Contemporary Issues in Social Sciences and Management Practices (CISSMP)
ISSN: 2959-1023
Volume 3, Issue 4, December 2024, Pages 29-41
Journal DOI: 10.61503
Journal Homepage: https://www.cissmp.com

Impact of Warehouse Operations Control, Procurement Practices, and SAP Implementation on Operational Efficiency

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ABSTRACT

Article History:
Received: May 21, 2024
Revised: Jul 12, 2024
Accepted: Aug 29, 2024
Available Online: Dec 30, 2024

Keywords: Warehouse Operations Control, operational efficiency, Middle East region

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

This study aims to determine the effect of warehouse operations control, procurement practices, and SAP implementation on operational efficiency with a view to improve organizational processes in logistics and procurement. A quantitative research design was adopted to test the proposed hypotheses, following a positivist philosophy to ensure structured data collection and statistical analysis. The target population comprised employees in logistics, procurement, and SAP implementation roles from organizations involved in supply chain management, particularly in the Middle East region. A sample of 300 respondents was selected using a convenience sampling method, ensuring diverse representation from key stakeholders across warehouse operations, procurement, and IT systems. Data was collected through an electronically distributed survey questionnaire, which included structured questions aimed at assessing the perceived impact of warehouse operations, procurement practices, and SAP implementation on operational efficiency. For data analysis, Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to explore the relationships between these variables and assess their direct and indirect effects on operational efficiency. The results of the research are useful for organizations that want to optimize their supply chain and logistics operations.

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DOI: https://doi.org/10.61503/cissmp.v3i4.240
Citation: Rehan, M. F., Khan, S. A., & Qureshi, U. K. (2024). Impact of Warehouse Operations Control, Procurement Practices, and SAP Implementation on Operational Efficiency. *Contemporary Issues in Social Sciences and Management Practices*, 3(4), 29-41.

1.0 Introduction

Warehousing operations, procurement practices and ERP systems (e.g. SAP) shape the operational efficiency of organisations (Antwi & Avickson, 2024). From a domestic perspective, increasingly competitive and global business environment makes operating efficiency a must for companies to be competitive and gain sustainable growth. Warehousing in today's scenario has become much beyond storage, it is about inventory management, order fulfillment and distribution process requiring efficient and timely warehousing. In one way or another, procurement practice ensures that quality materials and services are readily available and at lower costs (Calapre & Paspasan, 2024). Following this integration, organizations now have real time visibility and control of their supply chains and can act upon the dynamic nature of the market with practices such as those made available by platforms like SAP. a complex, yet imperative, factor that the interplay between warehouse operations control, procurement practices, and the deployment of SAP enables; and which promises significant operational efficiency, including cost reduction, productivity gains, and higher customer satisfaction.

The term warehouse operations control is used to refer to the balancing of resources, layout and strategies deployment being able to have goods flow through the supply chain (Mourtzis & Sgarbossa, 2024). Warehouse management that is effective does not leave your goods sitting and incurring unnecessary lead times, does not set up bottlenecks of processing and shipping your goods, nor does it affect your inventory accuracy. Inventory turnover, order accuracy rate, and labor productivity are considered key indicators of warehouse efficiency. These operations are complemented by procurement practices that strategically procure materials, negotiate contracts or ensure supplier reliability. This means that it helps in reducing costs as well as obtaining the inputs for production and distribution in the right time to ensure that there is no halt made on the production process. Enterprise-wide resource planning system such as SAP implementation bridges the two domains gap: Data from inventory, procurement, and logistics functions are integrated to give a consistent decision framework. SAP automates processes and provides real time insights to an organization so that they can better manage complexities and more efficiently drive efficiencies in warehouse operations and procurement (Antwi & Avickson, 2024).

While many supply chain management practices have seen enormous improvements, many organizations are still falling short of achieving optimum operational efficiency (Farooq et al., 2021). Extensive literature has emphasized the critical contribution of individual factors including warehouse operations and procurement practices to improving supply chain performance. Nonetheless, there are scant empirical studies that examine the combined effect of these factors, especially when augmented by implementation of advanced technological solutions, such as SAP. Most existing studies only concentrate on separate aspects, including what procurement’s impact is on cost efficiency or what effect technology has on inventory management. These fragmented methods do not offer a whole picture of the complementary relationships between warehouse operations control, procurement practices, and SAP implementation. There remains a gap in the literature that points to the need for research that integrates the examination of these interdependencies and their combined impact on operational efficiency (Solano & Cruz, 2024).

The theoretical underpinnings of this study are based on resource-based view and systems theory (Ristyawan et al., 2023). According to the RBV, competitive advantage of an organization is determined by its capability of effectively deploying and utilizing the valuable, rare, inimitable, and non-substitutable (VRIN) resources for the organization. Thus, warehouse operations and procurement practices are such resources, optimized and integrated. On the flip side, the systems theory says an organization is a complex system of interdependent parts working together to achieve larger systems goals. SAP implementation acts as an integrative mechanism, tying and harmonizing these components as a systems-based approach to operational efficiency. To combine these theoretical perspectives, a robust framework examining how SAP warehouse operations and procurement practices impact each other to create efficiency is proposed (Syed et al., 2024).

The research problem is that despite large investments in both technology and process optimization, many organizations still suffer from persistent inefficiencies (Joshi et al., 2024). Warehousing operations are mismanaged with poor inventory accuracy, poor order processing and more costs. The procurement practice pains include supplier unreliability, poor contract management, and misalignment of operational needs. However, if deployment of SAP is carried out properly, integrated with organizational processes, the chance of a solution to these challenges is present. However, this lack of connection between theoretical potential and practical outcome demands a deeper investigation into the mechanisms via which this combination of factors influences operational efficiency (Bei et al., 2024).

This problem is of considerable academic as well as practical significance. This research bridges the gaps in the literature and provides an integrated management of the warehouse operations control, the procurement practices and the SAP implementation. This, in turn, improves the understanding of their interrelationships and resulting impacts on operational efficiency, and proposes areas for further research. This study's findings are practically invaluable for organizations interested in enhancing supply chain performance. Through this research, critical success factors and potential bottlenecks are identified and actionable recommendations are provided to managers which a help them optimize their processes and achieve sustainable operational improvements.

Furthermore, this study addresses theoretical and practical gaps in addition to contributing to the increasing focus on sustainability and resilience in supply chain management. Efficient Warehouse operation and Procurement practice save costs, reduce waste, lower carbon footprint and foster sustainable practices. In addition, the objectives of these goals are further supported by SAP implementation through data driven decision making and increased transparency of supply chain activities. This study focuses on the exploration of these dimensions, and is in line with the wider objectives of sustainable development and responsible business practices with an accentuation of the strategic significance of the operational efficiency in the dynamic business environment of today.

However, there is a research gap in the holistic research that considers the firm's warehouse operations, procurement practices, and SAP implementation simultaneously. Although individual importance of these factors has been demonstrated by previous research, studies examining the

combined effect of these factors on operational efficiency are lacking. But this gap is especially pronounced in complex supply chain industries, where the interrelationships among these factors are crucial to reaching efficiency. Additionally, prior studies tend to ignore the contextual factors, for example, organizational size, type of industry and market dynamics, that significantly impact the success of these practices. This study aims to address these gaps by providing a holistic view of underlying factors of operational efficiency and provides nuanced insights for various organizational contexts.

Other than academic contribution, this study is significant practically. Results suggest a roadmap to organizations about how they can best incorporate best practices in warehouse management and procurement. They also emphasize that technology plays an essential role in achieving integration and promoting efficiencies. The study highlights that technological adoption and process optimization can be enablers for the firm's economic growth and competitiveness, key for policymakers. Furthermore, the research implies for technology providers to leverage the needs and challenges of organizations to create solutions that serve the needs of their organization.

Thus, this study intends to solve the complexities between the warehouse operations, the procurement, SAP implementation and associated effects on their operational efficiency. The research takes a holistic approach and applies powerful theoretical frameworks to bridge these gaps and deliver actionable insights for the academia, industry and policymakers. Conclusions gathered from this study will not only contribute to knowledge of these key factors, but will also help develop strategies to achieve sustainable operational improvements in a number of organizational contexts.

2.0 Literature Review

2.1 Theoretical Background

The theoretical framework of this study is based on the Resource based view (RBV) and the transaction cost economics (TCE) (Casati et al., 2024). RBV describes a firm achieving competitive advantage through its special and valuable, rare, inimitable and non-substitutable resources and capabilities. The perspective is particularly applicable to warehouse operations control, procurement practice and SAP system implementation; namely they are critical resources to enhance organizational efficiency from a strategic management point of view (Vukman et al., 2024). For instance, the warehouse operations are well controlled and the procurement system of the company can eliminate inefficiency of material flows by streamlining such flows.

Alternatively, TCE places the focus on the role of transaction costs minimization on improving the operating performance (Ketokivi & Mahoney, 2020). Reducing the cost component can be procured and achieved through proper procurement practices and supply chain integration, proper technology such as SAP systems that can decrease the cost of negotiating, monitoring and enforcement of contracts. These theories jointly provide the base of understanding on operational efficiency of warehouse control mechanisms, strategic procurement, and SAP implementation. This study combines these viewpoints by emphasizing that firms should draw upon their internal resources while keeping transaction costs to a minimum to enhance operational outcomes.

2.2 Empirical Studies

Warehousing operations control activities include inventory management, picking and packing processes, storage optimization and order fulfillment (Alherimi et al., 2024). Research consistently reported that efficient warehouse operation is critical to the operational efficiency of supply chain. Faber et al. (2018) found that the use of automated inventory systems and real time tracking technologies for warehousing can reduce stock discrepancies and other operational delays thereby increasing the overall performance of the supply chain. For example, demonstrated that adoption of advanced warehouse management systems (WMS) for manufacturing firms both decreased picking times by up to 40 percent and increased order accuracy.

They rather indicated that lean warehouse operations are important for a successful waste minimization and space utilization in a retail context, for instance (Čiarnienė & Mančas, 2024). The lean firms showed a lower cost structure and higher throughput rates. Combining these studies demonstrates the relevance of warehouse control in supporting operative efficiency, and align across the RBV's focus on strategic resources usage.

Procurement of goods and services is an effective means of attaining desired performance outputs and inputs, primarily driven by supplier selection, contract management and strategic sourcing practices (Sukhawatthanakun et al., 2023). However, we note that many recent empirical studies have demonstrated that strategic procurement can be leveraged to improve operational performance. Kumar et al. (2022) assert that firms using collaborative procurement strategies incurred 30% lesser lead time and 20% enhanced resource utilization. Because these practices help create closer supplier relationship and reduce transaction costs, they are consistent with TCE (Yin et al., 2023).

More importantly, supplier integration to achieve operational efficiency was stressed by (Pham et al., 2023). As such, they found that companies with long term partnerships with their suppliers were better equipped to cope with supply chain disruption and keep production flow steady. These findings are consistent with those of Schiele et al. (2020) in which supplier relationship management is found to improve communication and trust that, in turn, facilitates higher delivery performance and lower costs. This addressed the procurement as a means to improve transparency and accountability in procurement processes in developing economies, as studied. They found that firms using digital procurement tools higher attained cost savings and operational efficiency and drew out relevance of strategic procurement in a variety of settings (Althabatah et al., 2023).

Systems, Applications, and Products in Data Processing (SAP) systems are a great leap forward in the integration of technology into enterprise resource planning (ERP) and enterprise operational management (Antwi & Avickson, 2024). SAP constitutes a unified platform bringing together all procurement, inventory and financial functions and makes possible real time data sharing and decision making. Chand (2019) found out that firms that introduce SAP systems were benefitted by operational accuracy (25%) and decreased time in process cycle (20%). Improvements to SAP were cited as helping stream line processes and eliminating redundancies.

Further, found that organizations that used SAP experienced greater cross functional

cooperation resulting in quicker reaction to market change (Gannamneni et al., 2024). SAP implementation created data transparency, which is critical to warehouse and procurement success, found the study. In addition, assessed the advantages and disadvantages of using SAP in small and medium sized enterprises. In the beginning, SAP systems had been so expensive, yet, in the long run, there were many advantages such as more operational agility and less manual mistakes (Medina Serrano, 2024). Results have also shown the significance of SAP systems, as an operational efficiencies enabler in the particularly complex supply chain configurations. Yet, the interlock between warehouse operations control, procurement practices and SAP implementation is identified, leading to a synergistic effect on operational efficiency. Harmonizing them and eliminating redundancies is the only way to proceed as procurement and warehouse operations can be integrated with SAP systems. As per SAP firms which used the warehouse management module had better inventory accuracy, and less stock outs (Nasiri et al., 2024).

Moreover, the procurement practices are in line with the strategic alignment with the warehouse operations in order to ensure materials availability in a timely manner and hence ensure minimal impact to production delays Mwizerwa and Akumuntu (2024) mention that the two systems should be integrated to achieve lean and efficient supply chain operations. Furthermore, what makes this synergy even stronger is in the fact that SAP can in turn provide real time insights to firms allowing them to respond quickly to market demands and operational challenges (Sarferaz, 2022).

3.0 Methodology

This study sought to establish the impact of warehouse operation control and procurement practices to operational efficiency, through improvement of organizations processes in logistics and procurement, while also considering the influence of SAP implementation. The proposed hypotheses were tested using a quantitative research design. This research was based on positivist philosophy and so the structured methods were used to collect the data which was analyzed by using the statistical techniques. Next, the target population comprised of the employees in a logistics, procurement and SAP implementation role in different organizations that handle supply chain management from an area perspective, most important being the Middle East region. From this population a sample of 300 respondents was selected to represent key stakeholders in warehouse operation, procurement and IT systems.

The sampling methodology used was a convenience method, where respondents are accessed on convenience basis dependent on their availability and relevance to the study research problem. The data were collected mainly using A survey questionnaire. Structured questions related to warehouse operations, procurement practices and SAP implementation were included in the survey, enabling us to gather information on operational efficiency and its perceived impact. For a broader scope of data, the questionnaire was sent electronically directly to the participants where they were located from across geographical locations, Jeddah, KSA, and Basra, Iraq.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to test the relationships between the identified variables for data analysis. This was especially suited to exploratory research designed to uncover complex relations among multiple constructs. Analysis

was conducted to test the direct and indirect effects of warehouse operations control, procurement practices, and SAP implementation to firm operational efficiency and to understand the structural model and investigate the importance of each path.

The research process was followed with rigorously consideration of ethics. All participants provided informed consent, and were thus aware of purposes, procedures and risks of the study. Their responses were anonymized to maintain confidentiality and to protect their identity. The data was also stored securely and was used only for the purposes of this research. Participant recruitment did not involve any coercion. Participants had the right to withdraw from the study at any stage with retrieval.

4.0 Findings and Results

4.1 Measurement Model

4.1 Reliability Analysis Table

Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Warehouse Operations Control	0.85	0.89	0.63
Procurement Practices	0.78	0.84	0.57
SAP Implementation	0.82	0.87	0.60
Operational Efficiency	0.88	0.91	0.68

Cronbach's Alpha, Composite Reliability (CR) and Average Variance Extracted (AVE) were used to assess the reliability and validity of the constructs. All constructs Cronbach's Alpha values satisfied the minimum threshold of 0.7 (0.78 – 0.88), indicating strong internal consistency. Likewise, Composite Reliability (CR) values, which indicate the overall reliability of the latent variables, were all over the recommended threshold of 0.7 (0.84–0.91). Thus, these results show that the constructs are measuring the intended variables consistently with the items within each construct. Regarding convergent validity, both the Average Variance Extracted (AVE) values for all constructs exceeded the minimum accepted level of 0.5, namely between 0.57 and 0.68. These findings suggest that the constructs account for a great deal of the variance in their indicator. In particular, "Warehouse Operations Control" had an AVE of 0.63, which means that 63% of variance in its indicators is explained by the construct. For instance, "Operational Efficiency" revealed the highest AVE (0.68) suggesting that it has the strength of explanation. Finally, the overall measurement model fulfills the same criteria of reliability and convergent validity, which confirms the robustness of the constructs for further analysis.

Table 4.2 Validity Analysis (HTMT)

Constructs	Warehouse Operations Control	Procurement Practices	SAP Implementation	Operational Efficiency
Warehouse Operations Control	-			
Procurement Practices	0.67	-		
SAP Implementation	0.72	0.70	-	
Operational Efficiency	0.65	0.68	0.71	-

The validity of the constructs was assessed by Heterotrait-Monotrait Ratio of Correlations (HTMT) which estimates degree of differentiation between constructs. This was confirmed by their HTMT values being under the suggested threshold of 0.85 for each construct pairs. For example, 0.67 is the HTMT value between "Warehouse Operations Control" and "Procurement Practices," a moderate but in fact appropriate amount of correlation. Like "SAP Implementation" and "Operational Efficiency" also had HTMT value of 0.71, validating discriminant validity. These results demonstrate that the constructs of the model are not only reliable but also unique, precluding redundancy. Strong evidence of the differentiation of the latent variables is indicated by the HTMT values for all construct pairs (between 0.65 and 0.72). Thus, the validity analysis confirms adequacy of the measurement model and supports the constructs for hypothesis testing and further structural equation model.

4.3 Variance Inflation Factor (VIF) Table

Indicators	VIF Value
Warehouse Operations Control	2.1
Procurement Practices	1.8
SAP Implementation	2.4
Operational Efficiency	2.0

Multicollinearity among the constructs in the model was evaluated through the Variance Inflation Factor (VIF) values. The values of all VIF were less than five, the critical value of multicollinearity. In particular, “Procurement Practices” had the lowest VIF value of 1.8 and hence lowest collinearity with other constructs and “SAP Implementation” had the highest value of 2.4, which is also within acceptable limits. Thus, the results of these indicate that the predictor constructs of Warehouse Operations Control, Procurement Practices, and SAP Implementation do not lead to a situation where they explain too much variance in the dependent variable, Operational Efficiency. This gives the regression estimates stability and reliability, which then being a strong foundation for the structural model’s predictability and interpretability. The absence of multicollinearity lends confidence to the validity of the relationships being studied.

Table 4.4 Model Fitness Table

Fit Indices	Threshold	Achieved Value
Standardized Root Mean Square Residual (SRMR)	< 0.08	0.065
Normed Fit Index (NFI)	> 0.90	0.92
Chi-Square/Degree of Freedom (χ^2/df)	< 3.0	2.87

The model fitness was assessed using several key indices to ensure that the proposed model adequately represents the data. The Standardized Root Mean Square Residual (SRMR) value was found to be 0.065, which is below the recommended threshold of 0.08, indicating a good fit between the observed and model-implied covariances. The results indicate that the model is well specified and that the fit indices are acceptable on all measures, suggesting the reliability and validity of the model for further analyses using structural equation modeling.

Table 4.5 Structural Equational Model

Hypothesis	Path Coefficient (β)	t-Value	p-Value	Decision
H1: Warehouse Operations Control → Operational Efficiency	0.35	4.12	0.000	Supported
H2: Procurement Practices → Operational Efficiency	0.28	3.76	0.001	Supported
H3: SAP Implementation → Operational Efficiency	0.40	5.20	0.000	Supported

Analysis carried out using the structural equation modeling reveal that the predictor variables have a strong relationship with operational efficiency. The first hypothesis H1 which predicts “Warehouse Operations Control” has a positive influence on “Operational Efficiency” was approved by the path coefficient of 0.35, t value of 4.12 and p-value of 0.000. These results suggest that Warehouse Operations Control has a moderate but a significant positive effect on the Operational Efficiency. Hypothesis H2 concerning “Procurement Practices” and “Operations Efficiency” was also supported. This was true and was affirmed by the result of Procurement Practices of path coefficient, t-test and p- test as 0.28 dependent on Operational Efficiency which is ‘’ highly significant’, the t-static at 3.76 and p- value of 0.001. Finally, the last hypothesis, H3: “SAP Implementation” has a direct impact on “Operational efficiency” has the highest path coefficient of 0.40 qualified from the t statistics of 5.20 and p value of 0.000 hence SAP Implementation is another determinant of operational performance improvement. Together these highlight the importance of Warehouse Operations Control, Procurement Practices and SAP Implementation in enhancing Shuttle Operations.

Table 4.6 R^2 Values

Construct	R^2 Value
Operational Efficiency	0.62

Table 4.7 Effect Size (f^2)

Path	f^2 Value
Warehouse Operations Control → Operational Efficiency	0.15
Procurement Practices → Operational Efficiency	0.10
SAP Implementation → Operational Efficiency	0.20

R^2 is used to measure how much of the variance in the dependent variable (DV) can be explained by an independent variable (IV). The f^2 effect size test is applied to assess the impact of one IV on the dependent variable in multiple linear regression analysis. In the case of a single treatment, the f^2 statistic is calculated like a single effect size that encompasses the sum of two distinct effects: Causal Effects (CE) and Treatment Interaction Effects (TIE). The f^2 statistic is calculated similarly for multiple treatments. Operational efficiency has an R^2 of 0.62 and is determined by Warehouse operations control, Procurement practices, and SAP implementation. Such a proportion is large, signaling that the model successfully identifies the major drivers of operational efficiency in the situation concerning the study. Insights into the magnitude of influence of individual predictors on operational efficiency are provided by the effect size (f^2) values. Within the same training program, the effect size of Warehouse Operations Control to Operational Efficiency was 0.15, which is labeled as a medium effect and is interpreted in that it is moderately influenced. As a second impact vehicle, 'Procurement Practices' has an effect size of 0.10 suggesting a small to medium impact on operational efficiency. In terms of effect size however, “SAP Implementation” determines the largest effect of size 0.20 which states medium effect and hence has more influence on operational efficiency than the other predictors. The magnitude of these effect sizes represents the relative importance of each predictor in operationally determining efficiency.

5.0 Discussion and Conclusion

This study results show the roles of warehouse operations control, procurement practices, and SAP implementation in determining operational efficiency in organizations. The significant positive relationships among these variables and operational efficiency revealed that warehouse management, an efficient procurement process and adoption of SAP systems are key factors in increasing operational performance in any organization. According to these findings, they are in line with what the literature says about the importance of good supply chain management and

technological integration when it comes to improving organizational outcomes.

From a practical standpoint organization that seek to enhance operational efficiency must pay attention to their warehouses, procurement practices, and implement an advanced enterprise resource planning system like SAP. Areas of SAP implementation ($f^2 = 0.20$) and warehouse operations control ($f^2 = 0.15$) have a particularly strong impact on operational efficiency and their corresponding effect sizes are significant, and should drive resource allocation and strategy formulation. Additionally, the procurement practices have moderated impact ($f^2 = 0.10$) since it stresses the need to fine tune the procurement strategies in an attempt to improve operational performance.

This shows that what follows are broad implications, i.e., that managers and decision-makers, if they are interested in better operational outcomes, should make investments in these key areas. Keeping the DWH optimally running is possible by improving warehouse operations and optimizing procurement process. Further, the integration of SAP systems which has been found to have a large positive effect on operational efficiency, also needs to be considered as a strategic investment towards long run improvements to organizational performance. Moreover, the study adds to the existing body of knowledge in the field of operational efficiency, by disentangling the individual effects of supply chain management practices and technological adoption in a contemporary organization environment.

Based on the conclusions, this study presents valuable evidence that warehouse operation control, procurement practice and SAP implementation are significant drivers for operational efficiency. These areas could be focused on in organizations looking to improve their operations and thus improve their competitive advantage and internal processes. Furthermore, the research provides empirical support for the positive effect of these factors on operational outcomes and provides actionable insights for businesses that wish to improve their operational efficiency. These contributions will guide future research and practical applications of operations management and supply chain integration.

Muhammad Farooq Rehan: Problem Identification and Theoretical Framework
Shujaat Ali Khan: Data Analysis, Supervision and Drafting
Usman Kamal Qureshi: Methodology and Revision

Conflict of Interests/Disclosures

The authors declared no potential conflicts of interest in this article's research, authorship,and publication.

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