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The Impact of SAP Implementation and Inventory Management on Ship Operational Performance Through Purchase Performance

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Abstract

Purpose: This study aims to determine the level of influence of SAP implementation and inventory management on the smooth operation of ships through purchasing performance using path analysis.
Research Methodology: The data collection technique used a questionnaire survey of 47 samples consisting of all employees in the operational and purchasing divisions. The statistical tests used were classical assumption tests, model accuracy tests, and hypothesis tests.
Results: The results of the study using path analysis showed that SAP implementation had a variation in contributing to the smooth operation of ships through purchasing performance of 80.58%, while inventory management had a variation in contributing to the smooth operation of ships through purchasing performance of 23.49%.
Conclusions: SAP implementation directly influences purchasing performance by 91.8%, while inventory management has a 29% direct effect. SAP implementation directly impacts the smooth operation of the ship by 15.4%, and inventory management contributes 2.9%. SAP implementation contributes 80.58% to smooth ship operations through purchasing performance, whereas inventory management contributes 23.49%.
Limitations: This study is limited by the sample size, consisting of only 47 employees from the purchasing and operational divisions. Additionally, it focuses on one company, which may not fully represent the broader shipping industry.
Contributions: This study provides valuable insights into the impact of SAP implementation and inventory management on ship operational smoothness through purchasing performance, offering practical recommendations for improving operational efficiency in shipping companies.

Keywords: *Inventory Management, Purchasing Performance, SAP Implementation, Smooth Ship Operations*

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1. Introduction

One of the operational challenges is meeting the need for materials and spare parts for ship maintenance and upkeep planning. In order to meet the need for availability material And spare part, PT MBSS do purchase in a way direct to supplier/vendo (Agusinta et al., 2021)r. The ship maintenance and upkeep technical team often fails to meet maintenance targets because of the unavailability of materials when needed (Keke et al., 2021; Simion et al., 2020; Zhu et al., 2020). PT MBSS (PT. Mitrabahtera

Sejahtera) is also supported by a robust information technology system with the implementation of the SAP system, which has integrated data from each division—marketing, operations, purchasing, accounting, and finance—so that it is expected to achievement information the real one time so that with fast management can take decision or effectively and efficiently implementing business strategies. Anggraini (2021), Ayuningtyas and Ilman (2021), and Husnah (2017) research explains that delays in inventory management can result in decreased company performance.

Based on a preliminary survey, it was found that 55% of employees found that material availability data were not synchronized with SAP, 85% had delayed work due to the unavailability of required materials, and 70% of employees felt that the standardization of supervision for direct SAP implementation currently being implemented was effective.

The phenomenon in this study is the problem of smooth ship operations, which are considered suboptimal and result in expected results that do not meet company targets. Many factors influence operational smoothness, such as inventory management, SAP software implementation, and purchasing performance (Aprillita & Perkasa, 2021; Chima et al., 2021; Nadukuru et al., 2021). Even with an integrated SAP application system, delays in material supply still occur. If these obstacles affecting smooth ship operations are not immediately addressed, the smooth operation of the ship will decline (Bochek & Olson, 2020; Thompson, 2021; Wahyuningsih et al., 2021).

Several studies have been conducted on the factors that influence the smooth operation of ships. Shahbaz et al. (2018) and Syahrial and Sudono (2021) used the SEM method and found that the implementation of information technology in a company did not significantly affect the smooth operation of ships, with the study being limited to the managerial ranks. The same study was also conducted by Berlian Rms and Wahyuningsih (2021) and Dewi and Fuldyanto (2019) by optimizing standard operating procedures and was proven to improve the smooth operation of ships; however, this study did not show post-test results after the implementation of SOPs (Dewi & Fuldyanto, 2019; Saputro & Soleha, 2021). Abdullah (2021) and Naway and Rahmat (2019) explained that the technology factor as an intervening variable showed significant results on the smooth operation of ships obtained through SmartPLS software. However, in this study, the collection of data does not consider third parties such as vendors, as one aspect of the supply chain. Satria (2021) and Usmiati and Hidayat (2021) also researched the factors influencing the smooth operation of ships. The results showed that supplier performance and supplier location influenced the smooth operation of garage ships by 96.8%, whereas the remaining 3.2% was influenced by other variables not examined by the authors.

Based on the description Based on the above background, no one has conducted research related to the Influence of SAP Implementation and Inventory Management on the Smooth Operation of Ships through Purchasing Performance using the path analysis method.

2. Literature Review

2.1 Logistics

According to Balakrishnan (2019), in the Handbook of the Logistic Distribution, logistics is the process of planning, implementing, and efficiently controlling the effective flow and storage of goods and services, along with all related information, from a point of origin to a point of consumption to meet customer needs. SAP implementation is the application of information technology that integrates a company's operational activities (Kovács & Falagara Sigala, 2021; Solihin, 2021). In Book II Transportation & Logistics, Zijm et al. (2019) stated that the types of goods in the logistics sector consist of physical objects such as food, building materials, animals, equipment, and liquids. Similarly, the movement of intangible objects Tangible (abstract) data such as time, information, particles, and energy. The logistics

of physical goods generally involve the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing, and security (Gregson et al., 2017; Hou et al., 2017; Winkelhaus & Grosse, 2020). Logistics complexity can be analyzed, described in a model, visualized, and optimized using existing simulation software (Fathihani & Nasution, 2021; Topolšek et al., 2018).

Thus, logistics is a series of efforts that include the effectiveness of planning, implementation, and supervision of the process of moving goods or services, energy, or other resources from the point of origin to the point of use (Fathihani, 2021).

2.2 Smoothness Operational Boat

The smooth operation of a ship is the process of operating a ship without obstacles and can increase the productivity of a company (Han, 2020; Savchuk & Kirsta, 2019). Lasse (2014) stated that the smooth operation of a ship is the time available to operate the equipment. The results are stated in hours per day. Smooth operation of the ship is output from the level of success of ship, goods, and port equipment services within a certain period of time expressed in terms of time, weight units (tons), and other units (Bakar et al., 2021; Rizqi & Sakinah, 2021; Zhen et al., 2019). Based on the above definition, it can be concluded that the smooth operation of ships is of interest to management in terms of managing ports, operational planning, and port development (Ikhsani et al., 2021; Min et al., 2017; Yücel & Yurtören, 2019).

2.3 Performance Purchase

Performance Purchasing is the activity of procuring goods needed by a company for business continuity (Monczka et al., 2015). Purchasing can be defined as an effort to fulfill a company's need for goods or services and ensure timely delivery with appropriate quality and a favorable price (Klasa et al., 2018; Wardhani & Ully, 2021). The main objective of the purchasing department is to maintain the quality and value of the company's products, minimize the turnover of capital used to supply stock, maintain the flow of goods in and out, and strengthen the competitiveness of the organization (Nunuh & Wulandari, 2021; Parmenas, 2021; Ricardianto et al., 2021).

2.4 Management Supply

According to Herjanto (2010) and Ganesha et al. (2020) and Heriyanto (2021), inventory is recovered goods that will be used to fulfill certain purposes, for example, for use in the production or assembly process, for sales returns, or for spare parts for equipment or machinery. Inventory management determines the level and composition of raw materials and product inventories to protect the smooth production and sales of the company as well as the company's purchasing needs effectively and efficiently (Kuncoro & Harahap, 2021; Nofal et al., 2018; Nursaid et al., 2020; Setyawati & Aristiyanto, 2021).

2.5 Implementation SAP

SAP implementation is an information technology application that integrates a company's operational activities (ElFarmawi, 2019). According to Angolia and Pagliari (2018) and Susanto and Parmenas (2021), SAP is a business solution software consisting of enterprise resource planning and interrelated software solutions such as supply chain management, customer relationship management, product lifecycle management, and supplier relationship management.

3. Methodology

This research is classified as quantitative descriptive with three types of variables, namely exogenous, intervening, and endogenous variables (Butar-Butar et al., 2021; Syam et al., 2018), as shown in Table 1. Data were collected using a questionnaire with a Likert scale ranging from one to five. Data collection used a saturated sampling technique by including all 47 employees in the purchasing and operational

divisions. The data used were primary data derived from the questionnaire results and secondary data in the form of company data from PT. Mitrabahtera Sejahtera. The data obtained were statistically tested using validity and reliability tests, data normality, classical assumption tests, and hypothesis tests. The tested data were then analyzed using the path diagram method (path analysis) to determine the level of influence of each variable, both directly and indirectly.

Table 1. Research Indicators

Variable	Indicators
Exogenous (X1: SAP Implementation)	• Management support for purchasing performance • Physical components • Assurance of employee professionalism • Ease of automating and integrating business processes • Ease of achieving organizational goals and mission • Facilitation of employee task completion • Convenience in operating the SAP system
Exogenous (X2: Inventory Management)	• Periodic (daily) monitoring of material availability • Input of material availability data into the SAP system • Standardization of inventory planning and control • Updating material availability data in the SAP system
Intervening (Y: Purchasing Performance)	• Completeness of purchase requests • Authorization before placing orders to suppliers • Purchase order submission to suppliers • Confirmation of material availability from suppliers • Purchase order confirmation • Recapitulation of purchase order copies
Endogenous (Z: Ship Operational Smoothness)	• Safety equipment functions properly and certificates are valid • Navigation equipment (maps, radar) operates properly • Machinery operates properly along with supporting equipment • Towing equipment functions properly • Hull condition is in good condition and leak-free • Crew competence complies with safe manning certification

Based on Table 1, the research variables are operationalized into measurable indicators consisting of SAP implementation, inventory management, purchasing performance, and ship operational smoothness. Each variable is represented by several indicators that reflect the effectiveness of system integration, material availability control, purchasing activities, and the overall performance of ship operations.

4. Results and Discussion

4.1 Characteristics of Respondents

The data collection process based on respondent characteristics was divided into two categories: gender and length of service.

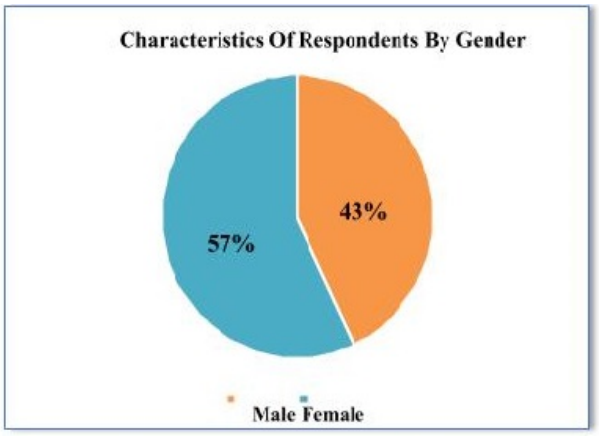

Figure 1. Characteristics respondents Based on Type Sex

Based on Figure 1, the number of male respondents was 57%, and female respondents were 43%. This figure is derived from the distribution of employees in the operational division (20 men and 11 women) and the purchasing/SCM division (7 men and 9 women). Therefore, the total number of respondents was 47 in this study.

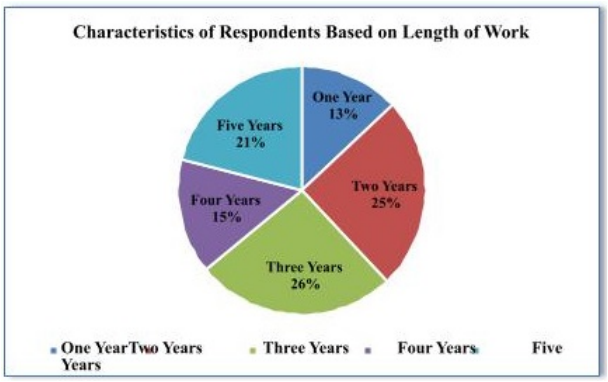

Figure 2. Characteristics Respondents Based on Long Work

Based on Figure 2, the average length of service of employees in the company is three years. Employees with the longest length of service are five years, which is 21%, four years of service are 15%, three years of service are 26%, 25% of employees who have worked for two years, and 13% of employees who have worked for one year.

4.2 Factors Which Influential

The influencing factors that have been identified are the endogenous variables (X), namely SAP Implementation (X_1) and Inventory Management (X_2), the intervening variable is Purchasing Performance (Y), and the exogenous variable is Ship Operational Smoothness (Z).

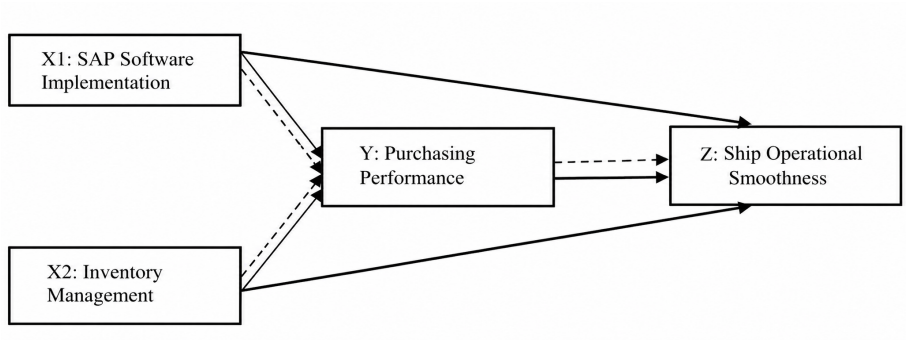

Figure 3. Framework Conceptual

Based on Figure 3, SAP software implementation and inventory management are proposed to have direct effects on purchasing performance and ship operational smoothness. In addition, purchasing performance acts as an intervening variable that mediates the relationship between the independent variables and ship operational smoothness. This model indicates that effective SAP implementation and proper inventory management can enhance purchasing performance, which subsequently contributes to smoother ship operations.

4.3 Test Statistics

Validity test for all question items from the SAP implementation variables (X_1), inventory management (X_2), Purchasing Performance (Y), and Ship Operational Smoothness (Z) the calculated r value > r table (0.2876) based on a significance test of 0.05, so that all items from each of the variables above are valid.

The basis for decision-making in reliability testing is that if the Cronbach's alpha value is greater than 0.60, the questionnaire is declared reliable or consistent. The calculation results showed a value > 0.60 (Table 2); therefore, all variables were acceptable.

Table 2. Results Calculation Reliability

Item	r Count	Information
Implementation SAP (X_1)	0.674	Reliable
Management Inventory (X_2)	0.614	Reliable
Performance Purchase (Y)	0.656	Reliable
Smoothness Ship Operations (Z)	0.616	Reliable

Based on Table 2, the reliability test results indicate that all research variables have met the reliability criteria, as each variable shows an r-count value above the required threshold. SAP Implementation (X_1) obtained a value of 0.674, Inventory Management (X_2) scored 0.614, Purchasing Performance (Y) reached 0.656, and Ship Operational Smoothness (Z) recorded 0.616. Therefore, all variables are categorized as reliable, indicating that the measurement instruments used in this study are consistent and suitable for further analysis.

4.3.1 Test Assumptions Classic

Normality Test

From the results of the calculation using the Kolmogorov-Smirnov test, the mark probability was greater than = 0.05, and it can be concluded that the observed data are normal.

Test Multicollinearity

The results of the analysis show that the VIF factor inflation variance is lower than 10 and the tolerance

is above 0.10, indicating that this model is free from multicollinearity.

Test Autocorrelation
The Durbin-Watson (DW) test found that the DW value lies between du and 4-du, so it can be concluded that there is no autocorrelation.

Test Heteroscedasticity
Using the Spearman correlation rank, the mark is significantly larger than 0.05, so it can be ensured that the model does not show symptoms of heteroscedasticity.

4.4 Analysis Track

In this study, path analysis is used for two sub-structures: the first is the influence of SAP implementation and inventory management has a positive effect on purchasing performance, and the second is the influence of implementation of SAP, management supply, and performance purchase to smooth ship operations. The following are the results of the parameter estimates of the model:

Table 3. Model Parameter Estimation Results

Model	Path Coefficient	t	p	R^2
Sub-Structure 1 ($X_1, X_2 \rightarrow Y$)				
X_1 (β_{X_1Y})	0.918	13.804	0.000	0.826
X_2 (β_{X_2Y})	0.290	0.439	0.003	
Sub-Structure 2 ($X_1, X_2, Y \rightarrow Z$)				
X_1 (β_{X_1Z})	0.154	0.814	0.020	0.742
X_2 (β_{X_2Z})	0.029	0.355	0.024	
Y (β_{YZ})	0.710	3.820	0.000	

Total Effect Calculation:

1) X_1 on Y through Z

$$\begin{aligned} \textit{Direct Effect} &= X_1Z = 0.154 \\ \textit{Indirect Effect} &= X_1Y \times YZ = 0.918 \times 0.710 = 0.6517 \\ \textit{Total Effect} &= DE + IE \\ &= 0.154 + 0.6517 \\ &= 0.8057 \approx 80.58\% \end{aligned}$$

2) X_2 on Y through Z

$$\begin{aligned} \textit{Direct Effect} &= X_2Z = 0.029 \\ \textit{Indirect Effect} &= X_2Y \times YZ = 0.290 \times 0.710 = 0.2059 \\ \textit{Total Effect} &= DE + IE \\ &= 0.029 + 0.2059 \\ &= 0.2349 \approx 23.49\% \end{aligned}$$

Based on Table 3, it is known that through sub-structural path I, the direct influence of SAP implementation on purchasing performance is 91.8%, and the influence of inventory management is 2.9%. Meanwhile, through sub-structural path II, the influence of SAP implementation on the smooth operation of ships through purchasing performance is 80.58%. In addition, the influence of inventory management on the smooth operation of ships through purchasing performance was 23.49%. The largest direct influence is SAP implementation on purchasing performance, and the largest indirect influence is SAP implementation on the smooth operation of ships through purchasing performance. The path diagram used is shown in Figure 4.

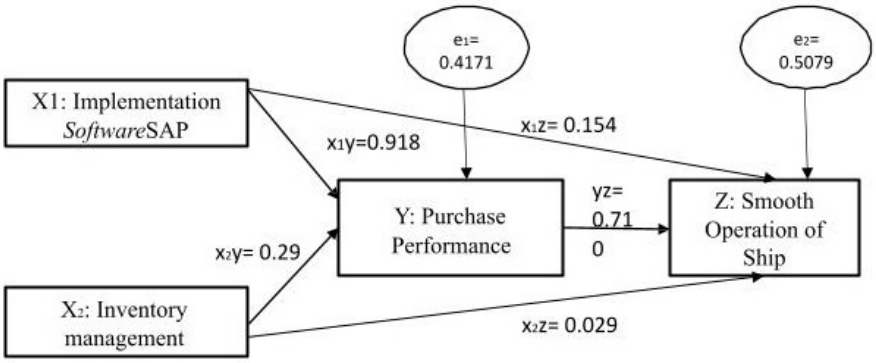

Figure 4. Path Diagram

Based on Figure 4, the structural model demonstrates that SAP software implementation and inventory management have direct influences on purchasing performance and ship operational smoothness. SAP software implementation shows a strong positive effect on purchasing performance ($x_{1y} = 0.918$), while inventory management also contributes positively with a smaller coefficient ($x_{2y} = 0.290$). Furthermore, purchasing performance significantly affects ship operational smoothness ($yz = 0.710$), indicating its important mediating role. Direct effects of SAP software implementation ($x_{1z} = 0.154$) and inventory management ($x_{2z} = 0.029$) on ship operational smoothness are also identified. The error terms ($e_1 = 0.4171$ and $e_2 = 0.5079$) indicate the proportion of variance explained by factors outside the model. Overall, the findings suggest that improving SAP implementation and inventory management can enhance purchasing performance, which subsequently supports smoother ship operations.

The results of the hypothesis testing show that the Total Effect is 0.80578 or 80.58% for sub-structural I, indicating that the indirect effect is greater than the direct effect (Garson, 2013; Susanto & Parmenas, 2021). Therefore, SAP implementation significantly affects the smooth operation of ships through purchasing performance. Simultaneously, SAP implementation has a positive effect on purchasing performance with an effect size of 0.825 or 82.5%, while the remaining 17.5% is influenced by other factors outside the model and the significance value. 0.000 < 0.05, so that Hypothesis I, namely that SAP implementation has an effect on purchasing performance, is accepted. The significant impact of SAP implementation is due to the indicators in the SAP application that support the company in purchasing performance, so that there is no data miscommunication that can hinder the smooth operation of the ship. This is in line with the research (Banerjee, 2018) that the implementation of the ERP system (SAP) can help improve organizational performance and increase productivity with smooth operations.

Testing of sub-structural hypothesis II with a Total Effect of 23.49%. Thus, it is known that the indirect effect is greater than the direct effect, so that inventory management has a significant effect on the smooth operation of ships through purchasing performance. Simultaneously, inventory management also has an effect. positive to performance purchase with magnitude influence simultaneous 0.073 or 7.3% While the remaining 93% is influenced by other factors outside the model, with a significance value of 0.003 <

0.05, Hypothesis II, namely inventory management, significantly influences purchasing performance. Although its influence is smaller than that of SAP implementation, inventory management also positively affects the smooth operation of ships through purchasing performance because inventory management requires synergy between the operational and purchasing/SCM divisions. to determine the actual amount of inventory needed to maximize purchasing performance according to quantity supply. If the supply amount can be maximized, operational performance can run smoothly without having to delay work later. can trigger the occurrence of loss. Chebet and Kitheka (2019) and Setyawati and Aristiyanto (2021) explained that inventory management significantly affects a company's smooth operation.

5. Conclusions

Based on the results of this study, it can be concluded that SAP Implementation has a direct influence on purchasing performance of 91.8%. Inventory management has a direct influence on Purchasing Performance of 29%. SAP Implementation has a direct influence on the smooth operation of the ship by 15.4%. Inventory management has a direct influence on the smooth operation of the ship of 2.9%. It has a direct influence on the smooth operation of the ship of 71%. SAP Implementation has a variation in contribution to influencing the smooth operation of the ship through Purchasing Performance of 80.58%. Inventory Management has a smaller variation in contribution to influencing the smooth operation of the ship through Purchasing Performance, namely 23.49%.

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Author Contributions

HS conceptualized the study and contributed to data collection and analysis. IKRA provided guidance on methodology and assisted in data interpretation. M and EBS reviewed the final manuscript and contributed to the writing and revisions.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this study. This research was conducted independently, and no financial or personal relationships influenced the results or interpretation of the findings.

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