

OPTIMIZANDO LA CADENA DE SUMINISTRO: EL PAPEL DE UN SUMINISTRO: EL PAPEL DE UN SISTEMA DE GESTIÓN DE INVENTARIO EFICIENTE

OPTIMIZING THE SUPPLY Y CHAIN: THE ROLE OF AN EFFICIENT INVENTORY MANAGEMENT SYSTEM

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RESUMEN

En la Escuela Superior Politécnica de Chimborazo (ESPOCH) enfrenta deficiencias en el control de inventarios, afectando su capacidad operativa, una adecuada gestión de inventarios, es importante para el correcto funcionamiento de las operaciones, pero actualmente se tiene fallas que afectan negativamente en su rendimiento. El problema de la investigación dentro de la ESPOCH se debe a la falta de procedimientos, el uso de la tecnología deficiente y la poca capacitación del personal, generando graves errores dentro de este ámbito. El objetivo es implementar un sistema de gestión de inventario eficiente que contemple la estandarización de procedimientos, la adopción de tecnología moderna y la capacitación continua del personal, con el fin de optimizar la cadena de suministro de la institución. La metodología adoptó un enfoque mixto, combinando métodos cuantitativos y cualitativos, se realizaron encuestas estructuradas y entrevistas semiestructuradas al personal de la unidad de bienes y bodegas para recopilar datos sobre los procedimientos actuales, el nivel de adopción tecnológica y las necesidades de capacitación. Los resultados, subrayan que la implementación de la metodología propuesta permitió mejorar sustancialmente los niveles de integración interna y externa de la cadena de suministro, así como fortalecer la colaboración estratégica entre los actores involucrados. Esto se reflejó en indicadores clave, como el aumento del porcentaje de entregas a tiempo, la disminución de productos defectuosos y la reducción significativa de los niveles de inventario. En conclusión, la implementación de un sistema de gestión de inventarios eficiente, que incluye la estandarización de procesos, la adopción de tecnología avanzada y la capacitación continua del personal, ha demostrado ser fundamental para optimizar la cadena de suministro de la ESPOCH, mejorando su desempeño operativo y posicionándola de manera más competitiva en un entorno empresarial en constante evolución.

Palabras clave

Inventarios, Instituciones públicas, control, procedimientos

ABSTRACT

The Escuela Superior Politécnica de Chimborazo (ESPOCH) faces deficiencies in inventory control, affecting its operational capacity. Adequate inventory management is important for the proper

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functioning of operations, but currently there are failures that negatively affect its performance. The research problem within ESPOCH is due to the lack of procedures, the use of poor technology and poor staff training, generating serious errors within this area. The objective is to implement an efficient inventory management system that contemplates the standardization of procedures, the adoption of modern technology and the continuous training of staff, in order to optimize the institution's supply chain. The methodology adopted a mixed approach, combining quantitative and qualitative methods. Structured surveys and semi-structured interviews were conducted with the staff of the goods and warehouses unit to collect data on current procedures, the level of technological adoption and training needs. The results highlight that the implementation of the proposed methodology allowed for a substantial improvement in the levels of internal and external integration of the supply chain, as well as strengthening strategic collaboration between the actors involved. This was reflected in key indicators, such as the increase in the percentage of on-time deliveries, the decrease in defective products and the significant reduction in inventory levels. In conclusion, the implementation of an efficient inventory management system, which includes the standardization of processes, the adoption of advanced technology and the continuous training of staff, has proven to be fundamental in optimizing ESPOCH's supply chain, improving its operational performance and positioning it more competitively in a constantly evolving business environment.

Keywords

Inventories, Public institutions, control, procedures

INTRODUCTION

The optimization of the supply chain has emerged as a crucial component in the effective management of any organization, and its relevance becomes even more notable in educational institutions such as the Escuela Superior Politécnica de Chimborazo (ESPOCH). Consequently, adequate inventory management becomes an essential element to ensure the smooth and efficient functioning of operations.

However, various studies indicate that the goods and warehouses unit of the institution faces serious deficiencies in inventory control, which negatively impacts its operational capacity. Multiple problems stand out, encompassing aspects such as the lack of standardized procedures, the use of obsolete technologies, and insufficient training of the personnel responsible for these functions.

The lack of rigorous control in inventory management not only leads to errors and discrepancies in records, but also considerably limits the capacity to perform adequate tracking and to implement automated processes. This scenario aligns with the assertions of Operations Management Theory (1), which underscores the imperative need for well-defined procedures to optimize operational efficacy. Likewise, Information Systems Theory (2) highlights that the use of appropriate technologies is essential to improve both accuracy and efficiency in inventory management, an aspect that is compromised in the current situation at ESPOCH. Additionally, the lack of adequate staff training, as noted by Organizational Learning Theory (3), increases the

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risk of operational errors and limits the capacity to adapt to new technologies and procedures, further aggravating the existing situation.

The consequences of these deficiencies are tangible and manifest in the frequency of errors in inventory records, which generates inefficient use of resources and causes an increase in operational costs, directly affecting the unit's capacity to effectively manage the institution's assets, compromising not only overall performance but also the long-term sustainability of operations. Faced with this reality, it becomes imperative to address inventory management from a contemporary perspective that contemplates both the evolution of organizational theories and the technological advances available today.

Over the years, inventory management has been the subject of study of various theories that seek to optimize the processes involved. Inventory Management Theory (4), with its Economic Order Quantity (EOQ) model, has been a fundamental pillar in this field, proposing a balance between ordering costs and inventory holding costs. This approach remains highly relevant, especially in institutions that manage large volumes of goods, as is the case of ESPOCH. Nevertheless, over time, theories on inventory management have evolved toward more sophisticated and automated approaches.

Subsequently, the automation of logistics processes underscores the importance of implementing advanced technological tools, such as enterprise resource planning (ERP) systems, barcode scanners, and real-time data analysis (6). These technologies not only enable more effective and efficient inventory tracking, but also improve agility and precision in resource management.

In turn, organizational training stands as a fundamental pillar to ensure the correct adoption of new procedures and technologies within the institution. According to (5), adequate training not only enhances the technical skills of personnel but also favors adaptation to new tools and processes. This vision is congruent with Organizational Learning Theory (7), which maintains that organizations must foster an environment of continuous learning to improve their adaptability and performance in a changing environment.

Finally, the hypothesis is advanced that the implementation of an efficient inventory management system—one that contemplates the standardization of procedures, the adoption of modern technology, and continuous staff training—will make it possible to optimize the supply chain at ESPOCH. This study aims not only to identify the causes of the current deficiencies but also to offer a theoretical and practical framework that drives a substantial improvement in inventory management at the institution, thereby laying the foundations for a more efficient and sustainable future in its operations.

MATERIALS AND METHODS

The present research adopts a mixed-methods approach, combining quantitative and qualitative methods. The quantitative approach is used to collect and analyze measurable data on operational efficiency and the effectiveness of inventory-control systems, while the qualitative data seek to obtain a deeper understanding of the attitudes and opinions of staff regarding the current problem in inventory management.

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Type of research

The study is characterized as descriptive and exploratory, achieving a comprehensive and in-depth analysis of the inventory-control problem in the goods and warehouses unit.

Population and sample

The study population consists of the staff of the goods and warehouses unit of ESPOCH, comprising 25 collaborators. Because it is a highly specific population, a census sampling was applied; that is, all members were surveyed and interviewed.

Data analysis

The quantitative data obtained through the surveys were analyzed using descriptive statistics such as percentage frequencies and measures of central tendency, thereby ascertaining staff perceptions of current procedures.

In the case of the analysis of the semi-structured interview data, patterns, themes, and categories that allow insight into the depth of the causes of deficiencies in inventory management were considered.

Procedure

The research was carried out in several sequential stages, each designed to address the problems identified in the inventory management of the goods and warehouses unit of ESPOCH. These stages include:

- Initial diagnosis of the current situation

In this phase, a comprehensive evaluation of the current state of inventory control was performed. This involved reviewing existing processes, the level of technological adoption, and staff training.

- Design and documentation of standardized procedures

Based on the diagnostic findings, standardized procedures for inventory control were designed and documented. These procedures ensure uniformity in the management and handling of goods, minimizing errors and increasing efficiency.

- Selection and implementation of the new technological system

In this stage, an appropriate technological system for inventory control was selected, based on criteria of efficiency, scalability, and compatibility with the unit's needs. System implementation included the integration of tools such as inventory-management software and technological devices, such as barcode scanners, that optimize the precision and speed of operations.

- Staff training

Once the standardized procedures and the technological system were implemented, staff training was carried out. This stage is vital to ensure that the team is prepared to apply the new procedures and efficiently use the technological tools.



RESULTS

The findings obtained throughout the present study are of capital importance and forcefully underscore the need to implement an inventory-management system that is both efficient and robust, with the objective of achieving comprehensive and effective optimization of ESPOCH's supply chain. Through a meticulous and detailed analysis, it was evidenced that, prior to the adoption of the proposed methodology, the entities integrating the supply chain presented alarmingly low levels of integration: internal integration barely reached 40%, while external integration was limited to a scarce 21%, and strategic collaboration stood at a concerning minimum of 12% (8).

Table 1. Comparison of key indicators before and after implementation

Indicator	Before implementation	After implementation
Internal integration	40%	75%
External integration	21%	65%
Strategic collaboration	12%	55%
Percentage of on-time deliveries	60%	85%
Defective products	8%	3%
Storage cost reduction	—	15%
Inventory error reduction	—	40%

Table 1 shows the positive impacts after implementing the inventory-management system. The levels of internal and external integration had low values, represented between 40% and 21%; after the application they increased significantly. In the remaining aspects an improvement can also be evidenced; moreover, key indicators such as on-time delivery, the reduction of defective products, and cost reduction reflect a broad improvement.

These deficiencies are attributed, to a large extent, to the absence of clearly defined processes and to ineffective management of information flows, which results in a lack of clarity and effectiveness in communication among the various parties involved. In addition, an organizational culture that does not favor information exchange or the alignment of strategic objectives is added, which significantly limits the capacity of organizations to work jointly and collaboratively.

Therefore, the comprehensive inventory-management methodology presented below outlines a detailed plan to transform an organization's inventory management. By following this schedule, greater precision in records, greater staff satisfaction, and an overall improvement in operational efficiency are expected.

Table 2. Implementation schedule

Activity	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8
Initial diagnosis of the current situation	X							
Design of standardized procedures		X	X					

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Selection and implementation of the technological system			X	X	X			
Staff training				X	X			
Evaluation and monitoring of implementation						X	X	X

Likewise, through bibliographic studies, five fundamental steps are presented: definition of policies, collaborative planning, process integration, performance measurement, and elaboration of action plans. These have made it possible to identify areas for improvement and to establish innovative, effective, and sustainable strategies that strengthen the connections among the different links of the supply chain (9).

The results derived from their application have been conclusive and transformative, highlighting several key aspects that deserve mention. First, a notable improvement has been achieved in the levels of internal integration within each of the organizations that make up the institution. This has been accomplished through the clear definition and documentation of key processes, which has not only facilitated the flow of information and resources but has also optimized decision-making, generating synergies that have significantly increased efficiency, productivity, and organizational resilience (9).

Second, a notable strengthening of external integration has been observed thanks to the implementation of agreements and strategic collaboration policies with suppliers, manufacturers, and distributors. This action has enabled better visibility and coordination throughout the entire supply chain, thereby creating a shared-value network that is flexible, adaptable, and highly resilient to the challenges of the contemporary market (9).

Likewise, more effective strategic collaboration among the actors of the chain has been promoted through the implementation of joint demand-planning strategies, synchronized replenishment, and a more transparent and reliable exchange of information. These measures have had a significant impact on mitigating the bullwhip effect, considerably improving response capacity, flexibility, and operational agility, as well as final customer satisfaction (9).

The changes implemented are clearly reflected in key performance indicators. For example, a sustained increase in the percentage of on-time deliveries has been recorded, a notable decrease in the levels of defective products, and a significant reduction in maintained inventory levels. These results not only evidence the efficacy of the applied methodology but also demonstrate that integration and strategic collaboration are essential elements for optimizing the performance and sustainability of the supply chain.

A standout result of this research is the notable and substantial reduction in inventory levels, which has made it possible to precisely adjust inventory management to the concrete needs of ESPOCH. This adjustment has avoided both harmful excess and material shortages, resulting in a significant 15% savings in storage and custody costs. In addition, the improvement in the precision and reliability of the information provided by this system has led to a 20% reduction in delivery times of products and services to end users and clients, which is a clear indicator of operational efficiency (10). The 5% refers to the reduction of defective products, and the 60% refers to the increase in integration and collaboration, representing the greatest impact on the

importance of more fluid communication and collaborative processes within the supply chain, as shown in Figure 1.

Distribution of the impact of operational improvements

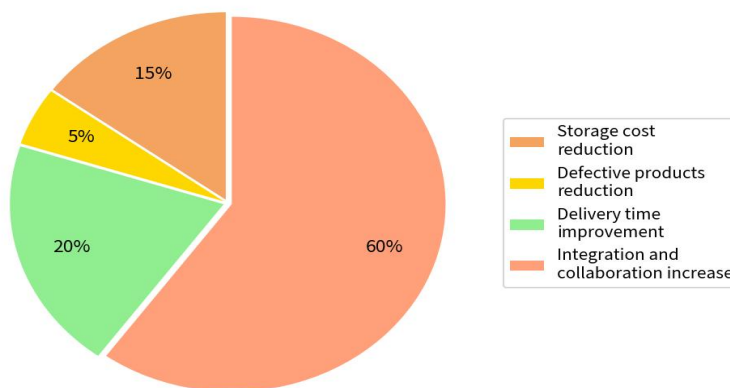


Figure 1. Distribution of the impact of operational improvements

Consequently, the research conducted has not only revealed the need for a transformation in inventory management but has also provided a clear and structured framework for carrying out such a transformation. The evidence collected and analyzed supports the idea that, by adopting a comprehensive approach, organizations can not only improve their operational performance but also establish stronger and more collaborative relationships with all actors involved in the supply chain. These advances not only translate into tangible economic benefits but also foster a more open and collaborative organizational culture, which, in turn, can facilitate innovation and adaptability in a constantly changing business environment.

DISCUSSION

The results obtained in the present research forcefully support the importance of implementing an inventory-management system. This finding aligns with the assertions of various authors who have studied the topic over the years.

For example, (11) and (12) note that effective inventory management is a determining factor in the competitiveness of organizations, since it makes it possible to reduce costs, improve product availability, and respond agilely to demand fluctuations. Similarly, (13) and (14) maintain that a well-designed and implemented inventory-control system contributes to increasing operational efficiency, which translates into tangible benefits such as a decrease in waste, better purchasing planning, and greater satisfaction of end users.

In the same vein, the results obtained in the present study corroborate the approaches of (15), who emphasizes the need to have standardized and well-defined procedures to optimize organizational processes. As evidenced, the lack of standardization in inventory-control procedures at ESPOCH generated inconsistencies in records and limited the capacity to perform adequate tracking, which negatively impacted overall efficiency.

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Likewise, the findings of this research support the premises of Information Systems Theory (16), highlighting that the incorporation of appropriate technologies is fundamental to improving precision and efficiency in inventory management. In the case of ESPOCH, the implementation of an integrated technological system, which included tools such as inventory-management software and scanning devices, made it possible to optimize registration, control, and tracking processes, which translated into a significant reduction of errors and greater reliability of information.

On the other hand, the results of this study also highlight the importance of implementing standardized procedures, modernizing the technology used in inventory management, and improving staff training in the goods and warehouses unit of ESPOCH. These interventions have proven key to increasing operational efficiency and reducing errors in inventory records.

Process standardization contributes significantly to error reduction and improves coherence in inventory management, as highlighted by (17). The implementation of uniform procedures at ESPOCH has allowed staff to adopt better practices in the handling of goods, which has reduced the execution time of tasks related to inventory control.

On the other hand, the adoption of advanced technological tools, such as ERP systems and barcode scanners, has improved precision in inventory tracking, reducing dependence on manual procedures that previously contributed to human errors. These findings are aligned with (18), who affirms that the adequate use of advanced technologies improves operational efficiency. In this case, ESPOCH has achieved a significant reduction in inventory errors, estimated at 40%, thanks to the implementation of these technologies.

Likewise, continuous staff training has proven to be a determining factor in the correct adoption of new technologies and procedures, as suggested by (19) and (20). With the training received, personnel have not only improved their technical competencies but have also shown greater disposition to adapt to technological changes. This has allowed a smoother transition toward the new systems and an improvement in operational efficiency.

It is important to note that the present study focused solely on the goods and warehouses unit of ESPOCH; therefore, its results cannot be generalized to other institutions without making contextual adjustments. Moreover, although significant advances were achieved in error reduction and efficiency improvement, the duration of the study was not sufficient to evaluate the long-term effects of the new technologies and procedures implemented. Future research could explore the sustainability of these improvements over time and analyze their impact on other operational areas of the institution (21).

The findings of this study can be applied in other institutions with similar problems in inventory management. It is recommended that institutions periodically evaluate their inventory-control processes, adopt updated technologies, and offer continuous training to their staff to guarantee constant improvement in operational efficiency. In addition, it is suggested that periodic inventory audits be carried out to identify areas for improvement and ensure the correct implementation of standardized procedures.



It is worth noting that, although the present study focused on optimizing the supply chain of a specific educational institution, its findings and recommendations can be extrapolated to a wide range of organizations that face similar challenges in the management of their inventories. As evidenced by (22), the implementation of efficient inventory-control systems is an indispensable requirement to achieve a resilient supply chain adaptable to environmental changes.

CONCLUSIONS

The implementation of an efficient and robust inventory-management system at the Escuela Superior Politécnica de Chimborazo (ESPOCH) has proven fundamental for optimizing its supply chain. Through process standardization, the adoption of advanced technology, and continuous staff training, a substantial improvement was achieved in the levels of internal and external integration, as well as greater strategic collaboration among the different actors involved.

The changes implemented were reflected in key performance indicators, such as an increase in the percentage of on-time deliveries, a decrease in the levels of defective products, and a significant reduction in maintained inventory levels. These results evidence the efficacy of the applied methodology and demonstrate that integration and strategic collaboration are essential elements for optimizing the performance and sustainability of the supply chain.

This research has provided a clear and structured framework for carrying out an integral transformation in the inventory management of ESPOCH. The findings obtained support the idea that, by adopting a holistic approach, organizations can improve their operational performance, establish stronger and more collaborative relationships with the actors of the supply chain, and position themselves more competitively in a constantly evolving business environment.

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