor, 2012; Hines, Holweg & amp; Rich, 2014; Vanichchincai, 2019). The argument behind this finding could be explained that the usage of the kanban system (LM5) in the manufacturing process enables tracking the amount of raw material inventory in the warehouse. The system provides the information of each component in terms of position. The Kanban system provides timely information to suppliers regarding the number of components shipped to match the manufacturing company's production needs.

The fourth hypothesis,vendor-managed inventory affects supply chain practices. This finding also supports previous studies stating that the implementation of a vendor managed inventory system in the company can

improve supply chain practices (Blackhurst, Craighead & amp; Handfield, 2012; Cooper & amp; Ellram,2013; Monczka & amp; Morgan, 2011; Vokurka & amp; Lummus, 2011). Vendor-managed inventory collaboration provides information from suppliers that helps manufacturing companies access inventory data (VMI2. This information helps manufacturing companies access inventory data and inform trading partners of the need for raw materials, and the suppliers should supply urgently and on time. Moreover, the fifth hypothesis test result shows vendor-managed inventory could enhance operational performance. Vendor-managed inventory enables the company not to hold any inventory since the vendor manages it. The finding is also in line with previous studies that suggested that implementing a vendor-managed inventory system in the company can improve operational performance (Cai & amp; Yang, 2014; Sari, 2012). The vendor from their warehouse will supply any requirement for raw material to support the manufacturing production schedule and, in the end, reduce total inventory costs (VMI5). This support will benefit the company in terms of reduced production costs from material holding costs. This result enables the company to outperform the competitor in terms of the cost or price dimension.

The last hypothesis of direct effect states that supply chain practices improve operational performance. These results are also in line with previous research showing that the company's adoption of supply chain practices improves operation performance (Abdallah, Anh & amp; Matsui, 2016; Hong & amp; Jeong, 2018). 2018). Adopting the supply chain practices obliges the company to interact with customers to determine the product specifications (SCP2). When the product specifications have been defined, the company could develop a new product that suits consumers' needs and expectations, especially during this pandemic. This finding revealed that the adoption of supply chain practices and vendor-managed inventory significantly increase lean manufacturing's impact on operational performance. This result is essential for the manufacturing company manager to consider in the pursuit of better operational performance particularly during the Covid-19 pandemic. Better partnership between members of the supply chain will accelerate the running of a business process, resulting in better operational performance. A good partnership can be done by involving the company's core suppliers in the process of developing new products so that suppliers can provide raw materials according to company needs. The company should always interact with customers to determine product specifications to supply finished goods according to their needs during a pandemic condition when consumers' lifestyle changes due to the new normal. Collaboration with suppliers accelerates information exchange between the company to respond to the market quickly and produce optimal operational performance. The information system used by suppliers helps manufacturing companies to find out what inventory is in the warehouse right away, and the suppliers can fill in the inventory of raw materials in the warehouse on time to respond to customer needs quickly and meet market needs.

CONCLUSIONS

This study aimed to examine lean manufacturing's effect on operational performance through Vendor managed inventory and supply chain practices in manufacturing companies in East Java. For this purpose, nine hypotheses have been formulated in this study, and the results reveal that the nine hypotheses are accepted empirically. Implementing lean manufacturing will affect supply chain practices, vendor-managed inventory, and manufacturing companies' operational performance in East Java. Supply chain practices and vendor-managed inventory, as expected, affect the operational performance of manufacturing companies. These findings support previous research that referred to the formulation of the nine hypotheses. This study contributes to important findings regarding the mediating role of the intervening variables. As shown in the indirect effect test results, the findings prove that implementing lean manufacturing indirectly improves manufacturing companies' operational performance in East Java through Vendor's mediating role managed inventory and supply chain practices. These findings prove that when a company wants to reduce waste or non-value-added activities, it needs all its supply chain members to be involved in planning and managing its production system. It can provide raw materials as needed and produce finished goods according to consumers' needs due to society's changing lifestyle due to this pandemic, resulting in a disruption of supply and demand in East Java's supply chain. With this research, it is hoped that it will become input for manufacturing companies' managers about the importance of applying variables in this study at this time. This research proposes an insight for the manager on improving the operational performance in supply chain management. This study also could contribute to the current research in supply chain management theory.

REFERENCES

1. Abdallah, AB, Anh, PC, & Matsui, Y. (2016). Investigating the effects of managerial and technological innovations on operational performance and customer satisfaction of manufacturing companies. International Journal of Business Innovation and Research, 3(10).
2. Anand, N., & Grover, N. (2015). Measuring retail supply chain performance. Benchmarking An International Journal, 1(22), 135–166.
3. Angulo, AO, Nachtmann, H., & Waller, MA (2014). Supply chain information sharing in a vendor-

managed inventory partnership. Journal of Business Logistics, 1(25).
4. Bhaird, K., Hu, KJ, & Simpson, R. (2011). The relationships between organizational culture, total quality management, and operational performance. Journal of Manufacturing Technology Management, 3(23), 345–678.
5. Blackhurst, J., Craighead, CW, & Handfield, RB (2012). Towards supply chain collaboration: An operations audit of VMI initiatives in the electronics industry. International Journal of Integrated Supply Management, 2(1). https://doi.org/https://doi.org/10.1504/IJISM.2006.008340
6. Blome, C., Paulraj, A., & Schuetz, K. (2014). Supply chain collaboration and sustainability: A profile deviation analysis. International Journal of Operations & Production Management, 5(34), 763–865.
7. Bowersox, DU, Closs, DJ, & Cooper, MB (2011). Supply chain logistics management. (McGraw-Hill, Ed.) (2nd ed.). New York: McGraw-Hill.
8. Cai, S., & Yang, Z. (2014). On the relationship between business environment and competitive priorities: The role of performance frontiers. International Journal of Production Economics, 151, 131–145. https://doi.org/, https://doi.org/10.1016/j.ijpe.2014.02.005
9. Claassen, MJ, Weele, V., & Van Raaij, EM (2011). Performance outcomes and success factors of Vendor managed inventory (VMI. Supply Chain Management: An International Journal, 13(6), 406–414.
10. Cooper, MC, & Ellram, LM (2013). Characteristics of supply chain management & the implications for purchasing & logistics strategy. The International Journal of Logistics Management, 2(4), 13–24.
11. D'souza, J., & William L. Megginson. (2011). The Financial and operating performance of privatized firms during the 1990s. Journal of the American Finance Association, 3(23), 445.
12. Day, DL, & DeSarbo, WS (2012). Measuring the performance of emerging businesses: a validation study. Journal of Business Venturin, 3(37).
13. Dora, MK, Kumar, M., Goubergen, D. Van, Molnar, A., & Gellynck, X. (2013). Operational performance and critical success factors of lean Manufacturing in European food processing SMEs. Journal of TRENDS IN FOOD SCIENCE & TECHNOLOGY., 2(31), 156–164.
14. Droge, C., Jayaram, J., & Vickery, SK (2012). The effects of internal versus external integration practices on time-based and overall firm performance. Journal of Operations Management, 6(22).
15. Dutta, S., Narasimhan, O., & Rajiv, S. (2013). Success in high-technology markets: Is narketing capability critical? Journal of Marketing Science, 18(4).
16. Flavin. (2012). The effectiveness of Vendor managed inventory (VMI) towards improving supply chain management : A contract manufacturer perspective. Journal of Business Logistics, 3(23), 456–786.
17. GE Indonesia. (2020). Ketika Covid-19 menghantam, lean management menjadi salah satu solusi. Retrieved February 27, 2021, from https://www.ge.com/news/reports/ketika-covid-19-menghantam-lean-management-menjadi-salah-satu-solusi
18. Guimarães, CM, Carvalho, JC de, & Maia, A. (2013). Vendor managed inventory (VMI): Evidences from lean deployment in healthcare. Strategic Outsourcing An International Journal, 1(6).
19. Handfield, RB, & Nichols, EL (2011). Transforming supply chains into integrated value systems. Journal of Supply Chain Management, 1(4), 115–124.
20. Hines, P., Holweg, M., & Rich, N. (2014). Learning to evolve: A review of contemporary lean thinking. International Journal of Operations & Production Management, 10(24).
21. Hong, PC, & Jeong, J. (2018). Supply chain management practices of SMEs: From a business growth perspective. Journal of Enterprise Information Management, 3(19).
22. IHS Markit. (2020). Indonesia manufacturing PMI 2020. Retrieved September 17, 2020, from https://tradingeconomics.com/indonesia/manufacturing-pmi
23. Jayalath, U., Samarasinghe, D., Kuruppu, G., & Perera, C. (2011). Quality management and supply chain management practices towards operational performance: A study of the rubber manufacturing industry of Sri Lanka. Journal of Theory and Practice, 2(8).
24. Jepchumba, & Ismail, N. (2015). Role of electronic data interchange on supply chain performance in manufacturing sector. Ournal of Business Management and Finance, 1(2).
25. Kushwaha, Gyaneshwar S. (2012). Operational performance through supply chain management practices. International Journal of Business and Social Science, 2(3).
26. Li, S., Nathan, R., & Rao, S. (2016). The impact of supply chain management practices on competitive advantage and organizational performance. Omega, 2(34).
27. Manzouri, M., Ab-Rahman, MN, Zain, CRCM, & Jamsari, EA (2014). Increasing production and eliminating waste through lean tools and techniques for halal food companies. Journal of Sustainability, 12(6), 9179–9204.
28. Monczka, E., & Morgan, E. (2011). Supply chain management (SCM): Theory and evolution. Journal of Business Logistics, 3(25).
29. Richard, P., Devinney, T., Yip, G., & Johnson, G. (2011). Measuring organizational performance: Towards methodological best practice. Journal of Management, 3(35).

30. Russell, RS, & Taylor, BW (2011). Operations management : Quality and competitiveness in a global environment. (J. Kennedy, Ed.) (10th ed.). New York.
31. Safitri, T. (2020). Manajemen risiko keamanan rantai pasok saat pandemi covid-19. Retrieved October 18, 2020, from https://supplychainindonesia.com/manajemen-risiko-keamanan-rantai-pasok-saat-pandemi-covid-19/
32. Sari, K. (2012). Exploring the Benefits of Vendor Managed Inventory. International Journal of Physical Distribution & Logistics Management, 7(37).
33. Shah, R., & Ward, PT (2012). Defining and developing measures of lean production. Journalof Operations Management, 25, 785–805.
34. Simchi-levi, D., & Kaminsky, P. (2011). Designing and managing the supply chain: Concepts, strategies, and case studies. (David Simchi Levi, Ed.) (4th ed.). New York: McGraw-Hil.
35. Skott, H. (2017). Make your supply chain LEAN with VMI. Journal of Business Logistics, 3(23), 658–895.
36. Spear, SJ (2011). The essence of just-in-time: embedding diagnostic tests in work systems to achieve operational excellence. Production, Planning and Control, 13(8), 754–767.
37. Sugiyono. (2011). Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D (5th ed.). Bandung: Alfabeta.
38. Tarigan, Z.J.H. (2018). The Impact of organization commitment to process and product innovation in improving operational performance. International Journal of Business and Society, 19(2), 335-346
39. Tarigan, Z.J.H., Siagian, H., & Bua, R.R. (2019). The Impact of information system implementation to the integrated system for increasing the supply chain performance of manufacturing companies. IOP Conference Series: Material Science and Engineering, 473, 012050, doi:10.1088/1757-899X/473/1/012050
40. Tri Ana Susanti. (2017). Implementasi lean manufacturing dalam meminimalkan non value added. Jurnal Supply Chain Manajemen, 3(28).
41. Vanichchincai. (2019). The impact of lean manufacturing toward supply chain practices : A study of Thailand's manufacturing industry. Journal of Business Logistics, 3(45), 672–846.
42. Vokurka, R., & Lummus, R. (2011). A conceptual model of supply chain flexibility. Industrial Management & Data Systems, 5(103).
43. Vokurka, R., Zank, GM, & III, CML (2012). Improving competitiveness through supply chain management: A cumulative improvement approach. Journal of Global Competitiveness, 1(12), 14–25.
44. Whalen, EA (2012). Challenges in supply chain redesign for the circular economy: A literature review and a multiple case study. Journal of Cleaner Production, 3(24), 786–867.
45. Widyarto. (2012). Peran supply chain management dalam sistem produksi dan operasi perusahaan. Jurnal Manjemen Dan Bisnis, 16(2).
46. Wittmann, CM, Lambe, JC, & Hunt, S. (2012). A theory and model of business alliance success. Journal of Relationship Marketing, 1(1), 17–36. https://doi.org/10.1300/J366v01n01_03
47. Zammori, F., Braglia, M., & Frosolini, M. (2011). A standard agreement for Vendor managed inventory. Strategic Outsourcing : An International Journal, 2(2), 165–185.