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Article

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MANAGEMENT | RESEARCH ARTICLE

Exploring the Nexus of inventory optimization and operational efficiency: Data-driven insights from public sector organizations in Ethiopia

Gemachis Debala^{1*}, Mohd Abass Bhat² and Shagufta Tariq Khan³

Abstract: This study explores the link between inventory optimization and operational efficiency in public sector organizations in Ethiopia. The study specifically examines the role of Capacity utilization, Inventory precision, IT infrastructure, administrative purchasing procedures, Workforce competence and proficiency, Record-keeping towards achieving optimal inventory management and operational efficiency in these organizations. The research is based on a quantitative approach, with primary data collected through a survey of 186 public sector organizations in Ethiopia. Utilizing a descriptive and explanatory research design, primary and secondary data were collected and analyzed through the application of SPSS version 24 and presented with descriptive and inferential statistics. The results indicate a significant and positive correlation between Inventory Optimization and operational efficiency. Additionally, multiple regression analysis revealed that inventory utilization, administrative purchasing procedures, record-keeping and documentation, staff skills and knowledge, inventory accuracy, and IT infrastructure have a significant impact on operational efficiency. Consequently, the study provides data-driven insights into the importance of inventory optimization in enhancing operational efficiency in public sector organizations in Ethiopia. This study recommends that the management of Ethiopian public sector organizations should focus on developing short administrative purchasing procedures, ensuring good record-keeping and documentation, utilizing adequate information and communication

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technology, and investing in staff skills training to enhance Inventory Optimization and overall organizational operational efficiency.

Subjects: Finance; Business, Management and Accounting; Industry & Industrial Studies

Keywords: inventory optimization; operational efficiency; administrative purchasing procedures; record-keeping and documentation; IT infrastructure; inventory utilization

1. Introduction

Inventory optimization and operational efficiency are two critical aspects of supply chain management that are essential for the success of any business (Bag et al., 2020; Panigrahi et al., 2023). Inventory optimization refers to the process of efficiently managing inventory levels to meet demand while minimizing costs. Operational efficiency, on the other hand, involves maximizing productivity while minimizing waste and reducing costs (Andersson et al., 2015). The nexus between inventory optimization and operational efficiency is an area of growing concern, especially in today's highly competitive business environment (Panigrahi et al., 2022). Organizations are increasingly seeking ways to improve their supply chain management processes to enhance their competitiveness, reduce costs, and improve customer satisfaction. A proficient inventory optimization system can offer significant competitive advantages to firms by reducing costs, enhancing operations, and ensuring profitability (Bhat & Tariq, 2020; Li et al., 2022). Specifically in hypermarkets, inventory optimization refers to a series of activities aimed at ensuring timely delivery of materials required for operations, in the required quantity, quality, and at the lowest possible cost. Timely inventory management is crucial as inventory excess can lead to increased costs, while inventory shortages can cause an inability to meet specific requirements within a particular time-frame (Pourhejazy, 2020). Khan and Siddiqui (2019) suggest that businesses should align market seasonality with production costs and procedures and organize products for sale in inventory optimization. Additionally, continuous observation and analysis of item movement and storage is necessary. Failure to properly conduct inventory optimization can result in significant damage to inventory, leading to increased costs for the company, and shortages in inventory to meet specific ends. Therefore, a well-organized inventory optimization system can enhance operational efficiency, lower inventory and distribution-related costs, improve customer service, track individual items along with their expiration dates, and help balance supply and demand (Bhat et al., 2022; H. Ahmed et al., 2022; May et al., 2017).

Several scholars, including Koumanakos (2008), Magoutas et al. (2012), Gul et al. (2013), and Afrifa et al. (2014), have emphasized that inventory optimization involves determining the optimal quantities to order and maintain, while considering associated costs. The literature has documented that excessive inventory levels can result in capital being tied up, inventory deterioration, obsolescence, damage, and loss due to theft, as pointed out by Karim et al. (2017). Conversely, inadequate inventory levels can lead to sales interruptions, poor customer relations, and underutilization of equipment and machinery, as outlined by Karim et al. (2017). Successful inventory optimization requires the ability to plan, monitor, and control inventory levels, which necessitates possessing the necessary knowledge, skills, and abilities. Akisimire et al. (2016) have emphasized that small business managers who possess basic knowledge of inventory optimization strategies and the ability to apply them can enhance their inventory management resulting in increased sales and profitability. It is crucial to recognize the importance of managers' understanding of "know-what," "know-when," "know-how," and "know-why" in planning, monitoring, and controlling inventory levels, regardless of the inventory optimization approach they choose to adopt.

Operational efficiency reflects management's effectiveness and efficiency in utilizing a company's resources to drive its overall performance, which in turn contributes to the economy of the country (Kamukama et al., 2017). In Africa, several business units/firms have failed due to poor operational efficiency. For instance, in South Africa, more than 70% of small businesses

collapse within the first five years of operations (Gomero, Bhat, & Khan, 2020; Solomon et al., 2013; Gomero et al., 2020), about 70% of small and medium enterprises (SMEs) collapse within 24 months in East Africa (Ojiambo, 2016), and in Kenya alone, approximately 46% of SMEs shut down in the first year of founding, and another 15% within the second year (Kangethe, 2018). In Uganda, poor operational efficiency in small businesses is evident in their continuous collapses, where 30% of them do not survive to celebrate even their third anniversary (Afunadula, 2018).

In Spain, after studying 8872 small and medium enterprises, Juan and Martinez (2002) concluded that managers of the firms can create a greater value by reducing the number of days of holding inventory in stores. In another study, Akelo (2011) tried to find out if the performance of non-profit organizations can be improved through inventory management practices. This study focused on a sample of seventy respondents from ten Non-Governmental Organizations which were mainly targeted in Nairobi and the results discovered that a unit increase in ABC Analysis leads to a factor of 0.683 increase in operational performance of Non-Governmental Organizations, while a unit increase in Economic Order Quantity leads to a factor of 0.702. Raymond and Bellah (2015), in an attempt to investigate the impact of inventory management practices on firm's performance, revealed that manufacturing firms in particular though use a variety of inventory management techniques such as action level methods, periodic reviews, just-in-time, material requirement planning, and economic order quantity to improve performance, action level methods, however, were used widely by these companies in anticipation of more effective results.

While there is a significant body of literature on inventory optimization and operational efficiency in various industries, including the private sector (Manatkar et al., 2016; Qu et al., 2022; Toor et al., 2022), there is limited research on the application of data-driven insights to these concepts in public sector organizations, particularly in Ethiopia. The nexus between inventory optimization and operational efficiency is also understudied in the context of public sector organizations (Opoku et al., 2020). Therefore, there is a need for research that investigates how public sector organizations in Ethiopia can utilize data-driven insights to optimize inventory levels and improve operational efficiency, as well as exploring the potential relationship between these two concepts. This research can help fill the gap in the literature and provide practical insights for policymakers and practitioners in the public sector in Ethiopia and other developing countries. We present initial empirical evidence on the specific mechanism that underlies the relationship between inventory optimization and operational efficiency in the context of public sector organizations in Ethiopia. Our findings contribute to the existing literature on the link between inventory optimization and operational efficiency.

2. Review of literature and hypotheses development

Inventory optimization is a crucial aspect of efficient operational management, aimed at achieving uninterrupted production and sales, minimizing holding costs, and enhancing customer satisfaction (Kamau & Kagiri, 2015). Successful inventory optimization ultimately leads to improved operational efficiency and liquidity, rather than just financial performance. To achieve this, organizations must implement an effective planning and budgeting system, and utilize reliable sales forecasts (Gomero, Bhat, & Khan, 2020; Orobias et al., 2020). Employing inventory management techniques such as the Economic Order Quantity and the ABC analysis methods can help to optimize inventory levels and mitigate the risks of production stoppages and holding costs (Nallusamy et al., 2017). Inventory optimization is necessary for organizations to ensure uninterrupted supply while minimizing holding costs (Oballah et al., 2015). Achieving this requires a sound understanding of the optimal inventory level, planning, monitoring, and control strategies, as well as the ability to put this knowledge into practice. Competent managers who possess the skills and abilities to implement effective inventory management system can transform inventory into a proactive force that reduces carrying costs and boosts confidence in supply and distribution service levels (Orobias et al., 2020).

Research studies have demonstrated a positive and significant relationship between inventory management and operational efficiency. A. D. Ahmed et al. (2016), for instance, found that

effective inventory management strategies positively impact the financial performance of Nigerian conglomerate companies. Similarly, Hamza et al. (2015) reported that SMEs' financial performance in the northern region of Ghana is positively associated with efficient inventory management. However, inventory management can be challenging given the risk of theft and obsolescence caused by changing tastes and preferences (Orobia et al., 2020). Therefore, it is essential to keep track of inventory movements and avoid unnecessary losses that may hamper operational efficiency (Bertagnolli, 2018). In an extant literature survey, several aspects representing inventory management have been recognized that include capacity utilization, inventory precision, IT infrastructure, administrative purchasing procedures, workforce competence and proficiency, and record-keeping and documentation. All these aspects of inventory optimization have been found positively impacting operational efficiency as confirmed from different studies. We present detailed review along with the hypotheses developed, in allied sections, of each of the factor of inventory optimization in connection with operational efficiency across contexts.

2.1. Capacity utilization and operational efficiency

Capacity utilization and operational efficiency act as a backbone towards a firm's productivity and profitability. Existing studies have explored the relationship between these two factors (Wu, 2012). The importance of capacity utilization in inventory management has captured significant attention from firms as it can play a crucial role in achieving competitive advantage. Hausman (2005) argues that firms struggle to fulfill production orders on time due to a lack of sophisticated tools to examine capacity utilization quickly. This highlights the need for firms to adopt advanced tools to manage their capacity utilization effectively. There is sufficient evidence that supports a positive relationship between capacity utilization and operational efficiency, which implies that higher capacity utilization leads to better operational efficiency in organizations. For instance, Adeyemi and Olufemi (2016) and Prajogo et al. (2018) reported a positive correlation between capacity utilization and operational efficiency. However, other researchers have contradictory views about the relationship between these two factors. Shrafat and Ismail (2019) found that although higher capacity utilization may lead to better operational efficiency, there is an optimal level of capacity utilization beyond which operational efficiency declines due to congestion and other operational issues. Thus, the relationship between capacity utilization and operational efficiency is complex and unclear yet.

H01: capacity utilization has no significant effect on operational efficiency.

2.2. Inventory precision and operational efficiency

Inventory precision, also known as inventory accuracy, is a crucial factor that influences the operational efficiency of businesses. The ability to maintain accurate inventory levels can help firms optimize their production processes, reduce waste, and meet customer demand in a timely manner (Hasan et al., 2021). As a result, several studies have explored the relationship between inventory precision and operational efficiency. The literature on inventory precision and operational efficiency is relatively sparse, with only a handful of studies focused on this topic. One of the earliest works in this area was Rinehart's survey of inventory accuracy at the US Navy depot of Rhode Island in 1960. While this study provided some initial insights into the importance of accurate inventory management, it was limited to a single case and may not be generalizable to other contexts (Khan & Siddiqui, 2019). More recently, Roohi et al. (2020) investigation into the level of inventory caused by inactivity has been considered a pioneering study in the field of inventory accuracy research. However, it is important to note that this study was focused on a specific issue related to inventory management and did not specifically examine the relationship between inventory precision and operational efficiency.

Another study conducted by Oballah et al. (2015) in the context of Kenya's public health sector found that inventory management practices significantly determine the performance of firms.

Specifically, the study revealed that inventory accuracy positively impacts organizational performance, while inventory shrinkage had a negative impact. While this study provides some valuable insights into the relationship between inventory accuracy and operational efficiency, it is limited by its focus on a single industry in a specific geographic context.

H02: *Inventory precision has no significant effect on operational efficiency.*

2.3. IT infrastructure and operational efficiency

Effective utilization of Information Technology (IT) infrastructure has become increasingly crucial for organizations seeking to enhance their operational efficiency. Studies have consistently demonstrated that IT infrastructure can significantly impact operational efficiency. For example, a study by Naway and Rahmat (2019) revealed that IT infrastructure can boost operational efficiency in supply chain operations by minimizing lead times and promoting communication and collaboration among supply chain partners. Likewise, Chandra et al. (2022) discovered that IT infrastructure can enhance operational efficiency in the healthcare sector by simplifying patient data management and facilitating communication between healthcare providers. The study concluded that a well-designed IT infrastructure can lead to improved patient outcomes and operational efficiency in healthcare organizations. Nel and Badenhorst-Weiss (2011) conducted primary research on 13 organizations with top brands from the Sunday Times using non-probability sampling procedures. They discovered that organizations that employ Information Technology in inventory management systems must effectively adhere to a robust supply chain management cycle to achieve improved performance targets. The findings emphasize the importance of managing supply chain drivers in accordance with a chosen supply chain strategy. Additionally, Information Technology can be successfully employed in retail businesses to further improve operational flows more effectively.

H03: *IT infrastructure has no significant effect on operational efficiency.*

2.4. Administrative purchasing procedures and operational efficiency

Administrative purchasing procedures and operational efficiency are critical components of any organization's success. Research suggests that the use of standardized administrative purchasing procedures can lead to improved operational efficiency, reduced costs, and increased productivity. Electronic procurement systems, centralized procurement systems, and best practices in procurement are effective methods to improve operational efficiency. However, organizations must also consider the potential limitations and challenges associated with implementing these procedures. In the context of inventory management, the procurement process begins when a need for goods or services arises in a government agency or any firm. This is followed by the formulation of a procurement strategy that involves several aspects, such as seeking and evaluating alternative solutions, delivery and payment for the property and/or services, assessing risks, ongoing contract management, contract awards, and consideration of contract options. The procurement process also includes the final disposition of property/assets when it reaches the end of its useful years of life. Rotich and Okello (2015) found that the use of electronic procurement systems can improve operational efficiency by reducing transaction costs, improving communication, and increasing transparency. Similarly, another study by Mishra et al. (2022) found that the implementation of best practices in procurement, such as supplier evaluation and selection, can improve operational efficiency and reduce costs.

Moreover, in a study conducted by Mwaura (2017) on inventory management automation and its impact on supermarket performance in Kenya's Western and Nyanza provinces, regular inventory management practices were found to have a positive and significant effect on supermarket

performance. The survey design targeted all eleven operational supermarkets in Kakamega, allowing valid inferences to be drawn. Juma (2013) focused on consumer services firms, while Belay (2017) investigated the effects of inventory management practices on operational performance in Ethiopian Airlines. The findings indicated that effective inventory management models have a positive effect on operational performance.

H04: *Administrative purchasing procedures have no significant effect on operational efficiency.*

2.5. Workforce competence and proficiency and operational efficiency

The literature suggests that there is a strong positive relationship between workforce competence and proficiency and operational efficiency across various industries. Organizations that invest in training and development programs to improve employee skills and knowledge may see improvements in their operational efficiency. According to Hernandez de Menendez et al. (2020), individuals employed in warehouses, which are essentially stores, are responsible for the distribution of inventory materials to designated storage or use locations. They oversee all activities related to storekeeping, including picking, shipping, and receiving of materials, as well as ensuring the safekeeping and physical security of the stored material. Other duties of these employees include managing the layout of the warehouse, maintaining accurate inventory records, fulfilling customer requests for stock materials, determining the physical movement and distribution of materials within the organization, developing truck and route schedules for material distribution, and resolving vendor-related problems in terms of quality, quantity, timing, and delivery.

In addition, warehouse employees are responsible for bin location assignments, receiving and storing material, conducting cycle counts, reconciling discrepancies between cycle counts and annual physical inventory, and collaborating with purchasing departments. According to Jubayer et al. (2020), training is crucial for improving the knowledge, attitude, and skills of warehouse employees through learning experiences that enable them to perform their duties effectively and efficiently. Training is essential to meet the current and future human resource needs of the organization while also enabling employees to enhance their job-related abilities.

H05: *Workforce competence and proficiency has no significant effect on operational efficiency.*

2.6. Record-keeping and documentation and operational efficiency

Record-keeping and documentation are critical components of organizational operations. They contribute to operational efficiency, facilitate decision-making, and mitigate legal and financial risks. Organizations must invest in the appropriate technology and processes to maintain accurate and comprehensive records and provide ongoing training and support to staff to ensure that record-keeping practices are followed consistently. While it is true that record-keeping and documentation play a crucial role in ensuring operational efficiency and mitigating legal and financial risks, the importance of accurate record-keeping extends beyond these benefits. In fact, as highlighted by TAYE (2022), maintaining accurate inventory records is necessary to provide satisfactory customer service, analyze inventory levels, and ensure that material availability meets repair or project demand. Similarly, as argued by TEKLEHAIMANOT et al. (2014), regular stock recording is necessary to maintain receipts, issuance, and remaining stock balances. Failure to do so can result in inaccurate stock balances, rendering records unreliable and less useful.

In the healthcare sector, as found by Gurmu and Ibrahim (2017), low-volume health facilities with poor automated recording systems had a positive relationship with pharmaceutical inventory control system performance. However, this relationship was negatively impacted by nurses managing inventory and service years less than one year, who had a negative relationship with Bin card updating practices. Inadequate supply of material from the suppliers was also linked to drug shortages, further emphasizing the importance of proper record-keeping in the healthcare industry (Okoye et al., 2022). In conclusion, accurate and up-to-date record-keeping is a crucial responsibility for personnel involved in inventory management, store management, and healthcare facilities. Neglecting this responsibility can lead to inaccurate stock balances, operational inefficiencies, and potential risks to legal and financial compliance.

H06: *Record-keeping and documentation have no significant effect on operational efficiency.*

3. Research methodology

3.1. A conceptual framework

The framework is adapted from previous studies and serves as the foundation of this study. The framework is formulated to explain the relationship of the dependent variable with several predictors. The independent variables include capacity utilization, Inventory precision, IT infrastructure, administrative purchasing procedures, Workforce competence and proficiency, Record-keeping, and documentation while the dependent variable is operational efficiency (see Figure 1) in selected public sector Bureaus of Benishangul Gumuz regional state, Ethiopia. It is presumed that the mentioned independent variables affect operational efficiency in the selected region.

3.2. Research design

This study adopts a mixed research approach, utilizing both quantitative and qualitative methods. Quantitative research involves asking predetermined questions to participants, with responses quantified and analyzed using statistical tools in an unbiased and objective manner (Hanson et al., 2005). Qualitative research, on the other hand, focuses on collecting and analyzing data in the form of words and concepts rather than numerical values (Aspers & Corte, 2019). The study employs an explanatory research design to elucidate and forecast the

Figure 1. Model of the study.

Source: Authors' compilation



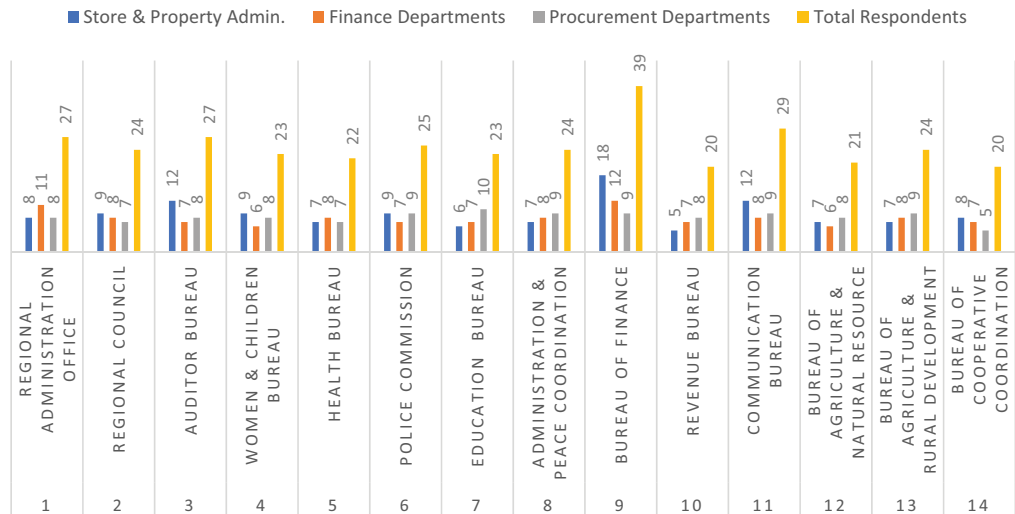
connection between independent and dependent variables, as well as a descriptive research design to outline inventory optimization practices that enhance operational efficiency. These methodological choices were made with the aim of ensuring a comprehensive and nuanced understanding of the research topic.

3.3. Sampling procedure

The study focused on a target population consisting of 24 public sector bureaus. To ensure a representative sample, the employees of 14 public sector bureaus in the Benishangul Gumuz regional state were purposively selected. These sectors were chosen due to their high inventory holdings in the region and the fact that they manage larger inventories than other zonal and Woredas offices (see Chart 1). The sample group included store clerks, purchasers, finance officers, and material or inventory officers and managers, with a total population of 348 individuals as reported by BOFED in 2019. This approach was taken to ensure a comprehensive and robust understanding of the inventory optimization practices in the public sector bureaus.

Chart 1. List of Target population of the study.

Source: BOFED Report, 2019



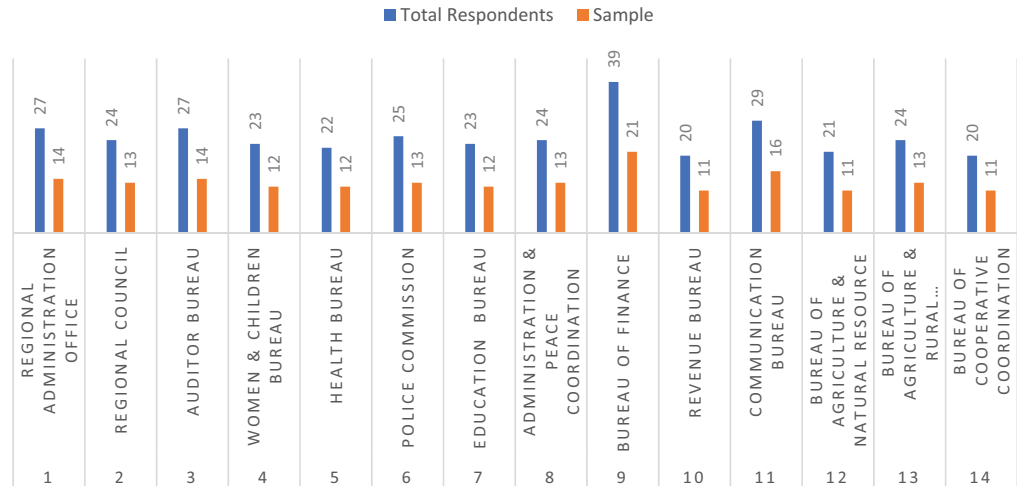
In order to determine the appropriate sample size for the study, the formula developed by Yamane (1973) was utilized. This method is particularly useful in situations where the population is both finite and homogeneous. Therefore, the following formula was applied:

$$n = N / (1 + N \cdot e^2) = 348 / [1 + 348 \cdot (0.05)^2] = 186$$

Here, n represents the required sample size, N represents the number of individuals in the population, and e represents the estimated variance in the population, which was assumed to be 0.5 in decimal form. By using this formula, the appropriate sample size of 186 was determined for the study, ensuring a reliable and accurate analysis of the data collected (see Chart 2).

Chart 2. Sample size for the study.

Source: BOFED Report, 2019



The questionnaire format used in this study was adapted from prior literature and authors designed in line with the study’s rationale and objectives. The data collection instrument was selected based on the research questions and objectives, research design, and the specific information required to be gathered. As the appearance and layout of the questionnaire can have a significant impact on respondents’ willingness to participate (Ohman-strickland et al., 2007), the questionnaire was created to be simple and easy to understand, in English, as the subjects were educated and capable of comprehending the language.

During the data analysis stage, the collected primary data was pre-coded and analyzed using specific statistical tools in SPSS V24 (Statistical Package for Social Science), mainly focusing on inferential statistics. The study utilized a linear regression model to examine the relationship between the dependent variable, operational efficiency, which was measured using six items adopted from King et al. (2010), namely a) competitiveness, b) customer base, c) growth rate, d) profitability, e) innovation, and f) number of employees, and six independent variables, including capacity utilization, inventory precision, IT infrastructure, administrative purchasing procedures, workforce competence and proficiency, and record-keeping and documentation. By utilizing this approach, the study aimed to provide a comprehensive understanding of the factors that impact inventory optimization practices and operational efficiency in the public sector bureaus under investigation.

4. Results of the study

The collection procedures involved personal administration, follow up after distribution of questionnaires through mobile phone calls for validation of data when they would be equipped for collection and personal collection. The response rate was found to be sufficiently satisfactory for analysis of the data. The unreturned questionnaires 16 (9%) could be credited to delay on the part of the respondent completing and hence being unable to return. Therefore, data collected from 170 (91%) respondents were proceeded with further analysis.

Table 1 presents the results of a study that investigated the relationship between several variables and operational efficiency in public sectors. The data indicate that all six variables under investigation have a positive and significant relationship with operational efficiency. The correlation coefficients (r) for each variable indicate the strength of the relationship between the

Table 1. Correlation analysis results

Variables		Operational efficiency
Capacity utilization	r	.456***
	P value	0.000
	N	170
IT infrastructure	r	.520***
	P value	0.000
	N	170
Inventory precision	r	.477***
	P value	0.000
	N	170
Administrative purchasing procedures	r	.369**
	P value	0.000
	N	170
Workforce competence and proficiency	r	.476**
	P value	0.000
	N	170
Record-keeping and documentation	r	.344**
	P value	0.000
	N	170

Note: (***) denote a p-value less than 0.001 (i.e., statistically significant at the 0.1% level)

Source: SPSS output

predictors and operational efficiency. The p-values indicate the level of statistical significance of the relationship.

It is found that Capacity Utilization has a positive and significant relationship with operational efficiency ($r = .456, p < 0.01$). This suggests that public sector organizations that make effective use of their resources and maintain high-capacity utilization levels tend to achieve higher levels of operational efficiency. This finding is in line with Prajogo et al. (2018) who also reported a positive correlation between capacity utilization and operational efficiency. Another factor “Inventory Precision” also has a positive and significant relationship with operational efficiency ($r = .477, p < 0.01$). This finding was corroborated with Oballah et al. (2015) who also found that inventory management practices significantly determine the performance of firms. Specifically, the study revealed that inventory accuracy positively impacts organizational performance. This implies that public sector organizations that have accurate and precise inventory control systems tend to have higher levels of operational efficiency. Similarly, Administrative Purchasing Procedures has a positive and significant relationship with operational efficiency ($r = 0.369, p < 0.01$). This suggests that public sector organizations that have efficient and effective purchasing procedures tend to have higher levels of operational efficiency. Rotich and Okello (2015) and Mishra et al. (2022) also found that the use of purchasing procedures can improve operational efficiency by reducing transaction costs, improving communication, and increasing transparency. Another factor “Workforce Competence and Proficiency” can also be found positive and significant determinant of operational efficiency ($r = 0.476, p < 0.01$). This implies that public sector organizations that have skilled and competent employees tend to achieve higher levels of operational efficiency. According to Jubayer et al. (2020), training is crucial for improving the knowledge, attitude, and skills of warehouse employees through learning experiences that enable them to perform their duties effectively and efficiently, that affects operational efficiency. Record-keeping and Documentation has a positive and significant effect on operational efficiency ($r = 0.344, p < 0.01$). This suggests that public sector organizations that maintain accurate and comprehensive records and documentation tend to achieve higher levels of operational efficiency. This

Table 2. Linear regression model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.564 ^a	.648	.659	.30837	.318	16.992	4	146	.000

Source: SPSS output

finding was found similar to TAYE (2022), who revealed maintaining accurate inventory records is necessary to provide satisfactory customer service, analyze inventory levels, and ensure that material availability meets repair or project demand.

Finally, it was also found that IT Infrastructure has a positive and significant relationship with operational efficiency ($r=0.520$, $p < 0.01$). This implies that public sector organizations that have efficient and effective IT infrastructure tend to achieve higher levels of operational efficiency. In line with this finding, Chandra et al. (2022) also discovered with specific reference to healthcare sector that by simplifying patient data management and facilitating communication between healthcare providers, IT infrastructure can enhance operational efficiency.

Overall, the results of this study suggest that public sector organizations can enhance their operational efficiency by focusing on improving capacity utilization, inventory precision, administrative purchasing procedures, workforce competence and proficiency, record-keeping and documentation, and IT infrastructure. The findings of this study are consistent with previous studies of Kaudunde (2013) and Okwaro et al. (2017) who also reported positive relationship between these predictor variables and operational efficiency in public sectors.

4.1. Multiple regression analysis

The degree of linear relationship between the variables under study was tested and analyzed using Multiple Regression technique. This revealed the strength and direction of the relationship between the variables (independent) and the operational efficiency of public-sector organizations.

As indicated in Table 2, the adjusted R square of 0.659 shows that the proportion of the variation in operational efficiency (i.e., 65.9 per cent) is explained by the independent variables (Capacity utilization, Inventory precision, IT infrastructure, administrative purchasing procedures, Workforce competence and proficiency, and Record-keeping and documentation). However, 34.1% of the variance in the dependent variable pertains to some other predictor variables not included in this study.

With the help of regression equation for predicting operational efficiency based on the independent variables of inventory optimization would be:

$$\text{Operational efficiency} = \beta_0 + \beta_1 (\text{Capacity utilization}) + \beta_2 (\text{Inventory precision}) + \beta_3 (\text{IT infrastructure}) + \beta_4 (\text{Administrative purchasing procedures}) + \beta_5 (\text{Workforce competence and proficiency}) + \beta_6 (\text{Record-keeping and documentation}) + \epsilon$$

The model equation would be ($Y = \beta_0 + \beta_1 \times 1 + \beta_2 \times 2 + \beta_3 \times 3 + \beta_4 \times 4 + \beta_5 \times 5 + \beta_6 \times 6 + \epsilon$) becomes $Y = 0.312 + 0.126 \times 1 + 0.312 \times 2 + 0.229 \times 3 + 0.136 \times 4 + 113 \times 5 + 487 \times 6 + \epsilon$.

where:

β_0 is the intercept or constant term

β_1 to β_6 are the coefficients or weights assigned to each independent variable

This regression analysis (Table 3) provides information about the extent of relationship between the Operational efficiency and six independent variables of inventory optimization: Capacity utilization, Inventory precision, IT infrastructure, administrative purchasing procedures, Workforce competence and proficiency, and Record-keeping and documentation, including the estimated coefficients, standardized coefficients, t-values, and p-values. These results can be used to identify which independent variables have the largest effect on the dependent variable with statistical significance.

Table 3. Coefficient of determination

Model	Unstandardized Coefficients		Standardized Coefficients		T	Sig.
	B	Std. Error	Beta			
(Constant)	.312	.490			.637	.525
Capacity utilization	.126	.103	.106		1.244	.041
Inventory precision	.312	.331	.341		4.137	.031
IT infrastructure	.229	.080	.207		3.869	.005
Administrative purchasing procedures	.136	.083	.121		3.650	.021
Workforce competence and proficiency,	.113	.069	.124		4.634	.004
Record-keeping and documentation	.487	.104	.355		4.678	.000

Dependent Variable: operational efficiency

Source: SPSS output

Further, the Beta (β) coefficient values shown in Table 3 indicated that Capacity utilization has a Beta (β) value of .126 with p -value of .041, administrative purchasing procedures has a Beta (β) value of 0.136 with p value = 0.021 and record-keeping and documentation Beta (β) value of 0.487 with p value of 0.000, Workforce competence and proficiency of employees has a β value of .113 with p value of 0.004, Inventory precision has a Beta value of .312 with p -value = .031, and IT infrastructure β = .229 with p - value of 0.005. Therefore, all the independent variables have positive and significant effect on Operational efficiency. These findings were corroborated with the study findings of Godana, (2014) who also reported that inventory optimization system has a significant effect on operational efficiency.

5. Conclusion and discussion

In Ethiopia, the nexus of inventory optimization and operational efficiency is a critical area that requires attention in public sector organizations. This study has provided valuable insights into the challenges faced by these organizations in managing their inventory and improving operational efficiency. The results suggest that adopting data-driven approaches to inventory management can help organizations optimize inventory levels and reduce costs while enhancing overall operational efficiency (Lotfi et al., 2022). However, the study found that long administrative purchasing procedures are common in public sector administration, which can be attributed to intra-departmental communication and planning, decision-making processes, and lengthy procurement procedures.

All the variables in this study exhibited a positive and significant relationship with operational efficiency, as indicated by the correlation results. Additionally, multiple regression analysis revealed that the independent variables, including capacity utilization, inventory precision, IT infrastructure, administrative purchasing procedures, workforce competence and proficiency, and record-keeping and documentation, have a strong and positive association with the operational efficiency of public servant organizations (Okwaro et al., 2017). The adjusted R square of 0.659 indicated that the proportion of variation in operational efficiency explained by the independent variables was significant.

The findings further revealed that increasing the record-keeping and documentation by one unit led to a 0.487 increase in the efficiency of public sector bureaus, while a unit increase in IT infrastructure resulted in a 0.229 increase in the efficiency of public servant governmental organizations. A unit increase in inventory precision led to a 0.126 increase in operational efficiency, while a unit increase in administrative purchasing procedures led to a 0.136 increase in operational efficiency. Similarly, a unit increase in staff skills led to a 0.113 increase in operational efficiency in public servant governmental organizations. The beta value of all the independent variables was positive and significant with a p -value of less than the significance level of 0.05, indicating that the null hypotheses were rejected while alternative hypotheses were supported, demonstrating that the listed explanatory variables determined operational efficiency in selected public sectors of BenishangulGumuz regional state of Ethiopia.

The study also found that employees of bureaus in BGRS were less comfortable with the long administrative purchasing procedures. One solution is to computerize the procurement process to collect real-time procurement data, increasing transparency and ensuring that goods and services are procured for the intended purpose. Furthermore, implementing new technology can reduce an excessive number of rigid rules and policies that hinder the process of material procurement. The study also highlighted record-keeping and documentation as one of the most crucial factors affecting operational efficiency, yet employees of BGRS bureaus were found to be less satisfied in this area. One solution to this problem is full automation of documentation and stock control systems, along with the adoption of a computerized stock record system for posting inventory control data. Additionally, IT infrastructure was found to be a major determining factor influencing the performance of public sector organizations; however, employees of bureaus in BGRS were evaluated poorly in Information and Communication Technology. The study recommends using

advanced Information and Communication Technology to ensure smooth communication between employees and managers related to inventory management in the bureaus.

Finally, the study suggests that workforce competence and proficiency in inventory optimization should be given opportunities for available staff, and the workforce should be upgraded through further education and training. Key management bodies in the bureaus should be trained in inventory optimization-related software (Yevu et al., 2021). Overall, managers of the bureaus should prioritize improving inventory optimization in their organizations to increase operational efficiency.

6. Implications of study

It is essential, Data-driven approaches to inventory management can help public sector organizations in Ethiopia optimize their inventory levels, reduce costs, and improve overall operational efficiency. To address the challenges identified in the study, organizations should streamline procurement processes, introduce advanced Information and Communication Technology, and provide training to key management bodies. By doing so, public sector organizations can improve their service delivery to citizens, enhance resource allocation and cost savings and inform policy-making in the country. The study can also contribute to the body of knowledge on inventory management practices in public sector organizations, specifically in Ethiopia, and can be useful for future research in this area.

7. Limitations and future directions

One potential direction could be to address the limitations of the research topic by exploring ways to mitigate the challenges of limited data availability, access to participants, cultural and language barriers, and lack of resources. For example, researchers could consider alternative methods for data collection and analysis, such as using secondary data sources or partnering with local organizations to gain access to participants. Additionally, future research could explore the potential applicability of the findings to other contexts beyond public sector organizations in Ethiopia to enhance the generalizability of the results. Furthermore, future studies could also investigate the long-term impact of inventory optimization and operational efficiency on organizational performance and sustainability, as well as explore the role of organizational culture, leadership, and change management in implementing such initiatives.

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