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Inventory Management Efficiency Strategy at UID Banten: A Study of Vendor Managed Inventory (VMI) Implementation

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Abstract. This study aims to evaluate the feasibility and readiness of implementing Vendor Managed Inventory (VMI) as a strategic approach to enhance inventory management efficiency at UID Banten, PT PLN (Persero). The research addresses operational challenges such as limited warehouse capacity, installation delays due to permit constraints, and accumulation of bulky materials, which adversely affect supply chain performance. The methodology involves an extensive literature review to identify critical readiness criteria, followed by the development of a conceptual model based on established frameworks. The model's criteria are empirically tested using Partial Least Squares Structural Equation Modeling (PLS-SEM), chosen for its suitability in exploratory research with small sample sizes and complex variable relationships. The findings indicate that successful VMI adoption requires attention to product characteristics, company capabilities, and performance targets, with enabling factors including digital infrastructure, data transparency, and strong supplier collaboration. The study concludes that, while VMI offers significant potential benefits, such as reduced holding costs, improved stock availability, and enhanced responsiveness, UID Banten must address specific readiness factors to ensure effective implementation and sustained operational improvements.

Keywords: *Vendor Managed Inventory, UID Banten, Inventory Management, Warehouse Efficiency, Supply Chain Strategy.*

1 Introduction

Unit Induk Distribusi Banten (UID Banten) is one of the distribution units owned by PT PLN (Persero) as the executor of small-scale power plant management, distribution, commerce, and customer management in quantity, quality, and reliability in accordance with established standards. The distribution unit is the spearhead of the company in distributing and managing customers to generate sales that lead to company's profits in [1]. PT PLN

(Persero) is the only energy company given the responsibility by the government to provide electricity to all levels of society. This distribution unit's income is generated by the distribution activity of supplies used to distribute electrical energy to customers.

Operational activities of distribution units will not be separated from the existence of supply chain management. Supply chain management (SCM) has an important role for companies in a tight and highly competitive world. Shy Huoy et al. in [2] define Supply Chain Management (SCM) as the coordination between individuals and organizations in using, obtaining, and delivering services or goods to markets and customers. In general, supply chain management is defined as the process of identifying the most effective strategies for the entire supply chain by coordinating various companies within the logistics network or by establishing business partnerships [3]. Effectiveness in supply chain management can be achieved by continuous improvement between customer service levels and internal operational efficiency of the company in the supply chain. There are five areas of decisions, Hugos in [4], that must be taken individually and collectively regarding decisions about production, inventory, location, transportation, and information.

One of the activities in the supply chain management process is the process of material purchasing. The purchase of materials certainly involves the warehouse as a storage location and receipt of materials from suppliers. Limited storage capacity sometimes becomes an obstacle when shipping the goods in distribution unit. Especially for large dimension goods, such as medium voltage cables, they use quite large storage capacity. Not only that, the installation of this cable is also sometimes delayed due to not having received a cable installation permit from the local government. This causes an increase in the accumulation of goods in the warehouse which also results in an increase in problems with storage.

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One of the most frequently discussed methods to improve supply chain efficiency is Vendor Managed Inventory (VMI). Sainathan & Groenevelt in [5] stated that VMI began to be known in the 1980s, where Wallmart as the largest retailer in the United States collaborated with Procter and Gamble (P&G) in managing their inventory. Wallmart gave P&G the authority to manage its inventory supply. Bahagia in [6] stated that VMI gives suppliers the authority to

take over the responsibility of inventory management, so buyers need to provide suppliers with access to obtain information related to inventory positions, as well as consumer demand for goods.

Implementation of VMI method is better than conventional method, with the justification that company management can invest sufficient funds to build infrastructure for using VMI supporting technology [7]. Minimizing total cost by VMI implementation can be achieved if the vendor can comply with the upper stock limit that has been set at the beginning and get a penalty if violated [8]. Another study results in an optimal or near-optimal solution by providing up to 76% cost improvement if the frequency of delivery to buyers is set to the same and provides savings in the supply chain compared to the non-VMI case, where savings of up to 28% can be achieved by the company [9].

By this time, challenges such as restricted storage space, installation delays owing to permit limits, and the buildup of heavy items such as medium-voltage cables have all had a substantial influence on operational performance on supply chain. The VMI method can be considered by Banten Distribution Unit management to overcome this problem, so that this distribution unit can still maintain the level of inventory availability. Implementation of VMI suggests that by adopting VMI can provide substantial benefits, including streamlined warehouse operations, improved supplier collaboration, and greater responsiveness to demand fluctuations.

To answer these challenges, this research will be conducted concerning the company needs to understand the right criteria to assess the readiness of company in implementing VMI, since there is no distribution unit in PT PLN (Persero) using this VMI method as an inventory policy.

2 Literature Review

2.1 VMI Definition

Bahagia in [6] defines VMI as a collaborative strategy method between buyers of goods and suppliers in managing inventory for their buyers (manufacturers, distributors, or retailers) so that buyers of goods do not need to manage their inventory. VMI is a business model where suppliers are responsible for managing inventory at levels and locations agreed upon by both parties. Not only that, VMI also allows suppliers to align manufacturing processes according to customer demand and inventory storage burdens, besides in the traditional system, are customer burdens, shifting to supplier burdens [2].

In a VMI system, the supplier determines the optimal stock levels for each product—within limits that have been previously agreed upon—and selects the inventory management policies necessary to sustain those levels. Initially, the retailer must approve the supplier's recommendations, but over time, many VMI initiatives aim to remove the need for the retailer to supervise individual orders [10].

2.2 Advantages of VMI System

Numerous studies have demonstrated that implementing VMI can provide significant advantages to members of the supply chain. Members of the supply chain could maximize competitiveness in the supply chain by cooperating with suppliers and buyers. This is a motivation that can be achieved through the implementation of VMI. Reducing inventory costs for buyers and reducing total costs for suppliers are the greatest benefits that can be achieved through VMI, so that both suppliers and buyers achieve greater profit margins through increased sales [11].

The level of competition in the supplier market and the degree of collaboration between buyers and suppliers are both positively linked to the adoption of VMI. In contrast, higher operational uncertainty for buyers is associated with a lower likelihood of adopting VMI. Companies typically implement VMI as part of an already established collaborative partnership between buyers and sellers [12].

Another research shows that combination of the fix & optimize algorithm and load-based estimation under a mixed fleet of electric in transportation resulted in a reduction in logistics costs of up to 19% and could reduce emissions by up to 27% if the company uses a closed VMI system [13]. The conflict of interest between vendors and buyers is reduced because vendors manage inventory in the buyer's warehouse and receive payment when goods are sold. Coordination between vendors and buyers can reduce total costs by 34.5% - 62.8% in the case of late delivery in the VMI-CS system compared to the traditional system [14].

2.3 Industrial suitability of VMI

Vendor-Managed Inventory (VMI) is highly adaptable across a wide range of industries, particularly those where efficient inventory management and strong supplier-buyer collaboration are critical. Sectors such as automotive manufacturing [12][13], pharmaceuticals [14], consumer electronics [15], and retail [16], have all successfully implemented VMI to address their unique supply chain challenges. In Indonesia, PT Kereta Api Indonesia, is already implement VMI in their fuel procurement [17].

Joseph et al. in [18] stated that industries and organizations with larges and numerous branches such as FMCG, where this sectors needs to maintain inventory at accurate and optimal levels to avoid running out of stock, would be one of the sector that will be highly successful in VMI implementation. Another sector that would be highly successful in VMI implementation is pharmaceutical and healthcare industries, where mistakes can have serious consequences. VMI implementation would be effective also in high value and unpredictable demand industries, such as tech manufacturing industry. This is necessary so the company can minimize lead time as much as possible to handle fluctuations in demand effectively. According to Joseph et al [18] classification, on this study, PT PLN (Persero), could be classified as the high value and unpredictable demand industry, since this company is the only energy company given the responsibility by the government to provide electricity to all levels of society and has significant value due to the distribution materials used by this company to meet customer needs and maintain service level both in terms of response time to disruptions and response time to complaints.

2.4 Company Readiness to VMI System

While VMI there are many advantages, numerous real-world experiences suggest otherwise. Some of the common challenges include the need for more detailed planning, high administrative expenses, inefficiencies in order processing and fulfillment-especially at distribution centers-and frequent failures by suppliers to utilize customer-specific data effectively for planning and production purposes. These issues have contributed to an increase in the number of cancellations and unsuccessful VMI initiatives [8].

Niranjan [19] develops a model to assess company readiness in VMI adoption base on three key features, that are product related, company related, and vendor related. Sumrit [14] then purpose five perspectives and criteria to assess the readiness of VMI adoption in company, there are hospital characteristics, vendor characteristics, collaborative culture characteristics, process alignment characteristics, and enabling IT infrastructure characteristics. Emmerich [20] purposed VMI 2.0 where this kind of VMI could be implemented in 4.0 industry. This VMI system could be successfully implemented if the company could design the information exchange between two parties. A standard VMI information exchange is extended in this VMI 2.0 system with a real-time information exchange option.

Moreover, information technology and integrated product system are two categories as an important enabler in VMI system to attain an effective information system [11]. The use of information technology in VMI is closely

related to the company's relationship with suppliers in sharing information. This information must be sent automatically and regularly [21].

3 Methodology and Purposed Framework

VMI system inventory has not been used by PT PLN (Persero) currently, therefore there is a need to assess the readiness of PT PLN (Persero) to implement the VMI system, particularly in Banten Distribution Unit. The research starts with an empirical investigation and a review of relevant literature as part of the preliminary phase. Following the literature review, the study proceeds according to the established research methodology. The following provides an in-depth description of the research methodology.

3.1 Setting the Criteria Model

The initial phase of this research involved gathering criteria data for assessing the company readiness to implement VMI system and formulating management efficiency strategies by conducting a literature review. Niranjan [19] prerequisites to VMI model will be our reference to develop. Based on literature review, a model was created and put forward for this research. The proposed model is shown in Figured 1.

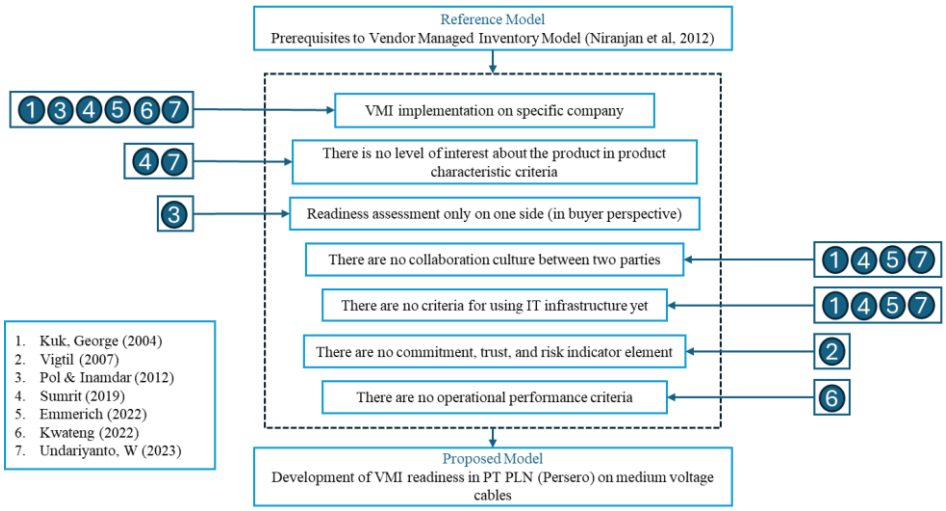

Figure 1 Criteria Model

3.2 Identification of VMI Implementation Readiness Criteria

In this phase, criteria will be identified from the literature based on the model proposed before. This table is the result of criteria identification that would be used in this research as a tools to assess the readiness VMI implementation.

Table 1 Criteria Identification

Criteria	Reference
Product Characteristic	
Standardized product, minimal customization	Niranjan et al (2012), Emmerich (2022), Undariyanto (2023)
Products have a high level of importance	Vigtil (2007), Sumrit (2019), Undariyanto (2023)
Low level of demand variance	Niranjan et al (2012), Sumrit (2019), Emmerich (2022), Undariyanto (2023)
High demand product	Vigtil (2007), Undariyanto (2023)
High holding cost	Undariyanto (2023)
High transaction cost	Undariyanto (2023)
Company Characteristic	
Company has stable revenue in these past years	Niranjan et al (2012), Sumrit (2019) Emmerich (2022), Undariyanto (2023)
Company has resources to support these implementation	Kuk, George (2004), Sumrit (2019)
Integrated of information and communication system between company and supplier	Vigtil (2007), Niranjan et al (2012), Sumrit (2019), Emmerich (2022), Undariyanto (2023)
Sales volume and return of equity of the product	Kwateng (2022)
Performance target of the company (acceleration of customer connection, customer satisfaction index, and service improvement)	Management Contract PT PLN (Persero) (2024)[22]
Company willingness in sharing information	Vigtil (2007), Sumrit (2019) Emmerich (2022), Undariyanto (2023)
Vendor Characteristic	
High level of trust and long-term relationship	Niranjan et al (2012), Sumrit (2019) Emmerich (2022), Undariyanto (2023)
Vendor willingness in cooperate with VMI system	Niranjan et al (2012), Sumrit (2019) Emmerich (2022), Undariyanto (2023)
Vendors are aware of the risk of VMI implementation	Vigtil (2007), Undariyanto (2023)
IT system integration	Sumrit (2019) Emmerich (2022), Undariyanto (2023)

3.3 Analysis Tool Proposed

Structural Equation Modeling (SEM) is a statistical technique that allows for the simultaneous examination of multiple relationships between variables, often using visual models and validation procedures. Notable characteristics of SEM include its ability to define latent constructs through dependency relationships and its capacity to represent complex models with both dependent and interdependent relationships among constructs, and its detailed analysis of covariances among observed variables using statistics such as means and standard deviations [23].

Hair et al [24] classified two widely adopted Structural Equation Modeling methodologies: CB-SEM (Covariance-Based SEM) and PLS-SEM (Partial Least Squares SEM). Both SEM methods perform across varied sample sizes, PLS-SEM consistently outperforms CB-SEM in statistical power, with its greatest margin of advantage observed in smaller studies.

This criteria model is then developed into an operational model by describing each assessment element into more detailed criteria. Then each criteria will be tested using the PLS-SEM method considering that this method is suitable for small sample sizes, is able to handle complex models, and has an easy and fast analysis process [25].

PLS-SEM method will be used in this research because of these considerations; (1) this is exploratory research or theory development as an objective of this research, (2) have smaller sample size (n<= 100, where this method will be an advantage of using PLS-SEM), (3) criteria in this model have relatively complex structural model (many constructs and many indicators.

4 Conclusion

In this article, we identified the criteria to assess the implementation of VMI system readiness. In our review, we start by identifying the lack of Niranjan (2012) model to assess the readiness of VMI implementation. Then, identifying the criteria that might be suitable for assessing PT PLN (Persero) in VMI implementation on medium voltage cables. For future research, we proposed to test the model using PLS-SEM. Expert judgment is essential for evaluating the model to verify its validity and reliability.

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