

The importance of supply chain management to enable the implementation of CIP central in a dairy industry in Ceará

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Abstract

The dairy industry extensively utilizes clean-in-place (CIP) systems for cleaning and sanitization, employing a closed-circuit cleaning method that enables the cleaning and sanitization of equipment, silos, piping, and isothermal tanks without disassembly. This process enhances safety and quality in initiating the production process. This research adopts a qualitative approach, employing a bibliographic search methodology that includes consulting various studies and documents such as research papers, reports, dissertations, monographs, studies, and scientific articles. The main objective of this study is to demonstrate the impacts of implementing a CIP Chemical Cleaning Central in a dairy industry. The findings indicate that cleaning through the CIP Central is an effective alternative, ensuring the removal of microorganisms to non-detectable levels while reducing the duration of the sanitization step and lowering energy consumption. These outcomes contribute to significant cost savings for the organization.

Keywords: Cleaning systems; Dairy industry; Economy; Chemical Cleaning Central

1. Introduction

The topic addressed in this study is of great relevance to the supply chain sector of the dairy industry, as it demonstrates the actual cost savings achieved through the implementation of a CIP Central, which has had a positive impact on the procurement process of the cleaning chemicals involved.

This study aims to present the arguments and benefits that were presented to the board of a specific dairy company regarding a project for implementing a new approach to chemical product acquisition. The proposed endeavor seeks to modify the purchasing of these items used in factory cleaning, transitioning from smaller unit-sized packaging to larger unit-sized bulk packaging, thereby reducing costs and generating overall savings.

Due to fierce competition in the business world and the increasingly compromised financial factors of companies, there is a growing need for cost reduction and optimization of internal processes in supply chain management to maximize profits in this highly competitive market.

Considering these aspects and the resulting changes demanded by the market, this study aims to demonstrate the benefits of purchasing cleaning chemical products through the implementation of a CIP Central (Cleaning in Place - Chemical Island) in a dairy industry. This implementation has had a significant impact on the quality and safety of processes, as well as the financial return. In other words, the value of the chemical products, previously purchased in

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drums, has transitioned to tank trucks, thus altering the entire process from supplier transportation to the factory's stock and distribution of chemicals to the production lines of the studied facility.

The methodology used adopts a qualitative approach, with the research procedure consisting of a bibliographic search, consulting studies and documents such as research papers, reports, dissertations, monographs, studies, and scientific articles.

The general objective of this research is to demonstrate the impacts that a CIP Central for cleaning chemical products can deliver in a dairy industry. The specific objectives defined are: describing the importance of supply chain logistics synergy, identifying the changes in the supply and storage of chemical products, and discussing the benefits of a cleaning central - CIP, which enhances process safety and quality.

This article is structured into four sections. The first section is the introduction, where the research objectives are shared. The second section is the theoretical framework, which presents a discussion among authors who address the researched topic. The third section describes the methodological procedures used to develop this study, and finally, the fourth section presents the final considerations.

2. Material and methods

The methodology employed in this study is characterized by a qualitative approach, with the research procedure consisting of a bibliographic search, consulting studies and documents such as research papers, reports, dissertations, monographs, studies, and scientific articles.

2.1. Regarding the qualitative approach, Flick et al. (2018, p. 12) present the following perspective:

The qualitative approach in scientific research allows for in-depth exploration and understanding of complex social phenomena, providing detailed information about participants' perspectives and experiences. Qualitative methods, such as in-depth interviews and participant observation, enable researchers to capture important nuances and details that would not be possible to obtain through quantitative methods. However, it is important to remember that qualitative analysis requires specific skills and competencies to ensure the reliability and validity of the results. Researchers must be careful when interpreting and reporting their data to avoid distortions and ensure that their conclusions are well-founded [1].

2.2. Regarding bibliographic research, Denyer and Tranfield (2019, p. 14) express their opinion:

Bibliographic research is an important tool for scientific investigation, allowing researchers to access and examine a wide variety of information sources relevant to their research questions. It is crucial that researchers are able to conduct effective bibliographic searches, carefully selecting appropriate sources and critically evaluating the quality and relevance of the information found. Bibliographic research can also help researchers identify gaps in the existing literature as well as areas for future research [2].

Among the authors that were researched and contributed significantly to enriching and supporting this work, notable mentions include Ballou, Goulart, Pak (2016), Campos (2018), Yhang et al. (2018), and Tamanini and Druzian (2022).

3. Literature Review

This foundation was organized into three subtopics. The first subtopic discussed the importance of synergy between the logistics and supply chain sector. The second subtopic analyzed the improvements in the change of supply and storage of chemical products. The third subtopic highlighted the benefits of a Cleaning Central - CIP, generating cost savings, safety, and quality in the process.

3.1. The Importance of Synergy between Logistics and Supply Chain

Logistics is one of the most critical activities in the supply chain, both in operational and financial terms, where a significant portion of a company's resources is consumed. With the advancement of technology in industries, the supply chain sector can benefit and contribute by offering work with greater excellence and increasing the level of negotiation accuracy.

Technology has been a transformative force in the supply chain sector, enabling companies to better manage their supply chains, increase efficiency and transparency, and improve relationships with their suppliers. Software solutions for procurement and acquisition management, process automation, and data analysis are becoming increasingly sophisticated, allowing companies to make more informed, data-driven decisions. However, it is important to remember that technology is not a magical solution to all supply chain problems, and effective implementation requires a careful and collaborative approach among all parties involved [3].

Cost reduction is the dream of every company, so there should be an incessant search for innovation, always exploring synergy with other departments, acting transparently in projects, and collectively achieving a competitive advantage.

Responsible for the continuous flow of materials/products and information, with the primary objective of meeting the needs of customers (internal/external), in the right place, at the right time, in the desired quantity and quality, at the lowest possible cost. In this context, the synchronization of the various agents operating in the supply chain is of fundamental importance to achieve the best results.

According to Goulart and Campos (2018, p.19), "logistics encompasses the involvement of information related to the receipt, storage, inventory, packaging, and transportation of materials and products [4]."

Logistics in Brazil is constantly evolving and taking on significant proportions in all industrial sectors. In the food, beverage, and construction materials sectors, logistics costs are estimated to reach R\$ 160 billion per year.

It is evident that logistics operations have a significant impact on the profitability of companies. Although logistics goes beyond transportation, it is one of the operations that requires greater attention, as it represents the largest portion of logistics costs within the company, on average accounting for 64% of the total logistics cost [5].

Among the sectors mentioned, transportation is of fundamental importance for the dairy industry, responsible for the movement of all materials used in the production and distribution of finished products.

According to data from the Brazilian Institute of Geography and Statistics - IBGE (2022), in 2021, the transportation, warehousing, and postal services sector had a positive result of 11.4% compared to the previous year, contributing significantly to the growth of the GDP, which was 4.6%, totaling R\$ 8.7 trillion in generated wealth during that period [6].

In the dairy industry, the reality is no different, as transportation expenses are among the highest costs, directly impacting the cost of products and, consequently, the final price for the consumer, requiring constant analysis of results and the search for alternatives to cost reduction.

Goulart and Campos (2018) point out that due to the country's transportation infrastructure, the agility and ease of access to cargo make the road mode the most suitable for short and medium distances. However, it has higher costs and lower cargo capacity [4].

Over time, the systems for receiving, supplying, and storing chemicals have been continuously improved. In this study, we will address a specific model called the CIP Central, referred to as a "chemical island" in the industry under investigation. The concept is based on the installation of stainless-steel silos with pipelines that store and subsequently distribute cleaning chemicals directly to the factory's production lines, eliminating the need for transportation between different areas within the facility.

As a result, the use of plastic containers, such as 50-liter drums, for storage is no longer necessary, as the process is entirely piped. This new procurement approach has yielded improved cost-effectiveness by utilizing tank trucks for transportation, enhancing process quality, and further enhancing the model's environmental sustainability.

Proper management of chemical products is crucial in dairy industries, as many chemicals are used during the production and processing of dairy products. The selection of chemicals, as well as their appropriate storage and handling, is crucial to ensure the quality and safety of dairy products. Furthermore, the use of improper chemicals or the lack of proper management can have negative impacts on the environment and the health of workers. Therefore, it is essential for dairy industries to implement strict policies and procedures for chemical management, including adequate training of employees and compliance with environmental and safety regulations [7].

Ballou (2007) comments that facility location is often determined by a fundamental factor. In the case of factory and warehouse location, economic factors generally prevail. For retail locations, the revenues generated by a particular location are usually the determining factor, with costs subtracted from revenues to determine profitability [8].

In the current uncertain and dynamic market environment, the need for organizational structures that can respond to persistent improvement in organizational processes is more critical than ever. Current organizational studies emphasize categorized processes and structures without developing continuity in the temporal and spatial layers of environmental change [9].

Inventory management and storage - Inventory is a matter that deserves greater attention from logistics professionals, especially in the analyzed sector, as the main focus is to keep the inventory at the lowest level possible, ensuring that products are not stored for too long while guaranteeing that there is always a sufficient quantity to meet internal customer demands.

In the case of the logistics system in the studied company, inventory levels remain constant. The company aims to maintain the same quantity in stock, as this helps minimize costs. The majority of internal processes in the company are mechanized, which makes it highly efficient in this aspect. Storage is the proper administration of space to maintain inventory.

A quality planning for storage is necessary to avoid problems. Therefore, companies maintain strict control over inventory inflows and outflows and base the quantity to be produced and stocked on the average monthly sales.

3.2. The Benefits of a Cleaning-in-Place (CIP) System: Ensuring Safety and Quality in the Process

The pipelines in dairy, beverage, and food industries are directly exposed to contamination from various organic and inorganic materials that pass through these production lines. This exposure to contamination poses a risk, especially to human health. Therefore, these pipelines require industrial cleaning, as mentioned by Tamanini and Druzian (2022, p. 01).

Maintaining a clean industrial plant is essential to ensure the quality of the produced goods and prevent the presence of microorganisms that could harm production and consumer health. To achieve this, the cleaning process must be thorough and meticulous. In industrial settings, Clean-in-Place (CIP) cleaning is one of the most commonly employed procedures as it minimizes potential human errors, ensuring efficient system sanitation [10].

One of the most widely used methods in the beverage and food industries to clean pipelines is CIP cleaning. According to Forni (2007, p. 02), "the concept of CIP cleaning is based on circulating chemical solutions within equipment to achieve cleaning and disinfection. The CIP system comprises several associated equipment that enables sanitation without dismantling [11]."

Furthermore, the closed system of CIP cleaning offers numerous advantages compared to manual cleaning. The main advantages include greater efficiency, shorter cleaning cycles, and reduced environmental impact [12].

Implementing CIP cleaning incurs higher costs compared to manual cleaning methods. However, it proves advantageous in the long run as it requires less labor, allows reuse of detergent solutions, ensures control and quality of sanitation, enhances food safety, reduces downtime, increases productivity, minimizes equipment wear, and eliminates the need for dismantling processing units [13].

The implementation of a Cleaning-in-Place (CIP) system is an important strategy to enhance hygiene and process safety in dairy industries. By utilizing this technology, the cleaning process of equipment can be automated, making it more efficient and cost-effective. Furthermore, CIP reduces the need for manual intervention, minimizing the risks of cross-contamination and improving worker safety. Another benefit of CIP is its ability to monitor and control the cleaning process, allowing for the identification of potential issues and adjustments to maximize effectiveness. Thus, implementing CIP is an important strategy to improve product quality, reduce costs, and increase efficiency in dairy industries [14].

In Brazil, the quantity of raw milk acquired, whether chilled or not, in the first quarter of 2018 totaled approximately six billion liters. About 99.9% of this production volume is processed in 1,917 establishments, which are inspected at the municipal, state, or federal level.

Notably, in the first quarter of 2018, the state of Minas Gerais was the largest milk producer, followed by the states of Rio Grande do Sul and Goiás [6].

4. Conclusion

The present study aimed to evaluate the benefits of a CIP Central from the change in the supply process, storage, to automated cleaning, where only after this procedure can the machines receive the raw material, free from any contamination, ensuring the highest levels of food safety.

Furthermore, it is worth noting that the high levels of quality and process safety from an environmental perspective take into consideration the residual impact on the soil, which is completely controlled, and the health of the employees. Previously, they had direct contact with this cleaning process, but now operators no longer need to enter tanks and containers to clean them and do not have to handle powerful cleaning materials.

It should be emphasized that the energy and water consumption in the CIP Central process proves to be more cost-effective compared to the previous operation, constituting an economic benefit for the company.

Another point addressed throughout this research was the involvement of supply management throughout the installation process of the CIP Central. Supply management in the implementation of CIP in a dairy industry involves the acquisition, storage, and distribution of chemical products, detergents, sanitizers, and other inputs used in the cleaning of production equipment. These inputs must be of quality and comply with applicable standards and regulations.

Furthermore, the research demonstrated that it is essential for supply management to have strict control over stocks, thus avoiding supply shortages or interruptions in the cleaning process. The lack of chemical products or sanitizers can directly affect the safety and quality of the end product, as microbiological contamination may occur.

The research indicated that proper supply management can also help the dairy industry reduce costs and increase CIP efficiency by identifying cost-saving opportunities, such as bulk purchasing of inputs and negotiating better prices with suppliers.

Therefore, it can be concluded that cleaning through the CIP Central proves to be an efficient alternative, generating quality and safety in the cleaning process by removing microorganisms to non-detectable levels, reducing the operation time of the sanitization stage, and also reducing energy consumption, thus generating savings for the organization.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors assure that there is no conflict of interest with the publication of the manuscript or an institution or product mentioned in the manuscript and/or important for the result of the presented study.

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