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RESEARCH PAPER

# Human technology organizational dimensions for sustainable logistics: a context mechanism outcome model[1]

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## ABSTRACT

**Goal:** the main goal of this article is to offer a preliminary Context Mechanism Outcome (CMO) model for sustainable logistics incorporating the HTO (Human, Technological and Organizational) dimensions.

**Design / Methodology / Approach:** The research is based on a scoping review following a well-known five step approach: identification of the research question and of relevant studies, selection of studies; results´ analysis and grouping, summarizing, and presenting the results.

**Results:** The relationships between the HTO dimensions, as well as their interplay, proved to be important for the success of sustainable logistics, in addition to providing relevant contributions to the economic, social and environmental performance of companies. The results generated from the HTO interactions, within the context of sustainable logistics, are ecological and environmental performance, economic financial performance and social performance. Research findings also indicate the lack of studies in logistics that incorporate the HTO dimensions, from the perspective of Triple Bottom Line (TBL).

**Limitations of the investigation:** The scoping review is based on two data bases (Scopus and Web of Science) with a limited number of combinations of themes and search keywords.

**Practical implications:** The proposal of a sustainable logistics management artifact can encourage practitioners to implement this practice towards making sustainable logistics a tool capable of creating value for their organizations.

**Originality / Value:** The research aids the development of sustainable logistics management artifacts to encourage the dissemination of the incorporation of HTO dimensions, from the perspective of TBL, to incentive further research and practical implementations in real-life settings.

**Keywords:** Operations Management; Supply Chain; Business Process and Triple Bottom Line.

## INTRODUCTION

Since logistics plays an important role among the various areas of the organization, mainly due to the costs associated with its activities, it is often used to generate competitive advantages, especially in the context of business logistics, which aims to ensure the availability

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of products and materials at the lowest possible cost on the market, with the highest level of quality, speed, and efficiency (Ceniga and Sukalova, 2020; Da Silva et al., 2017; Callefi et al., 2018).

Given its importance for today's organizations, different approaches are incorporated in its management to consolidate the maturity of logistics and its adaptation to new demands of society, including the vision of the human, technological and organizational (HTO) dimensions and sustainability. The HTO model is an analysis approach that consolidates human, technological, and organizational aspects, as well as their interactions, so that, applied in organizations, they can provide important information for continuous improvement and strategic decision-making (Rollenhagen, 2000; Ivert and Jonsson, 2014). This approach has been used in supply chain management and logistics problems, such as scheduling in Berglund and Karltun (2007) and information systems (e.g., advanced planning scheduling - APS) in Sales and Operations Planning (Rollenhagen, 2000).

With the spread of the term sustainability, there is a movement encouraging the implementation of the principles of the Triple Bottom Line (TBL - Economical Sustainability, Environmental Sustainability and Social Sustainability). Sustainable development starts to incorporate the elements of social equity, economic fundamentals, and environmental responsibility (Elkington, 2001). Organizations that traditionally focused their logistical strategies on the economic pillar, aiming at minimizing costs and maximizing profits, started to invest in sustainable practices (Silva et al., 2017; Callefi et al., 2018), now have a more holistic view of their operations, incorporating the other two pillars. Its current practices aim to generate positive results not only in the economic aspect, but also in the social aspects, through the generation of jobs and income; and in the environmental aspect through the reduction in the emission of polluting gases and in the reduction of energy consumption (Silva et al., 2017; Callefi et al., 2018; Geng et al., 2017). This trend is explained by the mismatch between the growing demand for natural resources and the scarcity of several of these inputs (Zhu et al., 2004). The importance of environmental, economic and social aspects in the practice of logistics is directly related to the impacts generated on the organization's performance, which can be divided into: i) Ecological performance: focus on minimizing energy consumption and the emission of polluting gases, the production of waste and the use of resources used, especially with regard to waste; ii) Social performance: focused on social aspects, such as concern for the well-being of employees and customers and job creation; iii) Economic performance: focus on obtaining profit, through sustainable production processes, focused on cost reduction by reducing the consumption of natural resources (Geng et al., 2017).

In logistics, there are some approaches that focus on sustainability with a vision that is sometimes more restricted and less comprehensive than TBL, such as green logistics and reverse logistics. In the evolution of logistics, first green logistics emerged, primarily focused on the environmental aspect, which seeks to coordinate the activities of the supply chain, in order to minimize impacts on the environment, ensuring that decision-making does not negatively interfere with future generations (Ceniga and Sukalova, 2020). Reverse logistics, on the other hand, is the area of logistics that takes care of the return flow of materials along the supply chain, through practices such as reuse and recycling (Silva et al., 2017), focusing on the economic-environmental pillar, through reduction operating costs arising from the reuse of materials (Soares et al., 2016). Thus, sustainable logistics emerges, with the vision of integrating the principles of reverse logistics focused on the economic- environmental pillar, by reducing costs and resources in the manufacture of new products, with the principles of green logistics, focused on the environmental pillar through stimulation the implementation of sustainable production processes, added to concepts related to social aspects such as the improvement of working conditions and well-being, generation of green jobs and balanced income distribution (Ceniga and Sukalova, 2020; Silva et al., 2017; Soares et al., 2016). The implementation of sustainable logistics, despite generating positive impacts on economic, environmental, and social performance, is challenging for many companies, as it demands

investments in infrastructure, technology, and qualified labor (Ceniga and Sukalova, 2020; Silva et al., 2017; Geng et al., 2017; Soares et al., 2016). These challenges can be eased through the use of management tools capable to provide important information for risk mitigation and strategic decision-making.

Thus, the analysis of sustainable logistics using the approach of HTO dimensions, from the perspective of TBL, can generate relevant data, especially when considering in this analysis the context in which the organization is inserted and the impact of the operation on performance. Therefore, in order to propose a management tool, this study will use the realistic assessment approach through the CMO model, which is composed of three components: the problem context (C), mechanism (M) and outcome (O) (Pawson and Tilley, 1997; Befani et al., 2007). The realistic evaluation approach, originally developed by Pawson and Tilley, (1997), based on the assumption that projects and programs work under certain conditions and are strongly influenced by the way different stakeholders respond to them. This approach follows the CMO principle, through the analysis of projects according to the following formula Context (C) + Mechanism (M) = Result (O) (Befani et al., 2007). In the CMO model, the context can be related to the socioeconomic and political environment, organizational context, history, and local culture. Some factors in the context may allow or prevent specific mechanisms from being activated. The interaction between the context and the mechanism is what generates the model results (Befani et al., 2007). This analysis model considers the context, mechanism, and results, regarding how the context in which a company is inserted impacts on HTO interactions and generates information capable of understanding how this relationship impacts on the generated results.

Within the context presented, this article aims to propose a CMO model for sustainable logistics incorporating the HTO dimensions, from the perspective of TBL. The questions that guide the research are the following: What are the relationships of the HTO dimensions of sustainable logistics? How to use the HTO dimensions in building a model that links its context and outcomes, focused on the performance of sustainable logistics?

In order to achieve the proposed objective, this article is structured in five sections, the first being introductory. The second section presents the theoretical foundation. Section 3 describes the research methodology used. Section four provides an analysis of the results obtained from the survey. Finally, the last section presents research findings and suggestions for future research.

## THEORETICAL FOUNDATION

### HTO Concepts

The HTO is an analytical approach that has been used as a perspective and as knowledge and analytical techniques that focus on human, technological and organizational factors, regarding their interactions and how their relationships impact the generated results (Rollenhagen, 2000). According to Berglund and Karltun (2007), 'H' represents the human dimension and can be defined as a combination of physical, cognitive, psychological, and social aspects. Already 'T' represents the technological dimension, which according to Mumford's socio-technical theory (Mumford, 2006) is technology itself, encompassing both machines and associations of controlled work organization, the work system. Finally, we have the organizational dimension, represented by 'O', which according to Porras and Robertson (1992) is defined as formal organizational arrangements and informal social structures.

In literature, there are several works that implement HTO approach. Regarding the human aspect, the study by Ivert and Jonsson (2011) identified in their work that the human aspects related to the user's empowerment, knowledge and commitment were essential for the successful implementation of a new technology. And the study by Gutierrez et al. (2015), who noted that user resistance hindered the implementation of a performance measurement system (PMS), which could have been avoided by appointing a leader capable of aggregating

information and solving problems, which was also discussed in (Callefi et al., 2018; Carvalho et al., 2014).

Regarding the 'T' dimension, Gutierrez et al. (2015) observed in their study that the quality of the imputed information directly impacted the successful implementation of a technological tool, whereas Yusof et al. (2008) complement by stating that the efficiency in data processing, as well as the quality of service were important factors in the implementation of a new system in the health field.

Finally, the organizational dimension, represented by 'O', was identified by Yusof et al. (2008) as being the support of top management and the sponsor, aspects that were considered fundamental, as they play a significant role in changing the user's perception and in encouraging the implementation of a new technology. The involvement of the senior management committee in alignment meetings proved to be essential for a clear understanding of the challenges generated by cultural change when implementing a new technological tool (Ivert and Jonsson, 2014).

To generate an HTO model, it is necessary to analyze the interactions that occur between its dimensions. A successful H-O (human and organizational) interaction plays an important role in organizational performance. The successful implementation of a new system depends on the fluid synergy between the project manager and users (Yusof et al., 2008). Planner's good interpersonal relationship was essential for the occurrence of meetings between different departments, which directly contributed to problem solving and decision-making (Gutierrez et al., 2015). In addition, top management support also played a significant role in changing the user's perception and encouraging the use of the new technological tool. Users' technical skills and competences are fundamental for a better strategic understanding of organizational processes. Technical capacity can be developed from training offered by the organization itself. In the study by Carvalho et al. (2014) identify that the programmer's knowledge to interpret data was essential for problem solving and decision making in the production scheduling process.

The T-O interaction (technological and organizational) is fundamental in the implementation of a new technology in an organization, especially when there is integration with existing systems (Ivert and Jonsson, 2011). In addition, managerial support and the presence of engaged leaders who encourage a more aware environment regarding the importance of technical advances for team members and more agile regarding the adoption of new technologies are also important (Yusof et al., 2008). Another relevant aspect is the quality of the company's information. A well-defined structure, with an organizational culture of attributing reliable information to the management software, is essential for the implementation of new technological tools in companies (Berglund and Karltun, 2007). The organization needs to play a facilitator role, so that the information technology (IT) area can improve organizational performance in the management process, and consequently in its strategy (Yusof et al., 2008).

For the H-T interaction (human and technological) to occur with synergy, the following criteria for the design of the scheduling software must be followed: level of support, transparency, autonomy, and presentation of information (Ivert and Jonsson, 2014). The software needs to be aligned with the task to be performed, fault-tolerant and provide relevant data for decision making (Gutierrez et al., 2015). Another important point in this interaction is communication. According to Yusof et al. (2008), the lack of communication between those involved and the IT team is obviously caused by the knowledge gap, as well as the individual characteristics of being more sensitive to the needs of different stakeholders.

Figure 1 shows the HTO approach in a framework, representing not only the dimensions, but also the interactions between human, technological and organizational aspects.

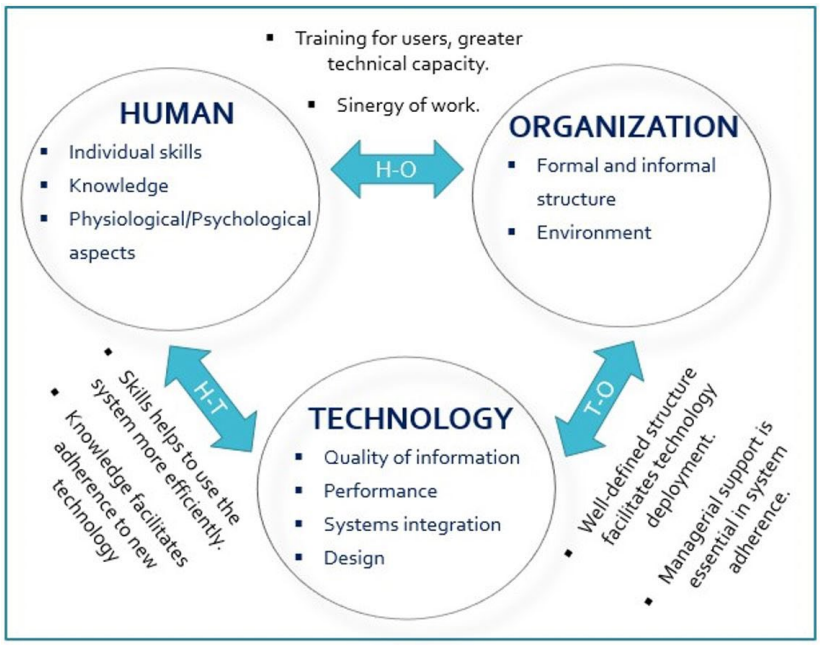


**Figure 1:** HTO model and its interactions.
Source: The authors themselves.

The example of HTO model presented, consolidates the human, technological and organizational aspects, as well as their interactions, in such a way applied into the organizations can provide important information for continuous improvement and strategic decision making. Interactions between the human (H), technological (T) and organizational (O) dimensions are fundamental for the successful implementation of the planning and scheduling system functionalities in the sales and operations planning processes (Ivert and Jonsson, 2014).

The HTO is a concept that can be applied to the analysis and evolution of the understanding of complex work activities. Successful development is only achieved if all three components are considered together (Berglund and Karltun, 2007). Professionals and managers, when using an HTO perspective, benefit from a more realistic view of the difficulties encountered in the implementation of new technologies and have a greater capacity to deal with them (Carvalho et al., 2014). Furthermore, they are able to have a better understanding of the practical results that can be achieved with this implementation. Therefore, the application of this approach to sustainable logistics is relevant and is part of the scope of this research.

## Sustainable Logistics

The origin of the concept of logistics with science was in military bases, because during wars, it was necessary to cover great distances for combat, which gave rise to the need to organize and plan the supply of food and water, weapons, accommodation, and medicines for the troops (Ballou, 2006). According to historical accounts, it was in France, at the beginning of the 17th century, that the practice of logistics was introduced for the first time in the world. The logistical strategy was a resource very well used by Alexander the Great, during the wars, his army could shoot down enemy armies almost twice as big as his, losing in these combats few of his men (Silva, 2010).

Despite its recognized importance in history, from an academic point of view, logistics only came to be recognized in the early nineteenth century and since then it has been studied from a strategic approach. In addition, it is used in companies that, due to the development in business complexity, especially in the management of materials and product deliveries in the supply chain, saw in this practice a way to gain competitiveness in a market that is increasingly

globalized (Silva, 2010). It was in the 1950s that the concept of business logistics gained momentum. This was mainly due to the development of complexity in the business, mainly in the management of materials and product deliveries in the supply chain (Machline, 2011). The growth of the logistics sector, driven by the intensification of globalization in recent years, has increased competition in the market. In order to become more competitive in this market, companies are seeking to continuously optimize the logistics area, through improvements in the planning, implementation and control of the storage flow of products, from the origin to the final customer, thus promoting the reduction of operational costs and available resources (Ballou, 2001).

The scarcity of natural and environmental resources, characterized by the growing demand for inputs by global supply chains, and greater concern for society, have led countries to intensify the design of sustainable public policies, thus giving rise to the concept of sustainable logistics (Julianelli et al., 2020). Sustainable logistics encompasses all actions taken in the organization's logistics area, aiming at minimizing impacts on the environment (Picelli and Georges, 2011).

In this context of constant and incessant search for the sustainability of the planet and in order to understand how to effectively balance organizational responsibilities in this *new era*, the Triple Bottom Line sustainability tripod theory emerges. In 1994, British sociologist John Elkington created the TBL concept defined as a business model based on sustainable actions, which considers not only the financial performance, but also the social and environmental performance of companies (Elkington, 2001). An example of sustainable practice focused on TBL is the reuse of waste, as it covers the economic factor (possibilities of gain with a representative product in the current market and obtaining production with a low-cost raw material); the social factor (source of employment and income generation for all those involved in the reverse chain) and the environmental factor (saturated waste, when discarded incorrectly, such as in sink drains and toilets, generate blockages in the sewage network (Julianelli et al., 2020; Azevedo et al., 2021).

The TBL can be understood as a complement to the concept of sustainable development, as it integrated elements such as social equality, economic criteria, and environmental responsibility and its essence is concentrated in three words: *people*, *planet* and *profit*, that is, it seeks a diversified vision for sustainability, providing a direct dialogue with the reality of business organizations (Elkington, 2001). It was in 1997 that the first company adopted this concept in its internal processes, the Shell oil company (Elkington, 1997). Despite the importance of sustainable logistics for the future of companies, however, many companies have not yet implemented all TBL guidelines in their operations (Furtado and Frayret, 2015). One of the reasons for this may be the fact that there is a lack of scientific production under this theme (Sehnem et al., 2015). Thus, it is observed the importance of scientific studies that elucidate more clearly and efficiently the understanding of sustainable logistics, within the scope of its operations and impacts generated on organizational performance, from the perspective of TBL. It is in this line that this article seeks to bring its contributions.

## METHODOLOGY

The integrative literature review is a form of research that reviews, critiques, and synthesizes representative literature on a given topic in an integrated way that can generate new frameworks and new perspectives on the topic studied (Torraco, 2005). Conducting a scoping review synthesizes the existing literature on a specific topic, in order to compare the results obtained from different studies in order to present the state of the art on a certain subject and highlight possible opportunities for conducting new studies (Fink, 2019). In this sense, scoping review is the methodology adopted in this article, whose main theme is sustainable logistics, approached from the perspective of the three pillars of the TBL, and which aims to build a CMO model. The approach presented by Arksey and O'Malley (2005) is adopted, based on its five steps: i) identification of the research question; ii) identification of relevant studies; iii) selection of studies; iv) analysis of results; and v) grouping, summarizing, and presenting the results.

In the first stage of the study, it was defined that Scopus and WOS (Web of Science) would be databases to be used due to their breadth in relation to the subject, high quality works and availability of multidisciplinary academic articles (Mueller, 2013), in addition to of their complementarities and relevance for operations management (Thomé et al., 2012).

Initially, a search was carried out for articles that addressed the main themes of this study, namely: *Sustainable Logistics, Triple Bottom Line, Environmental Sustainability, Financial Sustainability and Social Sustainability.* In order to expand the search capacity, some terms synonymous terms were included, such as*: Green Logistics, Eco-Logistics, TBL, Sustainability Tripod, Sustainable Nature, Sustainable Environmental Development, Economic Sustainability, Sustainable Economic Development and Sustainable Social Development*, according to the research protocol shown in Table 1.

**Table 1:** Criteria for selection of studies adapted. Source: The authors themselves.

| **Criteria for selection of studies** | | |
|---|---|---|
| 1st survey - All Fields (Sustainable Logistics and the "Triple Bottom Line", Environmental Sustainability, Social Sustainability and Financial Sustainability) | TITLE-ABS-KEY (((“Green Logistics”) OR (“Sustainable Logistics”) OR (“Eco-Logistics”) OR (“Environmental Logistics”)) AND ((“Environmental Sustainability”) OR (“Nature Sustainability”) OR (“Sustainable Environmental Development”)) AND ((“Financial Sustainability”) OR (“Economic sustainability”) OR (“Sutainable Economic Development”) OR (“Sustainable Financial Development”)) AND ((“Social Sustainability”) OR (“Sustainable Social Development”)) AND ((“Triple Bottom Line”) OR (“Sustainability Tripod”) OR (“TBL”) OR (“3BL”))) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)) | (ALL=(“Green Logistics”) OR ALL=(“Sustainable Logistics”) OR ALL=(“Eco-Logistics”) OR ALL=(“Environmental Logistics”)) AND (ALL=(“Environmental Sustainability”) OR ALL = (“Nature Sustainability”) OR ALL= (“Sustainable Environmental Development”)) AND (ALL=(“Financial Sustainability”) OR ALL=(“Economic sustainability”) OR ALL =(“Sutainable Economic Development”) OR ALL= (“Sustainable Financial Development”)) AND (ALL=(“Social Sustainability”) OR ALL=(“Sustainable Social Development”)) AND (ALL=(“Triple Bottom Line”) OR ALL= (“Sustainability Tripod”) OR ALL=(“TBL”) OR ALL=(“3BL”)) |
| 2nd survey - All Fields (Articles citing “Triple Bottom Line” and Sustainable Logistics) | TITLE-ABS-KEY (((“Green Logistics”) OR (“Sustainable Logistics”) OR (“Eco-Logistics”) OR (“Environmental Logistics”)) AND ((“Triple Bottom Line”) OR (“Sustainability Tripod”) OR (“TBL”) OR (“3BL”))) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)) | (ALL=(“Green Logistics”) OR ALL=(“Sustainable Logistics”) OR ALL=(“Eco-Logistics”) OR ALL=(“Environmental Logistics”)) AND (ALL=(“Triple Bottom Line”) OR ALL= (“Sustainability Tripod”) OR ALL=(“TBL”) OR ALL=(“3BL”)) |
| Boolean Operator | “AND” e “OR” | “AND” e “OR” |
| Data base | Scopus | Web of Science |
| Inclusion criteria | Use of Sustainable Logistics and “Triple Bottom Line” concepts. | Use of Sustainable Logistics and “Triple Bottom Line” concepts. |
| Exclusion Criteria | Studies published at conferences and articles written in languages other than English. | Studies published at conferences and articles written in languages other than English. |
| Year of publication | No restrictions | No restrictions |

Following the criteria and search presented above, some search combinations were performed, resulting in a total of 24 articles in the Scopus database and 22 articles in the WOS database, as shown in Tables 2 and 3, respectively.

**Table 2:** Search results on Scopus. Source: The authors themselves.

| **ARTICLE SEARCH - SCOPUS** | |
|---|---|
| Articles that cite Sustainable Logistics and the "Triple Bottom Line", Environmental Sustainability, Social Sustainability and Financial Sustainability | 0 article |
| Articles citing "Triple Bottom Line" and Sustainable Logistics | 16 articles |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 1 article |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability) and Sustainable Logistics | 2 articles |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability) and Sustainable Logistics | 1 article |
| Articles that cite the 2BL (Social Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| Articles citing the 2BL (Social Sustainability and Financial Sustainability) and Sustainable Logistics | 0 article |
| Articles citing 1BL (Environmental Sustainability), "Triple Bottom Line" and Sustainable Logistics | 2 articles |
| Articles citing 1BL (Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 2 articles |
| Articles citing 1BL (Social Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| *** Site search source Scopus TOTAL – 24 articles** | |

**Table 3:** Search results on WOS. Source: The authors themselves.

| **ARTICLE SEARCH - WOS** | |
|---|---|
| Articles that cite Sustainable Logistics and the "Triple Bottom Line", Environmental Sustainability, Social Sustainability and Financial Sustainability | 0 article |
| Articles citing "Triple Bottom Line" and Sustainable Logistics | 11 articles |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 1 article |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability) and Sustainable Logistics | 3 articles |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability) and Sustainable Logistics | 2 articles |
| Articles that cite the 2BL (Social Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| Articles citing the 2BL (Social Sustainability and Financial Sustainability) and Sustainable Logistics | 0 article |
| Articles citing 1BL (Environmental Sustainability), "Triple Bottom Line" and Sustainable Logistics | 4 articles |
| Articles citing 1BL (Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 1 article |
| Articles citing 1BL (Social Sustainability), "Triple Bottom Line" and Sustainable Logistics | 0 article |
| *** Site search source Web of Science TOTAL - 22 articles** | |

Critical analysis and synthesis are tools that together in literary review contribute positively to knowledge generation (Arksey and O'Malley, 2005). Thus, analyzing the articles found, it was identified that in the survey conducted in the Scopus database, out of the 24 articles found, six articles appeared in more than one search, so duplicates were excluded, thus resulting in a sample of 17 articles. In the WOS survey, it was identified that of the 22 articles found, 18 articles had already been collected in the search carried out in the Scopus database. Therefore, the total number of studies found in the Scopus and WOS database was 22 articles, as shown in Table 4.

**Table 4:** Results of Scopus and WOS searches after duplicate deletion. Source: The authors themselves.

| ARTICLE SEARCH | | | | | | |
|---|---|---|---|---|---|---|
| Articles citing "Triple Bottom Line" and Sustainable Logistics | 16 articles | - | | 11 articles | 10 articles | 1 article |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 1 article | 1 article | - | 1 article | 1 article | - |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability) and Sustainable Logistics | 2 articles | 1 article | 1 article | 3 articles | 2 articles | 1 article |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability) and Sustainable Logistics | 1 article | - | 1 article | 2 articles | 1 article | 1 article |
| Articles citing 1BL (Environmental Sustainability), "Triple Bottom Line" and Sustainable Logistics | 2 articles | 2 articles | - | 4 articles | 3 articles | 1 article |
| Articles citing 1BL (Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | 2 articles | 2 articles | - | 1 article | 1 article | - |
| *** Site search source Scopus and Web of Science** | | **TOTAL 22** | | | **articles** | |

New knowledge about previous research is created through analysis and synthesis, thus contributing to the creation of new perspectives on the studied topic (Arksey and O'Malley, 2005). Examining the resulting sample, it was defined that all studies that focused on only one or two dimensions of the TBL should be excluded, since the objective of this article is to focus on the approach encompassing the three pillars. Therefore, applying this criteria, another five articles were excluded, as shown in Table 5.

**Table 5 –**Articles excluded from the sample. Source: The authors themselves.

| ARTICLE SEARCH | SCOPUS | WOS |
|---|---|---|
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | - | - |
| Articles citing 2BL (Environmental Sustainability and Financial Sustainability) and Sustainable Logistics | 1 article | 1 article |
| Articles citing 2BL (Environmental Sustainability and Social Sustainability) and Sustainable Logistics | 1 article | 1 article |
| Articles citing 1BL (Environmental Sustainability), "Triple Bottom Line" and Sustainable Logistics | - | 1 article |
| Articles citing 1BL (Financial Sustainability), "Triple Bottom Line" and Sustainable Logistics | - | - |
| | **2 articles** | **3 articles** |
| *** Site search source Scopus and Web of Science** | **TOTAL** | **5 articles** |

After excluding the articles considered non-compliant, the resulting sample totaled 17 articles. In the next step, the information from the articles was consolidated into a Microsoft Excel spreadsheet. Information on authors' names, title, type of publication, language, authors' keywords, abstract, year of publication, among others, were catalogued. In this way, it was possible to make an initial analysis of the sample materials, in order to identify the main objectives of the selected articles, so that it would then be possible to carry out a more structured and complex exploration of the contents presented. Following the methodology of Arksey and O'Malley (2005), content analysis was performed, which according to Neuendorf (2002), is defined as the careful examination of human interactions through a systematic and objective analysis of the characteristics of the phenomenon. In this step, the content analysis approach adopted in Ceryno et al. (2013) was used.

In the initial analysis, the abstracts were read, all 17 articles have passed through to the next stage, in which the texts were fully read. In this reading, it was identified that four articles addressed one of the central themes, the TBL, in a superficial way, the concept was not presented in a complex way in order to significantly explore its three pillars, the economic, social and environmental. Thus, the four articles were removed from the sample, resulting in a final sample of 13 articles.

Results are presented in the next section of this article. Additionally, was used the realistic evaluation approach, originally developed by Pawson and Tilley (1997), which is based on the assumption that projects and programs work under certain conditions, following the CMO principle, defined as Context (C) + Mechanism (M) = Result (O) (Befani et al., 2007).

## RESEARCH FINDINGS AND DISCUSSIONS

### Content analysis

With the final sample resulting from 13 articles, the descending order of articles was performed according to the number of citations, represented in time, as shown in Table 6.

**Table 6 –** Final sample with 13 articles. Source: Scopus and WOS (accessed on 08/29/21).

| Authors | Article Title | Citations | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | < 2017 | 2017 | 2018 | 2019 | 2020 | 2021 | Total |
| Kleindorfer et al . (2005) | Sustainable operations management | 522 | 114 | 122 | 101 | 127 | 70 | 1056 |
| Markley and Davis (2007) | Exploring future competitive advantage through sustainable supply chains | 135 | 30 | 20 | 24 | 26 | 13 | 248 |
| Winter and Knemeyer (2013) | Exploring the integration of sustainability and supply chain management Current state and opportunities for future inquiry | 61 | 30 | 42 | 36 | 30 | 21 | 220 |
| He et al. (2017) | Performance measurement system and strategies for developing low-carbon logistics: A case study in China | 1 | 1 | 12 | 14 | 13 | 16 | 57 |
| Stindt (2017) | A generic planning approach for sustainable supply chain management - How to integrate concepts and methods to address the issues of sustainability? | 0 | 2 | 6 | 14 | 11 | 12 | 45 |
| Björklund and Forslund (2019) | Challenges Addressed by Swedish Third-Party Logistics Providers Conducting Sustainable Logistics Business Cases | 0 | 0 | 0 | 1 | 2 | 5 | 8 |
| An et al. (2021) | Nexus between green logistic operations and triple bottom line: evidence from infrastructure-led Chinese outward foreign direct investment in Belt and Road host countries | 0 | 0 | 0 | 0 | 0 | 6 | 6 |
| Zhang et al. (2020) | Green Logistics Development Decision-Making: Factor Identification and Hierarchical Framework Construction | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| Arya et al. (2019) | Modelling environmental and economic sustainability of logistics | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| Kumar et al. (2017) | Conceptualization of a research model for sustainable logistics practices and logistics transport performance | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Satolo et al. (2020) | Sustainability Assessment of logistics activities in a dairy: An example of an emerging economy | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Nero and Sreedhara (2019) | A study on the influence of sustainability related factors on the online purchase decisions of customers | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Martins et al. (2021) | Brazilian logistics practitioners' perceptions on sustainability: an exploratory study | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Analyzing the result obtained, it is possible to see that the two oldest works are the two most cited. However, analyzing citations by years of publication, Winter and Knemeyer (2013) is also highlighted. It is also noted that the number of works addressing these topics is on the rise, particularly from 2017 onwards. The analysis of results is organized in context (C), would be the organizational contexts, the mechanism (M) would be represented by the HTO model, and the results (O) would be the products generated from the HTO interactions from the TBL perspective.

**Context analysis – C (context)**

A realistic assessment is intended to help understand which mechanisms are triggered by which programs in which contexts. Some factors in the context may allow or prevent specific mechanisms from being triggered. The interaction between the context and the mechanism is what generates the model results (Pawson and Tilley, 1997).

In the CMO model, the context is represented by "C", and may be associated with different aspects such as the organizational context, the socioeconomic and political environment, history, and local culture (Befani et al., 2007; Machado, 2003). In this category, the organizational context will be analyzed, which is defined as the reality of the company and the environment in which it is inserted. It is a set of internal and external factors that affect the operation of the company and its processes (Neuendorf, 2002; Machado, 2003).

Analyzing articles, it is possible to identify that issues related to the company's location have an important influence on the implementation of sustainable logistics. The European Union (EU) created laws to effectively egulate and monitor hazardous materials, packaging waste, end-of-life solid waste and high energy consumption, thus encouraging sustainable practices within organizations (Zhang et al., 2020).

In addition to mandatory regulations imposed by governments, which have a significant effect on the development of sustainable logistics, another influencing factor is the location of production and distribution facilities, as they directly impact relations with suppliers and with the end customer (Winter and Knemeyer, 2013). The great challenge that China faces in the logistics sector due to the lack of a nationally integrated transport network (He et al., 2017).

Location also influences the labor issue. In Brazil, there is a predominance of inexperienced professionals who are not engaged in sustainable practices that promote social contributions (Martins et al., 2021). Technology is another factor influenced by location. Countries that invest more in technology have easier access to it, at a lower cost compared to other countries. The logistics industry in China has been experiencing significant growth, driven by the rapid development of e-commerce and the investment and development in technology, mainly in big data, cloud computing and intelligent logistics network system (He et al., 2017).

In the organizational context, there are more important factors such as the type of industry, the market branch and the type of product produced, aspects that can directly influence social indicators. Furthermore, each company must start from its own contextual situation and that the biggest challenge for these organizations is to understand their context and design a sustainable logistics system that will meet their needs (Björklund and Forslund, 2019).

**Analysis of HTO dimensions – M (mechanism)**

The combination of reasoning and resources is what makes a program work. This is known as the program engine (Befani et al., 2007). In this study, the mechanism (M) of the CMO model was developed based on content analysis from the perspective of the role of the HTO dimensions and their interactions in sustainable logistics.

Regarding the "Human" dimension, nine articles emphasized the importance of the organization having managers engaged in sustainable initiatives. Currently many logistics managers and employees do not have the knowledge and skills to implement sustainable practices (Zhang et al., 2020). The lack of qualified and experienced logistics talent in the

market is a hindering factor for the implementation of sustainable logistics (Ceryno et al., 2013; Machado, 2003; Satolo et al., 2020). . In the technological dimension, 11 articles mention the importance of investing in new technologies in the implementation of sustainable logistics, such as the use of radio frequency identification (RFID) to improve inventory tracking and visibility and the use of cross-docking to achieve cost-efficiency in delivery (Arya et al., 2019).

Information technology applied to the area of logistics can drastically reduce redundant activities, improve logistics efficiency, and further stimulate the development of sustainable logistics (Neuendorf, 2002). To invest in technology is a way to generate revenue, as well as improve the environmental performance of logistics (Arya et al., 2019).

Regarding the organizational dimension, 10 articles emphasize the importance of the organization has an organizational infrastructure, which seeks to optimize production processes, reducing the use of resources in operations, in order to improve operational efficiency and thus contribute to the success of the implementation of the sustainable logistics Martins et al. (2021), Bjorklund and Forslund (2019), Markley and Davis (2007) and Kleindorfer et al. (2005) add that having a sustainable supply chain is an effective organizational strategy in the search for competitive advantage and ensuring the satisfaction of its stakeholders. The result analysis in Table 7.

**Table 7 –** Table of articles regarding the approach HTO. Source: The authors themselves.

| Authors | HTO | | |
|---|---|---|---|
| | Human | Technology | Organizational |
| Kleindorfer et al. (2005) | x | x | x |
| Markley and Davis (2007) | x | x | x |
| Winter and Knemeyer (2013) | x | x | - |
| He et al. (2017) | x | x | x |
| Kumar et al. (2017) | x | x | x |
| Stindt (2017) | - | x | x |
| Arya et al. (2019) | x | x | - |
| Björklund and Forslund (2019) | - | x | x |
| Nero and Sreedhara (2019) | - | x | x |
| Satolo et al. (2020) | x | - | - |
| Zhang et al. (2020) | x | x | x |
| An et al. (2021) | - | x | x |
| Martins et al. (2021) | x | - | x |

## Analysis of the triple bottom line approach – O (outcomes)

Considering that the TBL in its environmental, economic, and social aspects, directly impacts the organization's performance, which is an important indicator for the implementation of sustainable logistics. It was considered in this study that the result (O) of the CMO model would be obtained through the analysis of HTO interactions from the perspective of TBL.

Out of the selected articles, all presented the reduction of polluting gases as an essential factor in the study of the environmental aspect of sustainable practices. Among these, five articles also mentioned the need to reduce the emission of solid waste into the environment. The focus on energy efficiency was studied by ten authors and the conscious use of natural resources by four, as shown in Table 8.

**Table 8 –** Table of articles regarding the approach to the environmental aspect. Source: The authors themselves.

| Authors | Environmental aspect | | | |
|---|---|---|---|---|
| | Decrease in the emission of polluting gases | Decrease in the emission of solid waste | Energy consumption | Cnsumption of natural resources |
| Kleindorfer et al. (2005) | x | x | x | x |
| Markley and Davis (2007) | x | - | - | x |
| Winter and Knemeyer (2013) | x | - | - | - |
| He et al. (2017) | x | x | x | - |
| Kumar et al. (2017) | x | - | x | x |
| Stindt (2017) | x | - | x | - |
| Arya et al. (2019) | x | x | - | - |
| Björklund and Forslund (2019) | x | x | x | - |
| Nero and Sreedhara (2019) | x | - | x | - |
| Satolo et al. (2020) | x | - | x | x |
| Zhang et al. (2020) | x | x | x | - |
| An et al. (2021) | x | - | x | - |
| Martins et al. (2021) | x | - | - | x |

The energy consumption reduction and the more conscious use of resources, promote greater efficiency in operations, leading to cost reduction (Satolo et al., 2020; Kleindorfer et al., 2005; Kumar et al., 2017). Bjorklund and Forslund (2019) presented important data on the implementation of sustainable logistics, which resulted in 70% savings in energy costs.

Regarding the economical aspect, all articles presented cost minimization as the most relevant point. Out of these articles, six articles were concerned with the need to invest in the acquisition of new technologies and equipment to enable the implementation of sustainable practices, as shown in Table 9.

**Table 9 –** Table of articles regarding the approach to the economic aspect. Source: The authors themselves.

| Authors | Economic aspect | |
|---|---|---|
| | Cost savings | Investment costs |
| Kleindorfer et al. (2005) | x | - |
| Markley and Davis (2007) | x | - |
| Winter and Knemeyer (2013) | x | - |
| He et al. (2017) | x | x |
| Stindt (2017) | x | - |
| Kumar et al. (2017) | x | - |
| Arya et al. (2019) | x | x |
| Björklund and Forslund (2019) | x | x |
| Nero and Sreedhara (2019) | x | x |
| Satolo et al. (2020) | x | - |
| Zhang et al. (2020) | x | x |
| An et al. (2021) | x | x |
| Martins et al. (2021) | x | - |

Materials and energy costs will continue to grow as the world economy expands, investing in sustainable practices capable of developing substitutes for renewable inputs and redesigning products to reduce material and energy consumption during manufacturing and use therefore becomes essential (Kleindorfer et al., 2005).

The implementation of a sustainable transport system can reduce operating costs through fleet optimization (Zhang et al., 2020). The adoption of organizational measures at the tactical and operational level can substantially improve environmental performance without requiring higher investments (Kumar et al., 2017).

In the social pillar, eight articles claimed that working conditions, such as health and safety, are important aspects in the analysis of social sustainability. In this theme, four articles addressed the issue of employment generation arising from the need to hire a workforce specialized in green transport, which is scarce in the market, causing a bottleneck that restricts the development of sustainable logistics (Zhang et al., 2020). Following, result analysis in Table 10.

**Table 10** – Table of articles regarding the approach to the social aspect.

| Authors | Social aspect | |
|---|---|---|
| | Work conditions | Job generation |
| Kleindorfer et al. (2005) | x | - |
| Markley and Davis (2007) | x | - |
| Winter and Knemeyer (2013) | - | x |
| He et al. (2017) | x | - |
| Stindt (2017) | - | x |
| Kumar et al. (2017) | x | - |
| Björklund and Forslund (2019) | x | - |
| An et al. (2021) | - | x |
| Zhang et al. (2020) | x | - |
| Arya et al. (2019) | x | - |
| Nero and Sreedhara (2019) | x | - |
| Martins et al. (2021) | - | x |
| Satolo et al. (2020) | x | - |

Source: The authors themselves.

Greater institutional quality helps to mitigate social concerns by improving the efficiency of logistical operations (Martins et al., 2021; Kumar et al., 2017; An et al., 2021). The hiring of human resources management focused on sustainable logistics is part of a movement towards corporate social responsibility (Zhang et al., 2020).

## CMO model

The results showed that of the 13 selected articles, all addressed the TBL, contemplating the three pillars: environmental, economic, and social, in order to enable, through the information provided, an analysis of how the roles of the human, technological and operational dimensions act in sustainable logistics. In the analysis carried out on the HTO perspective, out of the 13 articles analyzed, only in five articles it was possible to identify the three HTO dimensions and their interactions, in six articles two dimensions were identified, and in two articles only one dimension, as shown in Table 11.

**Table 11** – Analysis of articles regarding the HTO approach and the TBL perspective. Source: The authors themselves.

| Authors | HTO | | | Triple Bottom Line | | |
|---|---|---|---|---|---|---|
| | Human | Technology | Organizational | Environmeatal aspect | Economic aspect | Social aspect |
| Kleindorfer et al. (2005) | x | x | x | x | x | x |
| Markley and Davis (2007) | x | x | x | x | x | x |
| Winter and Knemeyer (2013) | x | x | - | x | x | x |
| He et al. (2017) | x | x | x | x | x | x |
| Kumar et al. (2017) | x | x | x | x | x | x |
| Stindt (2017) | - | x | x | x | x | x |
| Arya et al. (2019) | x | x | - | x | x | x |
| Björklund and Forslund (2019) | - | x | x | x | x | x |
| Nero and Sreedhara (2019) | - | x | x | x | x | x |
| Satolo et al. (2020) | x | - | - | x | x | x |
| Zhang et al. (2020) | x | x | x | x | x | x |
| An et al. (2021) | - | x | x | x | x | x |
| Martins et al. (2021) | x | - | x | x | x | x |

A CMO model was developed based on the analysis of the contents of the 13 selected articles. The following aspects of the organizational context were defined: location (country/state), type of company, branch of the company and stakeholders.

According to the articles, location is an important factor in the organizational context, as it defines the laws and regulations that the company must follow and for directly influencing issues related to the quality and availability of labor, as well as the availability of technology for the implementation of sustainable logistics (Stindt, 2017; He et al., 2017; Martins et al., 2021). Another relevant point is the location of stakeholders that directly impact the geographic dispersion of supply sources and customer demand (He et al., 2017). Finally, we have the type of industry and the market branch, considered important variables that can directly impact the organization's social indicators (Bjorklund and Forslund, 2019).

In this article, the mechanism of the CMO model was elaborated from the analysis of the contents, from the perspective of the role of the HTO dimensions and their interactions in sustainable logistics. The following aspects were defined for the human dimension: skills, technical and physiological/psychological skills. Regarding the technological dimension, the following topics were defined: information quality, performance, systems integration, and design. In the organizational dimension, there are the following points: formal and informal infrastructure and organizational environment.

According to the articles, knowledge and individual skills are fundamental characteristics for the implementation of sustainable practices (Zhang et al., 2020; He et al., 2017; Satolo et al., 2020). In addition, it is very important that the organization has managers engaged and concerned with sustainable issues (Zhang et al., 2020; He et al., 2017; Martins et al., 2021; Satolo et al., 2020; Arya et al., 2019; Markley and Davis, 2007; Kleindorfer et al., 2005; Kumar et al., 2017; Nero and Sreedhara, 2019). The investment in technology is a relevant factor in the implementation of sustainable logistics (Zhang et al., 2020; Stindt, 2017; He et al., 2017; Björklund and Forslund, 2019; Arya et al., 2019; Markley and Davis, 2007; Kleindorfer et al., 2005; Kumar et al., 2017; An et al., 2021; Nero and Sreedhara, 2019). The technology, when applied to the logistics area, may be able to considerably reduce redundant activities, improve logistics efficiency and further stimulate the development of sustainable logistics, thus promoting cost reduction and profit optimization (Zhang et al., 2020; Björklund and Forslund, 2019; Kleindorfer et al., 2005; Kumar et al., 2017). For example, the use of radio frequency identification (RFID) which helps to optimize tracking, as well as providing better inventory control (Zhang et al., 2020). It is necessary that quality information is included in the tool so that reliable reports can be generated. In addition, it is important to have adaptability regarding its design to facilitate the adherence of new users as well as the integration with other systems, to facilitate the flow of information.

A well-defined organizational structure, in a favorable organizational environment, are factors that facilitate the search for the optimization of production processes, aiming to reduce the use of resources in operations, in order to improve operational efficiency and thus contribute to the successful implementation of logistics sustainable (Zhang et al., 2020; Stindt, 2017; He et al., 2017; Martins et al., 2021; Markley and Davis, 2007; Kleindorfer et al., 2005; Kumar et al., 2017; An et al., 2021; Nero and Sreedhara, 2019). Thus, synthesizing the data presented, a CMO model was created, represented in Figure 2.

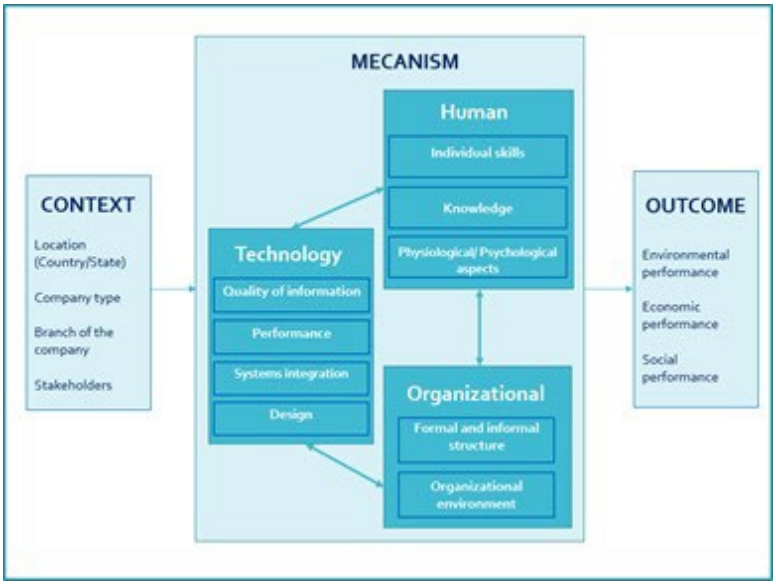


**Figure 2 –** CMO Model elaborated based on the content analysis of the final sample.

Source: The authors themselves.

Analyzing the 13 articles and identifying how the interactions of the HTO dimensions play a key role in the implementation of sustainable logistics, it was possible to see that the importance of analyzing the environmental, economic, and social aspects of TBL in the practice of sustainable logistics, is directly related to the results generated by this integration, thus completing the CMO model.

The results (O) were defined as the environmental-ecological performance: minimization of energy consumption, emission of polluting gases and the use of resources used; economic performance: focus on cost minimization by reducing resource and energy consumption and the implementation of sustainable production processes and social performance: focused on social aspects, such as concern for the health and well-being of employees and customers and generation of jobs (Zhang et al., 2020; Stindt, 2017; He et al., 2017; Martins et al., 2021; Satolo et al., 2020; Arya et al., 2019; Markley and Davis, 2007; Kleindorfer et al., 2005; Kumar et al., 2017; An et al., 2021; Nero and Sreedhara, 2019).

## CONCLUSIONS

The CMO model is a management tool that, when applied, can provide important information for continuous improvement and the decision-making process. It is relevant to have the configuration of the mechanism based on the HTO approach since the human, technological and organizational dimensions are significant parts for the existence of an organization and their interplay directly impacts its performance. Given the importance of the theme of sustainability, the perspective chosen for this approach was the TBL. By looking from the HTO perspective in the management of production processes, managers benefit from a more realistic view of the difficulties encountered in implementing new practices and a greater capacity to deal with them. The TBL perspective, on the other hand, has its importance due to its focus on sustainability, one of the most important and discussed topics today. Therefore, this article proposes a first CMO model for sustainable logistics based on the HTO approach under the TBL perspective. The approach was build-upon a scoping review.

Initially, an analysis of the organizational context of the articles was performed, in which the following variables were identified: location, type of company, branch of the company and stakeholders. It was defined that in the configuration of the model mechanism, the HTO approach would be used. The following dimensions and categories emerged: Human (skills, competences, and physiological/psychological aspects), Technological (information quality, performance, integration between systems and design) and Organizational (formal/informal structure and environment organizational). In response to the first research question, after identifying the HTO dimensions, an analysis was performed regarding their interactions. Among the conclusions obtained, for the successful implementation of sustainable logistics, it is essential that the organization has an organized infrastructure, with well-defined processes and an organizational environment favorable to new technological investments aimed at sustainable practices. Furthermore, the presence of professionals engaged with the skills and competences required to use this new technology is essential. Thus, the relationships between the human, technological and organizational dimensions, as well as their interplay, proved to be important for the success of sustainable logistics, in addition to providing relevant contributions to the economic, social and environmental performance of companies. To answer the second question, an analysis of the articles was subsequently carried out, from the perspective of TBL, in which it was identified that the results generated from the HTO interactions, within the context of sustainable logistics, are: ecological and environmental performance, economic financial performance and social performance. Thus, using the information presented, the CMO model was built, which links its context and outcomes, focused on the performance of sustainable logistics. During the preparation of this research, it was found that most of the logistics studies focus their strategies primarily on cost reduction and reuse of materials through the implementation of reverse logistics. Despite being fundamental for today, sustainable logistics is still an underexplored concept, regarding the integration of the three pillars of sustainability (economic, environmental, and social), mainly from the social aspect.

The CMO model proposed in this article aims to contribute to scholars, through the dissemination of sustainable logistics concepts in the context of the HTO dimensions, from the perspective of TBL. The research findings can also be used by industry practitioners, as it aims, through the proposal of a sustainable logistics management artifact, to encourage

professionals to implement this practice in their organizations, offering industry professionals an opportunity to make sustainable logistics a tool capable of creating value for stakeholders. Finally, this article also offers opportunities for future research. The first opportunity is associated with a better understanding of the social pillar, as studies incorporating this pillar are still scarce. A broader view of the context, beyond the organizational context given in this article is also recommended for the continuation of this research, as well as the application in an empirical study of the proposed model as a first effort to improve and validate it, especially regarding the search for generalizations.

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