

Supply Chain Integration through logistics digital transformation: A case study in a shipyard

DOI: 10.25043/19098642.291

Lien Tejada ¹
José Carrasco ²

Abstract

Shipyard industry in Cartagena is a very important hub for social and economic development. It is included in the region's strategic long-term plan (2008) as a high-priority productive sector, "as a result of the city's port development". Extreme competition, not only in terms of price but also in quality, flexibility, high-end technology, and velocity, has caused shipyard businesses to implement technologies integrally to be both effective and efficient. Digital transformation is the structured implementation of several technologies and methodologies that imply hyper-connection to automate and streamline manufacturing, operations and service processes. This study aims to find how digital transformation in logistics processes can leverage supply chain integration in a shipyard company.

An analysis will be made about how Artificial Intelligence (AI), Data Science, and the Internet of Things (IoT) can transform key processes such as inventory management, purchasing, foreign trade, and administration of relationships with suppliers and customers, thus generating greater efficiency, cost reduction, and quality improvements.

The proposed research focuses on implementing emerging technologies to optimize the entire supply chain in a typical Cartagena shipyard. The study will examine how Artificial Intelligence (AI), Data Science, and the Internet of Things (IoT) can transform key processes such as inventory management, procurement, importation, and supplier relationship management, resulting in increased efficiency, cost reduction, and improved quality.

Key words: Digital transformation, Logistics, Supply Chain, Shipyard.

How to cite this article

To cite this article, use the following format:

IEEE Format

[1] L. Tejada and J. Carrasco "Supply Chain Integration through logistics digital transformation: A case study in a shipyard in Cartagena, Colombia" *Ship Science and Technology* (Cartagena), vol. 19, no. 38, pp. 59-71, 2026. DOI: 10.25043/19098642.291

Date Received: October 18th, 2024

Date Accepted: November 16th, 2024

Publication Date: April 5th, 2026

Universidad Tecnológica de Bolívar. Cartagena, Colombia. ROR: <https://ror.org/01d171k92>

¹ Email: ltejeda@utb.edu.co

ORCID: <https://orcid.org/0009-0000-2686-8551>

Armada Nacional, Escuela Naval de Cadetes Almirante Padilla, Cartagena, Colombia. ROR: <https://ror.org/00dexc42>

² Email: joseabel1987@gmail.com

ORCID: <https://orcid.org/0009-0003-7681-705X>

Introduction

The shipbuilding industry in Cartagena, driven by port development, has positioned itself as a strategic sector. However, increasing competition requires a digital transformation to optimize processes and enhance competitiveness. This study aims to evaluate the impact of digital transformation on a shipyard's logistical processes, with an emphasis on supply chain integration.

Regarding the methodology, Frazelle's logistics master planning model will be adapted, developing a three-phase approach to guide the research. The justification for this study lies in the need to contribute to knowledge on digital transformation in the shipbuilding industry and to provide concrete recommendations for the implementation of technologies in the logistical processes of companies in Cartagena's shipbuilding sector, thereby contributing to improvements in efficiency and competitiveness.

Phase 1: Investigate. In this phase, a comprehensive review of the literature on digital transformation in the context of supply chain management was conducted, with particular emphasis on the shipbuilding industry. This review explored the potential benefits of emerging technologies, such as artificial intelligence (AI), data science, and the Internet of Things (IoT), for optimizing logistics processes. In addition, a detailed analysis of the current state of logistics operations at the shipyard selected was added, as the case study was carried out, including an assessment of existing systems, procedures, and challenges. This analysis aimed to identify areas where digital transformation could be implemented to improve efficiency, reduce costs, and enhance overall supply chain performance.

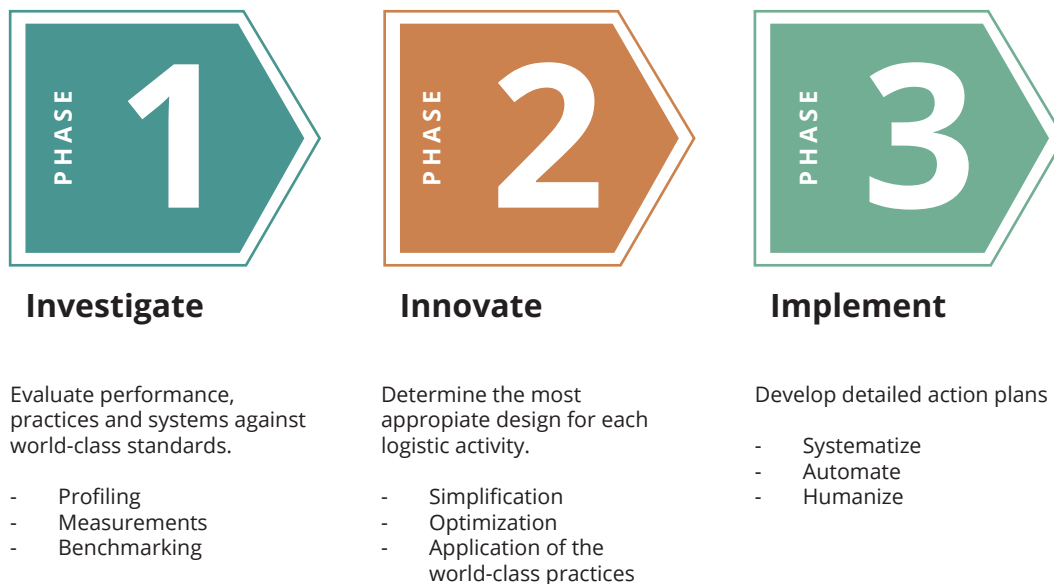
Furthermore, a comparative study of other shipyards and manufacturing industries was conducted to identify best practices and innovative approaches to logistics management.

Methodology

As illustrated in Fig. 1, the methodology consists of the following phases:

Phase 2: Innovate. A detailed review of each procedure within the logistics management process was conducted. This involved comparing actual practices with documented procedures and assessing the technological

Fig. 1. Frazelle's logistics master planning model.



capabilities of each subprocess. Subsequently, a comprehensive characterization was developed through a description of the initial ideas for a digital transformation plan.

Phase 3: Implement. Based on the detailed characterization, procedures susceptible to digital improvement and the potential implementation of Industry 4.0 technologies were explored. Potential technologies were identified, and initial design sketches were created. In addition, meetings were held with COTECMAR's Industry 4.0 technology experts, which enabled the development of an improvement plan for the materials management subprocess.

Research development

In order to address the objective of this research, Frazelle's methodology has been adapted to the specific context of the shipbuilding industry. This section details the research process, which is based on three main phases.

Phase 1. Investigate

In this phase, key aspects of the shipbuilding industry's supply chain context are explored, and, in particular, the performance, practices, and systems related to the digital transformation of logistics management at COTECMAR are evaluated.

Shipbuilding industry context

The shipbuilding industry is primarily dedicated to the construction, maintenance, and/or repair of maritime or inland waterway vessels. At the global level, this industry exhibits unique characteristics associated with project types, production capacities, logistical requirements, and construction or repair timelines, among others. According to Colombia Productiva, one of these characteristics is the diversity of industries that converge in shipbuilding activities: "It is important to highlight that the value chain

of the shipbuilding sector includes not only ship construction and repair activities (ISIC 3511), construction and repair of recreational and sporting vessels (ISIC 3512), but also the manufacturing of parts and components mainly from the metal-mechanical, plastics, and electrical sectors, among others, which are used in the production of ships and naval artifacts" (Colombia Productiva, 2020).

However, the global shipbuilding industry was also one of the sectors most affected by the COVID-19 pandemic. Between 2014 and 2022, the number of shipyards worldwide was reduced by half, reaching approximately 283 by the end of 2022 (Placek, 2023). The distribution of shipyards is uneven across countries due to factors such as technological development and labor costs. Shipbuilding activities are largely concentrated in Asia and Europe. These two continents have strategically distributed and specialized in specific types of vessels. For example, Asia focuses on the construction of large cargo ships, while Europe specializes in the construction of vessels of high technological complexity and, consequently, compounded construction processes, albeit in proportionally smaller numbers (Rosero, 2024).

Regarding the economic impact of this industry, some sources estimate its value at more than USD 140 billion, with projected growth rates of around 3%: "The global shipbuilding market was valued at USD 143.34 billion in 2022 and is expected to grow from USD 147.93 billion in 2023 to USD 190.32 billion by 2031, with a compound annual growth rate (CAGR) of 3.20% during the forecast period (2024–2031)" (Skyquest, 2024).

As previously mentioned, most shipyards are concentrated in Asia and Europe; developing countries, however, are also gaining ground in this sector. Countries such as Chile, Peru, and Colombia have achieved significant milestones in recent years. In the case of Peru, the construction of the BAP Unión stands out: "With an overall length of 115 meters and a beam of 14 meters, built in steel with

wooden finishes, four masts with four sails, constructed in Peru by the naval shipyard Servicios Industriales de la Marina S.A. (SIMA), the BAP Unión is the second largest sailing ship in the world, surpassed only by the Sedov of the Russian Navy" (*Government of Peru*, 2023). Chile and Colombia have similar capabilities, although they have primarily focused on meeting the needs of their respective armed forces.

In the case of Colombia, according to the Colombian Agency for International Cooperation, there are 38 shipyards. However, as clarified by the National Business Association of Colombia, only five of these shipyards meet international standards (National Business Association of Colombia, 2019). This situation poses a challenge for small shipyards in terms of formalization and compliance with requirements, as well as for government entities in promoting formalization and supporting the achievement of international industry standards and those of its supply network.

The Colombian shipbuilding industry reached exports of USD 2.4 million in the first half of 2024 (*Colombia Productiva*, 2024). Most shipyards are concentrated across the Colombian Caribbean coast, with COTECMAR and Astivik standing out as the ones with the greatest technological and productive capacity. In the case of COTECMAR, its operating revenues in 2023 exceeded COP 260 billion (*COTECMAR*, 2024). Even more relevant for this article, total purchasing amounts, according to COTECMAR's presentation at the strategic partners' meeting, exceeded COP 140 billion (*COTECMAR*, 2024).

This article presents a case study based on COTECMAR, illustrating how digital transformation integrates the different supply chain stakeholders to improve the overall logistics performance of the Corporation.

Supply chain

As previously mentioned, the supply network

of the shipbuilding industry involves a wide variety of elements that converge in the construction and repair of vessels. According to Colombia Productiva, more than 15 sectors are related to shipbuilding activities, as shown in Fig. 2, which presents a map of the different stakeholders in the shipbuilding sector prepared by Colombia Productiva (2020).

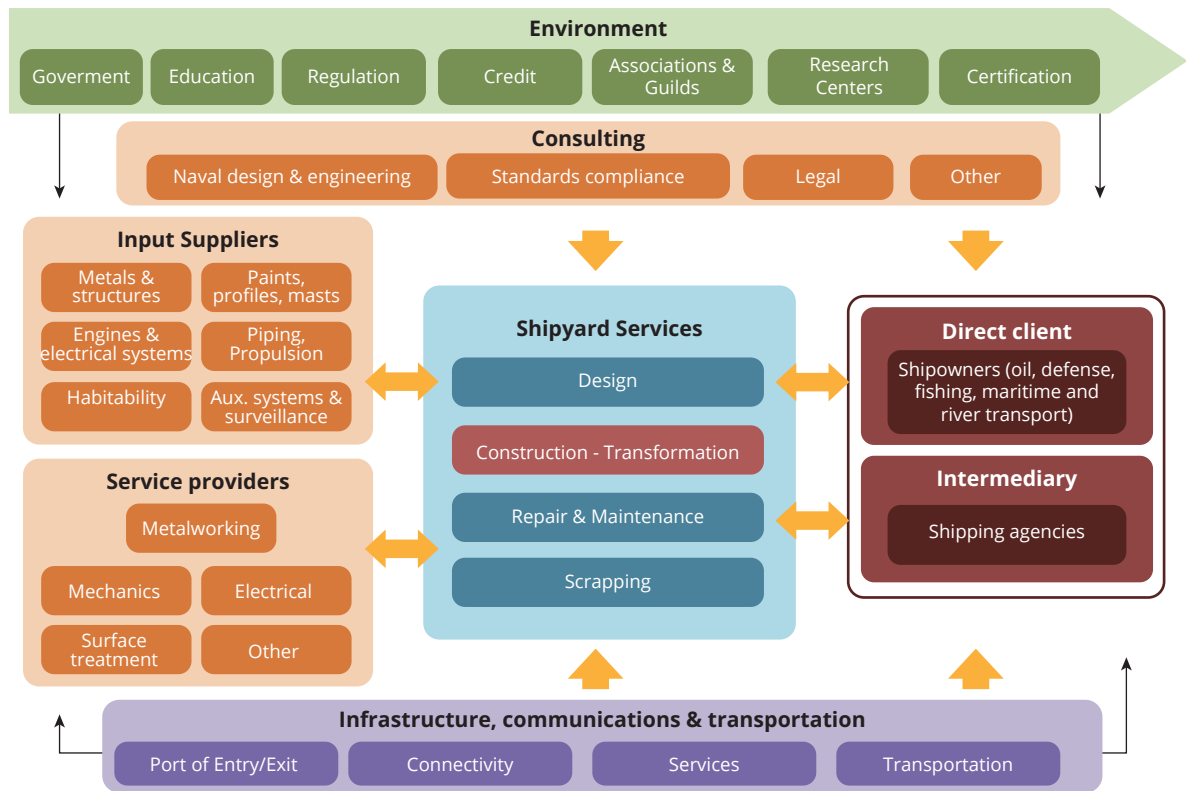
Considering that suppliers of goods may also be supplying elements to service providers, rather than a linear supply chain, an interconnected network of suppliers of goods and/or services is formed. Likewise, it is necessary to establish methods to classify and organize both suppliers and the goods and services acquired by the organization.

Within this organization, one of the first components of technological infrastructure that becomes particularly relevant is the Enterprise Resource Planning (ERP) system. "ERP systems are multidimensional software solutions composed of modules or applications, each of which serves a different business function" (*Zainab & Villány*, 2024). These solutions make it possible to integrate different functions within companies and complement one another, such as project creation, supplier categorization, classification and standardization of acquired goods, as well as procurement, storage, and distribution processes.

The first approach to characterizing the supply chain at COTECMAR is found in the Logistics Manual. In this document, the Corporation has established, among other aspects, a set of matrices aimed at segmenting providers, and the goods or services to be supplied, considering two main variables: supply risk and impact on profits.

This analysis enables the establishment of a starting point for the application of purchasing strategies according to the quadrant in which the items are located. An example of these strategies is the adoption of Vendor Managed Inventory (VMI) models for items classified within the routine quadrant.

Fig. 2. Map of shipbuilding sector stakeholders.



Source: Colombia Productiva (2020).

Logistics process

In the case of COTECMAR, two important aspects stand out for understanding the organization's capabilities. First, the Corporation holds an ISO 9001 quality certification; and second, it operates an ERP system provided by SAP. Certification of the Quality Management System demonstrates that the organization has established processes, procedures, manuals, and other guidelines across all areas. Likewise, the implementation of the ERP system for the modules corresponding to the entire logistics process improves purchase traceability, as well as the availability of information to build databases and conduct subsequent analyses (see Fig. 3).

The COTECMAR process map (Fig. 4) outlines three main categories of processes: strategic, core, and support processes. Logistics

management, a critical support process, is responsible for handling the flow of resources (materials and services). This process is further divided into two subprocesses: Procurement management and Materials management.

Currently, the main document framing the logistics process is the Logistics Manual (COTECMAR, 2016). This document sets out various guidelines associated with logistics management: "Its purpose is to define and adopt the general guidelines applicable to the logistics operations carried out by COTECMAR, to ensure effective logistics management aligned with productivity improvement." Among the most relevant aspects of the Logistics Manual, the Corporate Purchasing Management Matrix for materials stands out, which is presented in Fig. 5.

Fig. 3. SAP modules in the logistics management process.

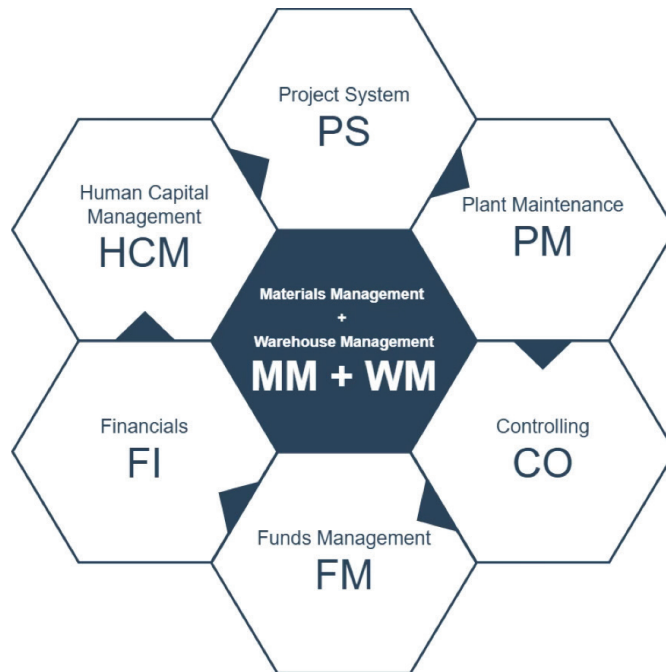


Fig. 4. COTECMAR process map

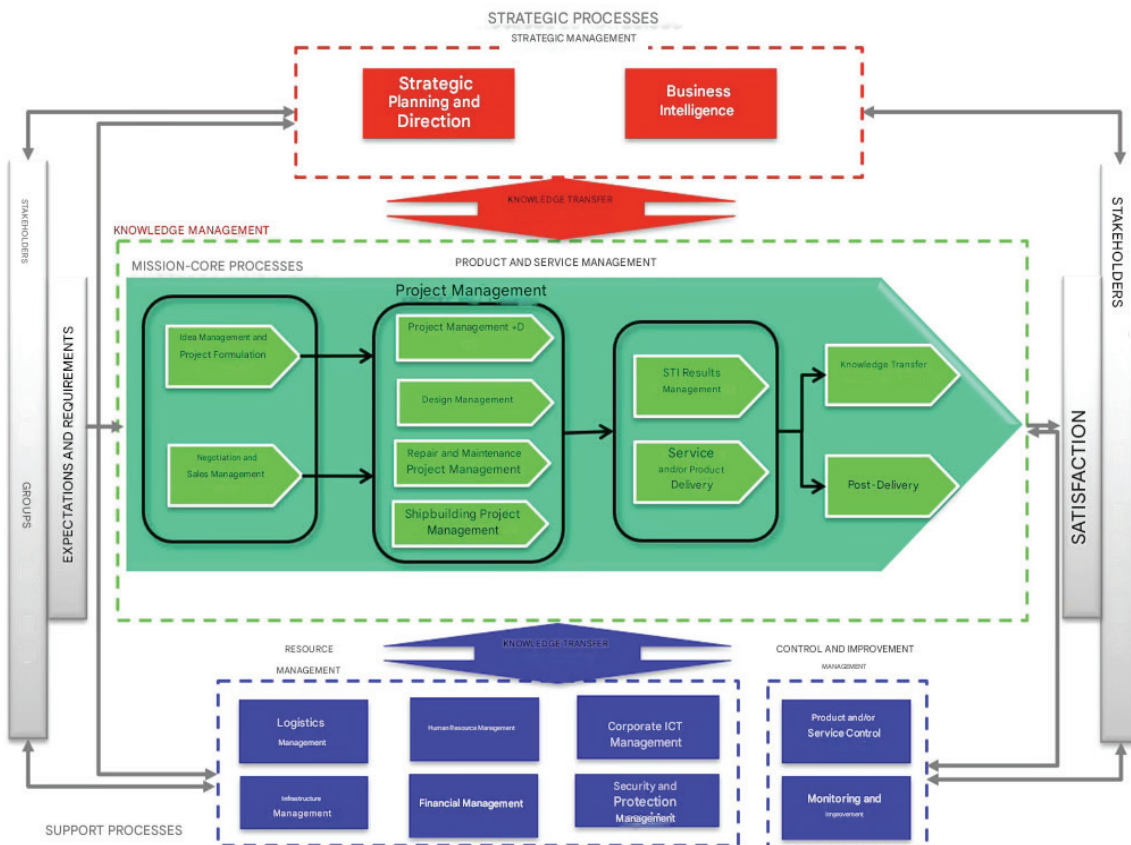
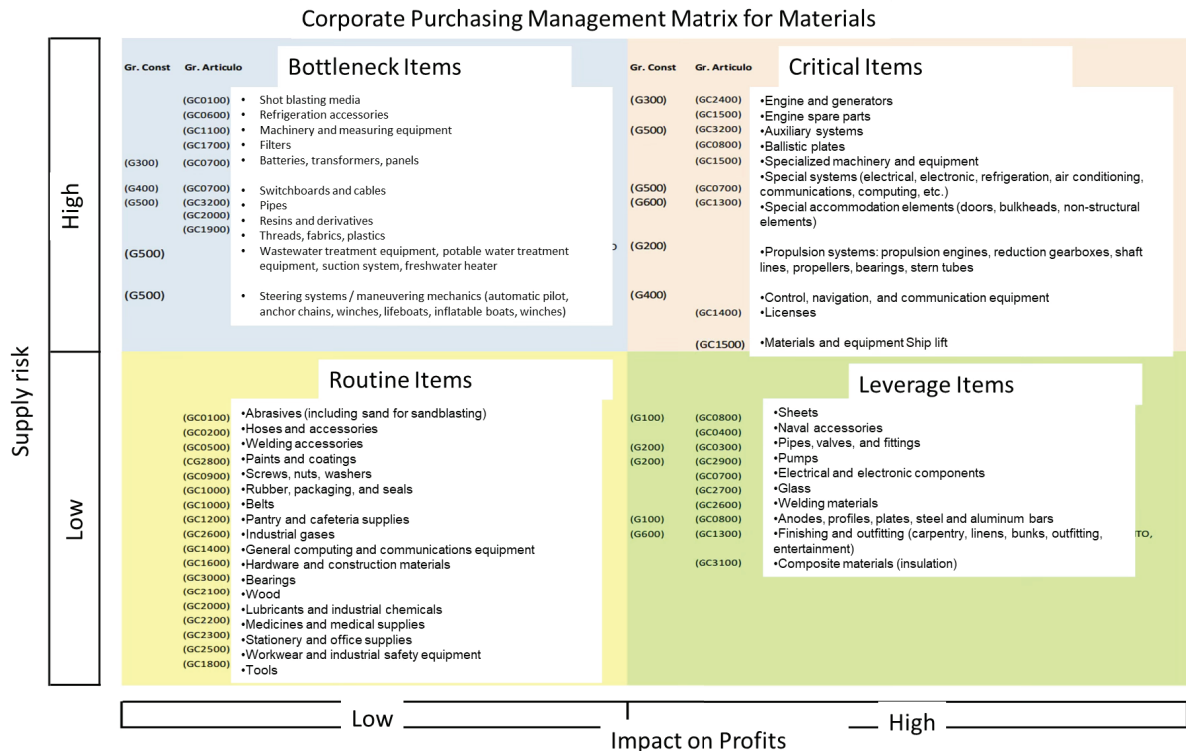


Fig. 5. Corporate purchasing management matrix for materials.



Logistics process

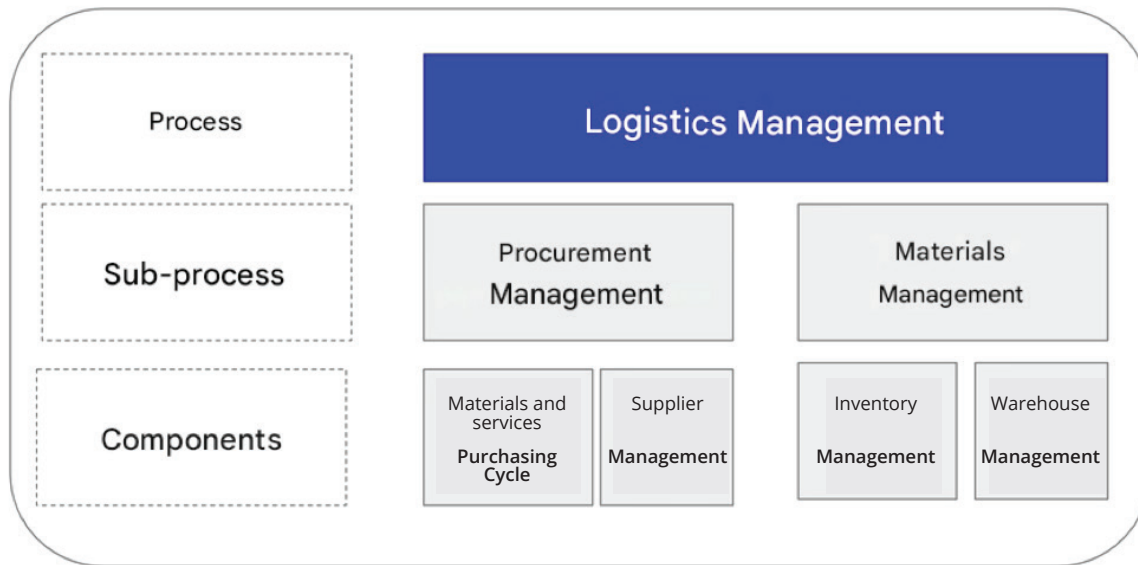
In the case of COTECMAR, two important aspects stand out for understanding the organization's capabilities. First, the Corporation holds an ISO 9001 quality certification; and second, it operates an ERP system provided by SAP. Certification of the Quality Management System demonstrates that the organization has established processes, procedures, manuals, and other guidelines across all areas. Likewise, the implementation of the ERP system for the modules corresponding to the entire logistics process improves purchase traceability, as well as the availability of information to build databases and conduct subsequent analyses (see Fig. 3).

The COTECMAR process map (Fig. 4) outlines three main categories of processes: strategic, core, and support processes. Logistics management, a critical support process, is responsible for handling the flow of resources (materials and services). This process is

further divided into two subprocesses: Procurement management and Materials management.

Currently, the main document framing the logistics process is the Logistics Manual (COTECMAR, 2016). This document sets out various guidelines associated with logistics management: "Its purpose is to define and adopt the general guidelines applicable to the logistics operations carried out by COTECMAR, to ensure effective logistics management aligned with productivity improvement." Among the most relevant aspects of the Logistics Manual, the Corporate Purchasing Management Matrix for materials stands out, which is presented in Fig. 5.

This matrix is fundamental, as it enables the grouping of the various goods required by Cotecmar into four main categories, which constitutes a starting point for establishing specific purchasing strategies for each quadrant.

Fig. 6. Logistics management process: subprocesses and components.

Likewise, the Logistics Management process is established in accordance with the Quality Management System, and its objective is defined as: "To ensure the satisfaction of the Corporation's stakeholders through compliance with the Logistics Model to achieve corporate objectives" (COTECMAR, 2023). Its scope "Begins with the planning of the supply of goods and services. It includes planning activities, supplier selection and development, acquisition and/or procurement, verification, storage, and distribution" (COTECMAR, 2023).

This Logistics Management process is carried out through two subprocesses: Supply Management and Materials Management. These subprocesses are overseen by the Administrative Department, which ensures the availability of the necessary resources. The department is made up of four divisions: Purchasing, Foreign Trade, Logistics Management, and Warehouse and Distribution.

Supply Management refers to the process of purchasing goods and/or services and is based on the following scope: "It begins with the management (creation and updating) of supplier master data, includes the purchase and/or service request from the internal

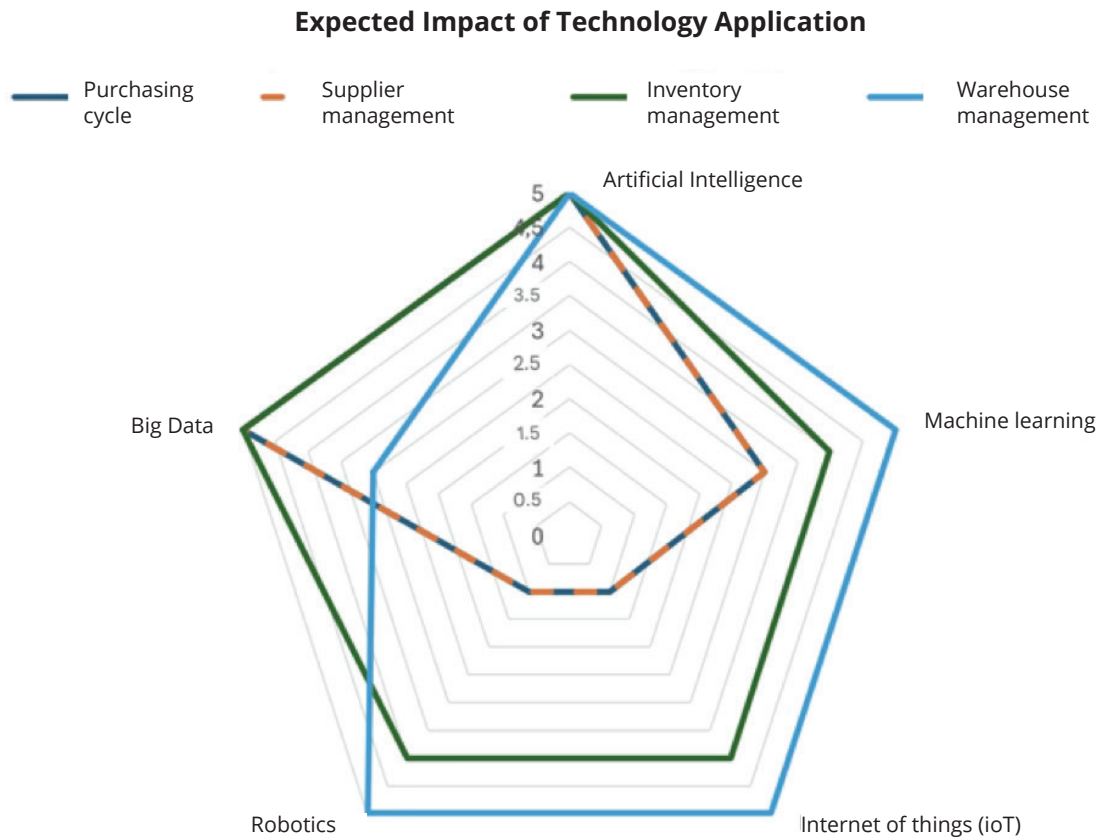
customer, and ends with warehouse entry and acceptance of service delivery by the interested parties" (COTECMAR, 2023). Materials Management, in turn, refers to storage and distribution activities and comprises the following scope: "It begins with the planning of material requirements and ends with their delivery to internal customers."

Additionally, the process includes a strategic indicator that is calculated based on three tactical indicators: sustainability in purchasing, logistics lead times and purchasing timeliness. The average of these three indicators is calculated to obtain the purchasing efficiency indicator. This indicator is not calculated automatically; instead, it requires the allocation of working time from the Logistics Management area, not only for analysis but also for its processing.

Phase 2. Innovation

Digital transformation involves not only the adoption of new technologies but also the reengineering of processes. In this section, various alternatives for redesigning logistics activities are explored with the aim of achieving greater efficiency, flexibility,

Fig. 7. Impact of technology application (Source: Authors' own elaboration).



and adaptability to market demands. The principles of simplification, optimization, and the application of world-class practices guide this process.

Technology and digital transformation

The implementation of technologies at COTECMAR has been fundamental to the development of its processes. According to Carrasco (2019), information technologies should constitute one of the foundations for the implementation of a Lean purchasing strategy. This same use of technology has been applied transversally across the Corporation in different areas. In engineering design, 3D deck simulators are used; in shipbuilding processes, developments in aluminum welding have been implemented; in human talent management processes, SAP modules have been deployed; and in purchasing areas, consumable dispensers

integrated with SAP have been implemented in operational areas.

However, digital transformation must be further strengthened through the adoption of new tools available in the current environment. Industry 4.0 technologies have the potential to change the dynamics of the Logistics Management process and its respective subprocesses, as detailed below.

Through a consensus of experts in technology and logistics, it was identified that technologies such as artificial intelligence (AI), machine learning (ML), big data, robotics, and the Internet of Things (IoT) offer high potential for integration with the existing SAP ERP system. Figure 7 illustrates the expected impact of each technology on the different components of the logistics management process, obtaining equal scores for both the

purchasing cycle and supplier management. It is important to highlight the fact that the integrated implementation of these solutions promises a significant improvement in the overall efficiency of logistics management.

Considering that the logistics management process receives both external inputs (suppliers) and internal inputs (internal customers), it becomes necessary to strengthen existing connections through technological integration, such as: the reception and tracking of purchase requisitions and material reservations; the reception, processing, and updating of quotations and price lists issued by suppliers through a direct connection portal, eliminating the need to manually transcribe data into spreadsheets from quotations that may arrive in different file formats; the monitoring of key milestones and deadlines in purchase orders and contracts; and the proactive analysis of demand in order to keep warehouses and supplier containers operating under the VMI modality up to date.

This integration between suppliers and internal customers within the logistics process has important references in the shipbuilding industry, highlighting, in particular, the application of technologies such as IoT in production areas integrated with the ERP system: "The IoT platform must necessarily be connected to the ERP system, as this is where all information related to the products to be manufactured is stored. Since access to and data extraction from the ERP may vary depending on the information required, obtaining the desired data becomes labor-intensive and time-consuming. Therefore, the

first defined functionality is the consultation of MBOM information in the ERP system and the availability of materials in the warehouse" (Munín Doce, Míguez González, Díaz Casás, & Ferreño González, 2021).

Phase 3. Implementation

In order to generate tangible value from the designed solutions, their implementation must be carried out. This phase will focus on the execution of specific action plans, which will enable the systematization, automation, and humanization of logistics operations.

To optimize implementation timelines and ensure solution quality, the principles of agile methodologies will be combined with SAP Activate best practices. This synergy will allow for incremental deliveries, risk reduction, and improved end-user satisfaction.

The SAP Activate methodology is a project implementation approach used to plan and execute complex SAP solutions. Prior to the implementation plan, data cleansing and data quality assurance must be considered. Most of the identified technologies involve a high level of data-driven information usage; although the SAP ERP consolidates information and facilitates data management, it relies on human resources for data entry, which may affect new implementations. This situation has been identified as an area for improvement in other studies that underscore the lack of clear information in procurement processes (Carrasco, 2019).

In accordance with the above, a training and knowledge transfer phase should be

Fig. 8. SAP Activate Methodology for SAP Project Implementation.



Table 1. Identified modifications.

Type of development	Description	Technology
Reports	Process performance metrics reports	Big data
Reports	KPI dashboards	Big data
Interface	Connection with Aveva design software	Artificial intelligence
Interface	Web connection with suppliers	Artificial intelligence
Conversion	Electronic data interchange with suppliers	Artificial intelligence
Enhancements	Telemetry for inventory level detection (gases and bulk products)	Internet of Things
Forms	Digital signature of workers receiving materials	Big data
Enhancements	Automatic delivery of items using smart shelving systems	Robotics
Workflows	Automatic stock replenishment	Machine learning

included for the personnel participating in the project. During the execution of any project that directly involves improvements to the functionalities of the SAP ERP, all SAP functional and technical consultants, along with the client's project team, will work on SAP RICEFW objects, which refer to Reports, Interfaces, Conversions, Enhancements, Forms, and Workflows.

Table 1 presents the main modifications identified to integrate the logistics chain of a shipbuilding company into its digital transformation process, grouping the feasible developments according to the main applicable technologies.

The first group of developments focuses on the use of Big Data as a key tool for decision-making by providing refined and organized information. Information related to process metrics and their practical projection facilitates the establishment of baselines and the assessment of the impacts of integrating digital transformation into the logistics chain. The work "A conceptual framework for developing dashboards for large mobility data" (Conrow *et al.*, 2023) provides relevant references for the presentation of information

derived from large databases and includes examples of dashboards.

The second group of developments focuses on the integration of artificial intelligence with digital platforms starting from the vessel design phase, facilitating the identification and use of components in construction processes, reducing both direct and indirect procurement costs, as well as enabling integration with suppliers and contractors to streamline and automate purchasing and inventory processes. The application of artificial intelligence also extends to supplier selection and bid evaluation processes, which have the potential to maximize the contribution of the procurement area to strategic activities while automating tasks of a lesser complexity. "A medium-sized company that implemented an AI-driven data analytics system managed to reduce its supplier selection time by 70%. According to a McKinsey study, companies that use AI tools in supply chain management reported a 15% improvement in operational efficiency, which directly translates into significant cost savings. These systems analyze millions of data points in real time and use advanced algorithms to evaluate criteria such as cost, reputation, and product quality,

thereby maximizing the potential to identify the ideal supplier" (*Psicosmart*, 2024).

The two groups described above can be implemented in the medium term; in contrast, the development of the third group, which is associated with physical infrastructure, requires greater investment and is, therefore, proposed for long-term implementation. Robotic and telemetry solutions involve high costs and, hence, their implementation must be subject to careful cost-benefit analyses. The article "The role of robotization in work design: a comparative case study of logistics warehouses" presents examples of robotization in warehouses: "Several managers mentioned how the substantial investment in robots made it difficult to achieve a return on investment within their relatively short contracts" (*Berkers, Rispens, & Le Blanc*, 2022).

Conclusions

The implementation of Industry 4.0 technologies in technologically advanced and digitally pioneering organizations must be transversal across all processes in order to ensure a comprehensive digital transformation. Lessons learned from production processes should facilitate implementation within logistics processes. In addition, an analysis must be conducted to ensure that the organization achieves a return on investment for each implementation, particularly for those requiring high levels of investment in robotics and automation.

Digital Transformation follows a sequence of activities that involve different areas within the organization. In addition to the references presented in this study, other methodologies are applicable to different types of groups or organizations depending on their capabilities and implementation objectives. However, most methodologies seek integration with the existing capabilities of the shipbuilding industry.

As new capabilities and processes emerge, threats against organizations also arise or evolve. Therefore, the concept of cybersecurity must be strengthened in parallel with technological capabilities. Encryption technologies and blockchain help protect organizations within an environment that is highly dependent on digitalization and system connectivity.

Contributions

- Lien Neil Tejeda Lopez: Conceptualization, methodology, data analysis, manuscript writing, final editing.
- José Carrasco: Manuscript writing, data validation, layout/design.

Funding source

This research received no external funding.

References

- [1] Agencia Presidencial de Cooperación Internacional de Colombia . (2021, Octubre). Retrieved from <https://www.apccolombia.gov.co/index.php/comunicaciones/noticias/industria-colombiana-de-astilleros-recibira-us5-millones-para-acelerar>
- [2] Asociación Nacional de Empresarios de Colombia. (2019, Abril). Retrieved from <https://www.andi.com.co/Home/Noticia/8397->
- [3] BERKERS, H., RISPENS, S., & LE BLANC, P. (2022). The role of robotization in work design: a comparative case study among logistic warehouses. Retrieved from The International Journal of Human Resource Management: <https://doi.org/10.1080/09585192.2022.2043925>

- [4] CARRASCO, J. (2019, DICIEMBRE). Lean Procurement Strategy at COTECMAR. from <https://www.gob.pe/institucion/munilapunta/noticias/760527-bap-union-orgullo-peruano>
- [5] CONROW, L., FU, C., HUANG, H., ANDRIENKO, N., ANDRIENKO, G., & WEIBEL, R. (2023). A conceptual framework for developing dashboards for big mobility data. Retrieved from Cartography and Geographic Information Science: <https://doi.org/10.1080/15230406.2023.2190164>
- [6] Colombia Productiva. (2020). Informe de Vigilancia Tecnológica e Inteligencia Competitiva Astilleros. Retrieved from <https://www.colombiaproductiva.com/CMSPages/GetFile.aspx?guid=69f6ca86-e3f5-4bff-9500-6b5f1063fe5e>
- [7] Colombia Productiva. (2024, Septiembre). Mipymes podrán ser proveedoras de fabricantes de embarcaciones menores. Retrieved from <https://www.colombiaproductiva.com/ptp-comunica/noticias/mipymes-podran-ser-proveedoras-de-fabricantes-de-e>
- [8] COTECMAR. (2016, Julio 25). Manual Logístico. Cartagena.
- [9] COTECMAR. (2023, Noviembre 7). Caracterización Gestión Logística. CR-GESLOG-001.
- [10] COTECMAR. (2023, Abril 20). Caracterización Subproceso Gestión de Aprovisionamiento. CR-GESLOG-003.
- [11] COTECMAR. (2024). Informe de Gestión y Sostenibilidad 2023. Retrieved from <https://www.cotecmar.com/sites/default/files/media/documentos/2024-03/Informe%20de%20gesti%C3%B3n%202023%20digital%20vf.pdf>
- [12] COTECMAR. (2024, Mayo). Reunion de Aliados Estratégicos 2024. Cartagena.
- [13] Gobierno del Perú. (2023, Mayo 05). Bap Unión Orgullo Peruano. Retrieved from <https://www.gob.pe/institucion/munilapunta/noticias/760527-bap-union-orgullo-peruano>
- [14] MUNÍN DOCE, A., MÍGUEZ GONZÁLEZ, M., DÍAZ CASÁS, V., & FERREÑO GONZÁLEZ, S. (2021). Construcción Naval e Industria 4.0. Retrieved from <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ruc.udc.es/dspace/bitstream/handle/2183/27607/M%C3%B3dulo%203-ConstruccionNavaleIndustria4.0.pdf>
- [15] PSICOSMART. (2024, Agosto). El papel de la inteligencia artificial en la selección de proveedores y en la evaluación de ofertas. Retrieved from <https://psicosmart.pro/articulos/articulo-el-papel-de-la-inteligencia-artificial-en-la-seleccion-de-proveedores-y-en-la-evaluacion-de-ofertas-16300>
- [16] PLACEK, M. (2023, Diciembre 19). Retrieved from <https://www.statista.com/statistics/1102673/active-shipyards-worldwide/>
- [17] ROSERO, F. (2024, Agosto). Distribución de la Construcción Naval en el Mundo. Retrieved from <https://www.escueladeformacionastillera.net/distribucion-de-la-construccion-naval-en-el-mundo/>
- [18] SKYQUEST. (2024, Abril). Shipbuilding Market Insights. Retrieved from <https://www.skyquestt.com/report/shipbuilding-market>
- [19] ZAINAB, J., & VILLÁNY, B. (2024). Machine learning-driven optimization of enterprise resource planning (ERP) systems: a comprehensive review. In Beni-Suef University Journal of Basic and Applied Sciences (p. 13). Springer.