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Logistics Integration And Automation: The Impact Of Information Systems (LIS) On Business Management

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Abstract:
The increasing complexity of supply chains and the search for operational efficiency have driven the use of information technologies in logistics management. In this context, the Logistics Information System (LIS) emerges as a strategic tool for the integration, automation and monitoring of logistics operations, providing greater traceability, process optimization and cost reduction. This study aims to analyze the impact of LIS on logistics, highlighting its benefits, challenges and influence on the operational efficiency of companies. The research was conducted through an exploratory and bibliographic review of articles, annals and books, which showed that technologies such as the Internet of Things (IoT), Big Data, Artificial Intelligence (AI) and Blockchain play a fundamental role in the modernization of logistics. The results indicate that the adoption of LIS enables improved logistics planning, reduced operational failures and improved decision-making. However, challenges such as the need for investments in technological infrastructure and information security still represent barriers to its implementation. It is concluded that the adoption of SIL ceases to be a differential and becomes a strategic necessity, that is, SIL is an essential factor for the competitiveness of companies in the current scenario, allowing greater agility, efficiency and innovation in the supply chain.

Key Word: *Logistics; Logistics Information System; Integration; Operational Efficiency.*

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I. Introduction

The increasing complexity of supply chains and the need for more agile and efficient logistics processes have driven the use of information technologies in logistics management. In this context, the Logistics Information System (LIS) emerges as an essential solution for the integration, automation and monitoring of logistics activities, enabling more precise and strategic decision-making.

SIL enables the management of flows of goods, information and financial resources in real time, promoting greater visibility, traceability and process optimization. By applying technologies such as the Internet of Things (IoT), Big Data, Artificial Intelligence and Blockchain, companies can reduce operating costs, minimize errors and improve customer satisfaction by ensuring faster and safer deliveries.

Given this scenario, this article aims to analyze the importance of integrating SIL into logistics, identifying its benefits, challenges, and impacts on the operational efficiency of companies. To this end, a study will be carried out based on a bibliographic review and analysis of a case study in a company in the logistics sector, aiming to understand how the adoption of this system can transform supply chain management.

Throughout the article, fundamental concepts about Logistics Information Systems, technologies applied to integrated logistics and the main impacts of this system on the performance of organizations will be addressed. Finally, the research seeks to contribute to the understanding of best practices in the implementation of LIS, assisting companies and managers in the adoption of technological solutions for more efficient and competitive logistics.

II. Theoretical Framework

Concept of Logistics Information System (LIS)

According to Nazário (1999), the Logistics Information System (LIS) refers to the set of technologies and processes used to collect, store, process and distribute information within the supply chain. This includes

logistics management software (TMS, WMS, ERP), communication networks (EDI, IoT, RFID) and integrated platforms that facilitate automation and data-driven decision making.

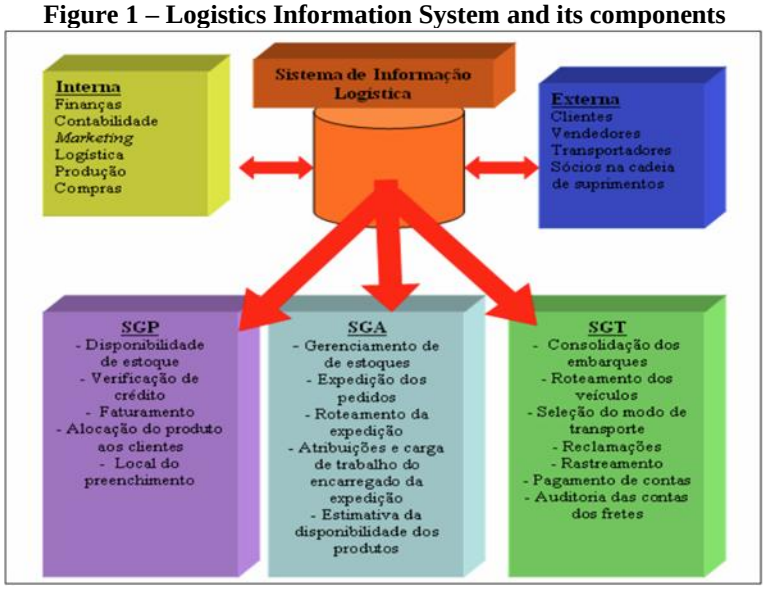
According to Nunes et. al (2008), the Logistics Information System (LIS) must be comprehensive and have sufficient capacity to enable communication between the company's functional sectors (such as marketing, production, finance, and logistics) and between participants in the supply chain, including vendors and customers. Sharing strategic information, such as sales data, shipments, production schedules, inventory availability, and order status, helps reduce uncertainty throughout the supply chain. This allows users to identify ways to make better use of the availability of this information to optimize processes and decision-making.

The information system, according to Laudon and Laudon (2007) , is defined as a set of interconnected components that have the power to collect, store, process and distribute information that can be used in decision-making, coordination or control of an organization. In this sense, it is understood that an information system is considered a database that stores information both internal and external to the organization with the aim of improving its management decisions.

For O'Brien (2004), Information System can be characterized in two ways, the first as being a set of people or procedures that collect and distribute information to the organization, while the second is a system that receives data (input) and processes it into products (output). In this case, we realize that people can also be considered active protagonists in an information system.

In this way, we can understand Information System as a conglomerate of interconnected information, both external and internal, which can be disseminated through technological channels or through people through interpersonal relationships, and which aims to keep the organization informed about internal and external processes for better assertiveness in decision-making and company control.

Figure 1 – Logistics Information System and its components



Source: Ballou (2006).

Logistics Concept

Having completed the understanding of what an information system is, it is time to understand what logistics can be. According to the Council of Supply Chain Management Professionals (CSCMP), logistics can be defined as "the part of supply chain management that plans, implements and controls the efficient, effective and reverse flow and storage of goods, services and information between the point of origin and the point of consumption, in order to meet customer needs". Therefore, it is understood that for the CSCMP, logistics is considered a management activity that should be valued not only for its complexity, but mainly for its importance to the organization.

According to Costa, Dias and Godinho (2010), logistics can also be understood as the activity that seeks to balance other activities of the organization with other distinct and conflicting forms that normally do not communicate with each other but are necessary to achieve the organizational objective (profit). According to the authors' description, it is possible to understand that logistics is considered the activity responsible for decoding the language of each sector of the company and passing it on to others involved in the activity, making clear the management role that logistics has in the organization.

Logistics is a process of efficiently planning, implementing and controlling activities ranging from the production of materials to the provision of services. However, it analyzes operational and strategic

components, always seeking the correct cost, involving everything from the flow and storage of raw materials, inventory during production and finished products and information related to these activities, from the point of origin to delivery to the consumer (CSCMP, 2024).

This process encompasses a range of activities, such as transportation, storage, distribution, inventory management and information control, with the aim of ensuring that the right product, in the right quantity, is available in the right place at the right time. To achieve this efficiently, it is necessary to coordinate operations in an integrated manner, aligning the company's internal logistics with its external partners.

Logistics, therefore, is not limited to the physical movement of products, but also involves the management of data and information that accompanies the product throughout its journey. In addition, efficient logistics seeks to reduce costs and maximize customer satisfaction, using innovative technologies and practices, such as automation, artificial intelligence and data analysis, to optimize each stage of the logistics process.

It is therefore understood that, in addition to planning physical materials, logistics also manages virtual data and processes that are not necessarily part of the company's production chain, but somehow interfere in the distribution of its products and/or services.

In short, logistics can be understood as an activity of managing the flow of materials, physical resources and informational resources, aiming at better operationalization of the activities of the production chain and the reduction of costs in the supply chain for the organization, so that such reduction does not hinder the company's productive performance.

After understanding the concepts of Information System and Logistics separately, it is time to bring the two parts together and understand their concept, how they act together and their importance. According to Nazário (1999), Logistics Information System can be defined as a link that connects interdependent logistics activities in an interconnected process, using hardware and software to control and manage logistics operations within an organization and its supply chain.

2.3. SIL integrated with Logistics

For Bowersox et al. (2006 apud Aragão, 2009), SIL is a tool that can be used to integrate logistics activities into a single process that provides operational benefits for the companies that use them, such as cost reduction, better service provision, etc.

The Logistics Information System (LIS) is an essential tool for the efficient management of logistics operations, enabling the collection, storage, processing and dissemination of information within the supply chain. When integrated with logistics, LIS enables greater control over inventory, transportation, storage and distribution, ensuring process optimization and strategic decision-making based on accurate, real-time data.

The Logistics Information System (LIS) integrated with logistics is a competitive advantage for companies seeking greater efficiency, cost reduction and better control over their operations. With advanced technologies such as Big Data, IoT, Artificial Intelligence and Blockchain, LIS allows for more strategic and dynamic logistics management, ensuring an optimized supply chain and high-quality customer service.

Why SIL is important for logistics systems

According to Nazário (2008), obtaining accurate and timely information is essential for the efficiency of logistics systems for three main reasons:

a) Customers consider information about order status, product availability, delivery schedules, and invoices to be essential components of customer service;
b) The quest to reduce total inventory in the supply chain leads executives to recognize that information can significantly minimize the need for inventory and human resources. In particular, requirements planning, based on up-to-date information, contributes to inventory reduction by reducing uncertainties related to demand;
c) Information increases operational flexibility, allowing us to accurately identify which resources should be used, in what quantity, in what way, at what time and place, providing a strategic advantage for the organization.

SIL acts as a link that interconnects logistics activities in an integrated process, combining hardware and software to monitor, control and manage logistics operations (Fleury, Wanke & Figueiredo, 2013).

2.5.SIL Levels

The logistics information system has four different functional levels, which are structured in a pyramidal manner (Figure 2), which according to Fleury, Wanke and Figueiredo (2013), this structure is to show the hierarchical levels and what the top activity depends on the others to be carried out.

Figure 2 - Functionality of a logistics information system.

Source: Fleury; Wanke; Figueiredo (2013).

a) Transactional system: constitutes the basis of logistics operations, characterized by formal rules, communication between different areas, high volume of transactions and an operational focus on daily activities. It is from this system that the order cycle occurs.
b) Management control: this level uses information from the transactional system to manage logistics activities, requiring performance indicators and reports for monitoring. The main indicators include lead time and transit time.
c) Decision support: characterized by the use of software aimed at supporting operational, tactical and strategic activities, contributing to more efficient management.
d) Strategic planning: logistics information plays a fundamental role in the development and improvement of logistics strategies, assisting in long-term decision-making.

The hierarchical structure of logistics systems allows for efficient and integrated management of operations. The transactional system guarantees the operational basis, recording and processing essential transactions. Management control uses this information to monitor and optimize logistics activities, supported by key indicators. At the decision support level, specialized software helps formulate strategies and improve operational efficiency. Finally, strategic planning uses logistics data to develop and improve long-term strategies. In this way, the integration of these levels contributes to more efficient, agile and competitive logistics.

Communication Technologies and Tools

The advancement of information and communication technologies (ICT) has revolutionized modern logistics. Some of the most impactful technologies include:

1. Internet of Things (IoT): The use of connected devices enables real-time monitoring of products and vehicles during transportation. Smart sensors can be used to track the temperature, humidity and location of goods, which is essential for sensitive products such as food and medicine. IoT also contributes to predictive vehicle maintenance, helping to avoid breakdowns and delays.
2. EDI (Electronic Data Interchange): EDI is an electronic document exchange system that enables fast and secure communication between different parties in the supply chain, such as suppliers and carriers. This eliminates the need for paperwork and reduces the margin for error in communication.
3. Big Data and Analytics: Collecting and analyzing large volumes of data allows companies to predict demand patterns, optimize delivery routes, and adjust inventory according to actual needs. Data analytics helps predict future trends and adapt quickly to changes in the market or consumer demand.

For Brito and Trevisan (2015, p.26) The perfect meeting between Big Data and Logistics:

The logistics sector has an astonishing potential to benefit from the technological and methodological advances of the Big Data culture. The increasingly complex nature of economic development, which generates new types of business networks and new needs in the flow of goods, has transformed logistics into an essential element of competitiveness.

4. Blockchain: Used to ensure transparency and security in transactions within the supply chain, blockchain can be fundamental in product traceability, offering an immutable history of each stage of the logistics process, from origin to final destination.

Benefits of Information Systems in Logistics

Some benefits that the integration between these two can bring:

1. Operational Efficiency: The main advantage of adopting these systems is the improvement in operational efficiency. By automating processes and using real-time data, companies can reduce response time, reduce errors and improve logistics planning, which contributes to more agile and effective management.
2. Cost Reduction: Process integration and automation contribute to reducing operating costs. The use of tools such as WMS, for example, optimizes the use of warehouse space and minimizes shipping errors, resulting in less waste and rework costs.
3. Improved Visibility and Transparency: The use of technologies such as IoT and blockchain provides greater visibility into logistics operations. This is essential for both managers, who can monitor performance in real time, and customers, who can access the status of their deliveries and check the traceability of products.
4. Improved Decision Making: With the use of accurate data and information, decision making becomes more strategic. Managers can quickly adjust logistics processes in response to variations in demand or changes in market conditions. Data analysis allows for the prediction of problems before they occur and the taking of corrective actions in a timely manner.
5. Increased Customer Satisfaction: Well-managed logistics, with accurate information and on-time deliveries, has a direct impact on customer satisfaction. Efficient communication also improves the consumer experience, as companies can offer a more transparent and higher-quality service.

Impacts on companies' operational efficiency

Operational efficiency is a critical factor for the competitiveness of companies in the current scenario, marked by complex supply chains and a dynamic market. In this context, the Logistics Information System (LIS) stands out as an essential catalyst for improving logistics processes, optimizing resources, reducing costs and improving decision-making.

SIL integrates data, processes and technologies to provide a continuous flow of information within the supply chain. By connecting different sectors – purchasing, storage, transportation and distribution – the system allows companies to make more assertive decisions, based on updated and real-time data. In addition, its automation capacity minimizes operational failures and reduces dependence on manual processes, ensuring greater efficiency and reliability.

Challenges and Considerations

Although Information and Communication Systems in Logistics bring numerous advantages, their implementation is not without its challenges. Adopting these technologies requires significant investments in infrastructure and training. In addition, integrating different systems, especially in companies with global operations or legacy systems, can be complex. Another important point is information security: sharing data between different agents in the supply chain requires rigorous measures to ensure that information is protected against fraud or leaks.

III. Material And Methods

This study is characterized as an applied research, of a qualitative nature, with a descriptive approach. The study aims to analyze the integration of the Logistics Information System (LIS) in supply chain management, identifying its impacts on operational efficiency and decision-making.

The study was carried out mainly using the exploratory bibliographic research methodology, which is developed when using previously published materials such as books, articles and theses (Gil, 2008). It was developed independently or partially constituted descriptive research, as well as documentary research regarding the nature of the sources (Gil, 2008).

The research was conducted through several stages, with the aim of understanding each part that makes up the main focus of the study. The objective was to understand and explain the meaning of the Logistics Information and Communication System tool, as well as its benefits and technologies integrated into the process. Academic works, scientific articles, dissertations and published theses, available in databases such as Google Scholar, SciElo and CAPES Periodicals, were consulted.

IV. Result

The research revealed that the adoption of the Logistics Information System (LIS) positively impacts the operational efficiency of companies, promoting greater control over logistics processes and improving integration between the different sectors of the supply chain. Through the literature review and the case study, it was identified that the use of technologies such as IoT, Big Data, Artificial Intelligence and Blockchain contributes significantly to the automation and optimization of logistics activities.

The main benefits observed include reduced operating costs, minimized errors and failures in processes, and improved decision-making based on accurate, real-time data. In addition, greater visibility into logistics operations has enabled improvements in route planning, inventory control and agility in distribution, resulting in greater customer satisfaction.

Despite the advances provided by SIL, some challenges were identified, such as the need for investments in technological infrastructure, employee training and the adaptation of legacy systems for efficient integration. Issues related to information security were also identified as a critical factor, requiring rigorous measures to protect data shared between different agents in the supply chain.

V. Conclusion

The Logistics Information System (LIS) has proven to be an essential tool for companies seeking to improve their operational efficiency and remain competitive in a dynamic and globalized market. The integration of this system with advanced technologies has provided significant improvements in logistics management, allowing for a more agile, reliable and strategic flow of information.

The research highlighted that SIL not only optimizes processes and reduces costs, but also strengthens internal and external communication and the ability of companies to adapt quickly to market changes, offering a more efficient service aligned with customer expectations. However, to ensure successful implementation, it is essential that companies invest in the necessary infrastructure, in training their professionals and in the security of shared data. When SIL is implemented properly, it enables cost reduction, improved customer service and increased competitiveness in the market.

In the face of technological innovations, the adoption of SIL ceases to be a differential and becomes a strategic necessity, allowing companies to achieve higher levels of productivity and sustainability in the management of their supply chains.

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