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UMA REVISÃO DE LITERATURA SOBRE O DESIGN E PLANEJAMENTO DE CENTROS DE DISTRIBUIÇÃO

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ABSTRACT

Highlights: Given the difficulties of practical implementation of a Distribution Center (DC) project, it is essential to provide an elaborate DC project study. Therefore, this study seeks to answer the research questions related to the main decisions for designing and planning the DCs and whatever the characteristics, advantages and barriers of such decisions.
Aim: Identify the main DC project and planning methods, consolidating their characteristics, difficulties, and highlighting gaps and research opportunities.
Design / Methodology / Approach: The methodology of this work is a systematic review of the literature divided into three stages, which are: (i) definition of the bibliographic portfolio and research axes; (ii) bibliometric analysis; and (iii) analysis and discussion of theoretical lenses, presenting gaps and research opportunities. The retrieved articles and the conclusions of this research are restricted to the search period until July 2018.
Results: This study describes how the DC implantation project concept was applied, which methods are proposed and which difficulties were found in the implantation and project, according to the literature. As a result, despite the consensus on the practical importance of DC project, most research assesses project stages in isolation. The stages of location definition and the order picking process are the most mentioned. And finally, the context and distribution network are little considered in the analysis of DC project decisions.
Research Limitations: The study derives from the research of scientific articles from specific databases and is analyzed from the perspective of the theoretical lens of distribution networks. Therefore, the literature analysis through other perspectives may present other results and research gaps.
Practical Implications: In practical terms, the research assesses how DC planning and implementation takes place in the context of distribution networks, thus helping managers to make decisions during the project of new DC installations, ensuring better results in their operation.
Originality / value: Few investigations extensively analyze the distribution network and all phases of a DC project planning targeting a specific business segment, making practical application less feasible, a gap filled by this study.

Keywords: Distribution centers; Project and planning of facilities; Literature review.

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1. INTRODUCTION

Companies are increasingly looking to accelerate material flow by reducing the time between order receipt and delivery and, consequently, inventory costs. In this context, there is a tendency to increase inventory centralization, facilitating direct and continuous delivery at each point of the supply chain, highlighting the relevance of Distribution Centers (DC) for business performance (Rheem, 1997; Nozick *et al*., 2001; Rodrigues; Pizzolato, 2003). The implementation of a DC in the supply chain is the result from the need for more efficient, flexible and dynamic distribution that can respond quickly to customer demand (Rodrigues; Pizzolato, 2003; Hiremath *et al*., 2013; Santos, 2015). Thus, a significant part of the effectiveness of logistics activities depends on the way DCs operate in supply chains (Baker, 2004; De Santis *et al*., 2018).

Several decision support models for DC operations have been proposed in the literature, but there is still considerable difficulty in applying these models to guide their operations effectively (Gu *et al*., 2007; Baker; Canessa, 2009). In other words, a solid theoretical basis for DC project still seems to be missing (Rouwenhorst *et al.,* 2000; Goetschalckx *et al.,* 2002; Dotoli *et al*., 2015; Vieira *et al.,* 2017; De Santis *et al.*, 2018; Holzapfel *et al*., 2018). Vieira *et al*. (2017) point out that a company's distribution strategy ensures the success of its internal operations, and the way its internal activities are organized is influenced by the characteristics of its distribution strategy. Therefore, such methods should consider the relevant characteristics of the context in which the DC is inserted and its distribution network, in order to improve the results of these projects. Such a gap in the literature has raised the following research questions:

1. What are the main decisions for designing and planning DCs?

2. What are the characteristics, advantages and barriers of such decisions?

To answer these questions, this article aims to identify the main stages and decisions of DC projects, and analyze these decisions from the perspective of the contextual characteristics that the company is inserted, indicating advantages and barriers. Thus, the literature will be evaluated through the theoretical lens of distribution networks. The method used for this research is a literature review, as it intends to reinforce the proposed object of study, besides justifying the research differential, from the identification of gaps and perspectives (Paré *et al.,* 2015).

The contribution of this study is made in three ways. First, from an academic point of view, the research aims to bring together content about DC project planning, raise the state of the art on the topic, and present gaps and research opportunities. Secondly, in practical terms, research envisages assessing how DC planning and implementation takes place in the context of distribution networks. Finally, this research helps to make decisions during the project of new DC installations, ensuring better results in their operation.

2. DISTRIBUTION CENTER PROJECTS

Demand for DCs has recently increased due in part to the wider variety of products and services being offered and the shift to smaller customer orders (Higginson; Bookbinder, 2005; Zhuge *et al.,* 2016). Centralizing the flow of materials and information through DC facilitates higher levels of supply chain efficiency (Litomin *et al.*, 2016), increasing the relevance of proper DC project and planning (Hou *et al.,* 2010; Hua *et al.*, 2016).

The processes contemplated by a DC are: receipt, storage, order picking, shipping (Rouwenhorst *et al*., 2000; Gu *et al*., 2007; Vieira *et al.,* 2017), cross-docking (Choy, 2012; Faber *et al.,* 2013), product packaging (Faber *et al.,* 2013; Vieira *et al.,* 2017), and returns (Faber *et al.,* 2013), among others. The combination of such processes reduces order preparation, execution and delivery time, reducing total shipping cost and improving service level (Litomin *et al*., 2016).

As detailed by Tompkins *et al.* (2013) in Figure 1, facility planning can be subdivided into location and project. Localization addresses the macroscopic issues of the facility, such as accessibility of logistics and proximity modes with suppliers and customers. The installation project deals with the microelements, which include the systems of installations, physical arrangement and material handling. Although these project phases provide very general guidelines when considering DC project, other specific decisions must be taken into account (Ballou, 2006), which gives rise to the need to properly identify such methods.

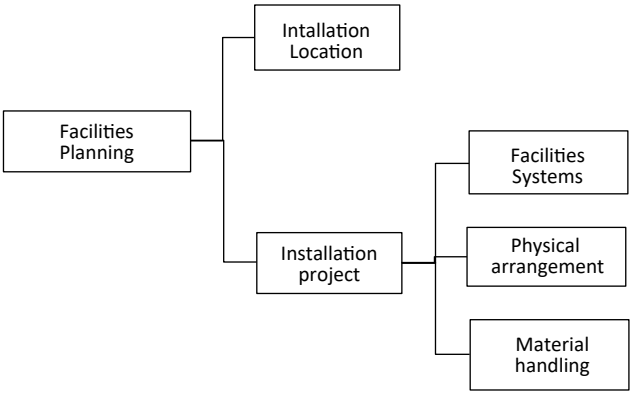

Figure 1. Plant Planning Project Phases
Source: Made from Tompkins *et al.* (2013)

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3. METHOD

To achieve the research objective, which is to identify, from a systematic literature review, the main DC project and planning methods, a bibliographic research is used. The bibliographic research is made from the survey of theoretical references already analyzed and published, such as books and scientific articles. The bibliographic research is made from the survey of theoretical references already analyzed and published, such as books and scientific articles (Fonseca, 2002). The work method is proposed in two steps: a) bibliometric analysis; and b) analysis and discussion of theoretical lenses. To achieve the steps, the bibliographic portfolio is defined.

To define the bibliographic portfolio (BP) used in the research, the research axes were first defined: (i) implementation project and (ii) distribution center. Then, the keywords were combined to search for publications in titles, abstracts and/or keywords. The scientific articles were identified by keywords in the Scopus, Web of Science and Science Direct databases, as suggested by Ntabe. *et al.* (2015) and Chen *et al.* (2017) on the theme of logistics and supply chain. Also, in searches on the Capes journal portal on the subject related to keywords, among the articles presented and peer reviewed, 90% were in these three databases. In order to validate the keywords used in the initial search, a compliance check was performed. For this, three articles with high citation (over 400) from the portfolio initially identified in the databases were selected, and their keywords compared to those used in the research axes (Ensslin *et al*., 2010). Thus, it was possible to identify that the articles also have the term "project and planning of facilities". Therefore, such term was incorporated into the search axes and a new search in the same databases was performed, concluding the crude BP. The search period in the databases occurred during July 2018.

For the filtering process, both publications and the following criteria were analyzed (Ensslin, 2010): (i) removal of duplicate articles; (ii) weighting of the Journal Article only; (iii) article titles aligned with the research theme; (iv) abstracts aligned with the research theme; and (v) review of the full text of articles aligned with the research theme. The software used for the registration and selection of articles was EndNote X7®. As shown in Table 1, the Science Direct database obtained the largest number of publications. By eliminating duplicate and non-journal articles, the base has been reduced to 5,570. Finally, the abstracts of the papers were read individually to check the contribution to the theme and, of the 1,623 articles, 203 presented the abstract aligned to the theme, and in the full reading of the article, only 67 presented a real contribution to this research, in order to form the bibliographic portfolio (see Table 2).

Table 1. Bibliographic Portfolio Survey

Keywords *"Facilities project and planning" OR "Project" OR "Facilities planning" AND "Distribution Center*" OR "Warehouse*"*	Data base		
	Scopus	*Science Direct*	*Web of Science*
	2.000	3.125	2.304
Total	7.429		

Source: The authors

Table 2. Article filtering process

Publication analysis criteria	
(i) and *(ii)*	5.570
(iii)	1.623
(iv)	203
(v)	67

Source: The authors

4. RESULTS ANALYSIS

Bibliometric analysis was divided into two stages: (i) analysis of basic variables and (ii) analysis of advanced variables.

Analysis of basic variables

In the consolidation of the basic variables, the first step analyzes the BP regarding the most relevant journals and authors, in addition to the year of publication and research methods of the articles. For the advanced bibliometric analysis, the articles were counted for the following variables: (i) analysis of DC project proposals; and (ii) difficulties in implementing the DC project.

As for journals, Table 3 shows the distribution of publications by journal contained in the BP. In this regard, it is highlighted the European Journal of Operational Research, IIE Transactions, International Journal of Production Research, which feature more than eight publications each. Based on the 67 articles that make up the BP, 166 authors were identified, of which 12 present more than two published articles (see Table 4). It should be noted that the author René B. M. de Koster presents the largest number of publications (five articles) in the BP.

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Table 3. Number of publications per journal

Journal	Total publications
European Journal of Operational Research	10
IIE Transactions	9
International Journal of Production Research	8
International Journal of Operations & Production Management	3
Computers & Industrial Engineering	3
International Journal of Production Economics	3
Transportation Research Part E	2
Int J Adv Manuf Technol	2
Others (26)	1

Source: The authors

Table 4. Number of publications by author

Authors	Total publications
Koster, R. B. M.	5
McGinnis, L. F. / Choy, K. L. / Meller, R. D.	3
Gu, J. / Goetschalckx, M. / Marchet, G. / Lee, C. K. M. / Yu, S. / Parikh, P. J. / Baker, P. / Ho, G. T. S	2
Outros 154 autores	1

Source: The authors

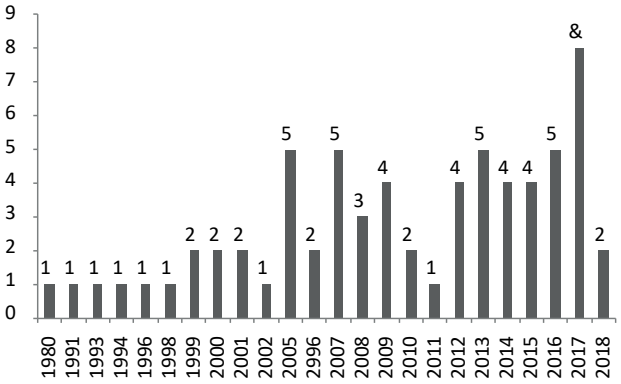

Figure 2. Time evolution of BP publications

Source: The authors

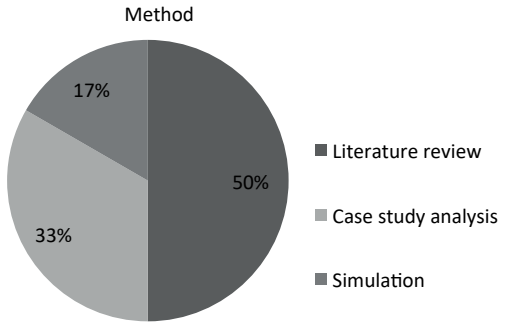

Figure 3. Literature research methods for DC project proposals

Source: The authors

For the year of publication of the articles of BP, as shown in Figure 2, it is clear that the theme of DC project proposal is not recent, since the first publications date from the 1980s. However, it should be noted that from 2005 there was a significant increase in publications on the topic, reaching its peak in 2017, with eight papers published. This fact demonstrates the growing relevance of adequate DC project, given the complexity that supply chains have been acquiring in recent years in a globalized market (Higginson; Bookbinder, 2005; Zhuge *et al.,* 2016).

Among these studies, according to Figure 3, half used the literature review research method to propose the DC project and 33% used the case study analysis method. Therefore, there is a shortage in DC project proposals that structure a planning and project methodology based on theory and practice. Among the works of BP related to DC project, the literature review is the most used (Rouwenhorst *et al.,* 2000; Gu *et al.,* 2007; 2010).

Advanced Variable Analysis

For analysis of the first advanced variable proposed by DC project, Rouwenhorst *et al*. (2000) propose that a DC project process goes through several steps which are: concept, data acquisition, functional specification, technical specification, equipment selection, layout, planning, and control policy selection. Alternatively, these steps may be situated at a strategic, tactical or operational level. Thus, DC project can be viewed as a set of decisions at the various project levels, and for each level, decisions are put into perspective using three aspects of a DC: (i) processes; (ii) resources; and (iii) organization.

At the strategic level, project decisions have a long-term impact, especially decisions that concern high investments. Thus, the main aspect of DC project involved at the strategic level is process (aspect i), which is evidenced from the decisions regarding the project of the process flow and the selection of storage system types. At the tactical level, several medium-term decisions must be made, usually related to the "resource" (e.g. storage system size and number of employees) and "organization" aspects (e.g. layout determi-

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nation). Finally, at the operational level, the main decisions concern personnel and equipment (resource) assignment and control issues (Rouwenhorst *et al*., 2000).

The research by Gu *et al.* (2007; 2010) identifies operating problems related to the four major DC functions (receiving, storing, order picking, and shipping). In addition, they include performance appraisal and support tools for DC project, involving five main steps (see Table 5). The stages and decisions of the DC project of Gu *et al.* (2007) were adapted by grouping a few steps that are listed, including a DC location step, which is often quoted in BP. The first two steps, determining the overall structure of the DC and its sizing, complement the steps already cited by Rouwenhorst *et al.* (2000). In the layout stage you have the detailed configuration of the DC, such as aisle and picking areas, as well as pallet stacking patterns in the storage areas. The equipment selection step comprises decisions focused on the appropriate automation level for the DC, such as types of equipment for storage, transport and order picking. Finally, the operation strategy selection determines how the DC will be operated with regard to order storage, collection, organization and picking. Such decisions impact the operational efficiency of the information and material flows on the DC, which increases the need for their alignment with the decisions of the previous steps.

Bodner *et al*. (2002) classify the DC project literature into two broad categories. The first category addresses the general problem of DC project, while the second category addresses the specifics of DC project, such as the project of a storage system or an order picking system. Vieira *et al*. (2017) divide the DC project into distribution strategies, internal activities and characteristics of distribution operations, and propose a decision model for DC operations based on strategic, tactical and operational aspects, such as Rouwenhorst *et al*. (2000). The study by Hsieh and Tsai (2006) points out that previous work on the order picking operation of a DC is usually limited to the order picking policy and picking script, and few focus on a combined solution about designing the number of layout aisles, order picking policy, storage allocation planning, average picking density within a corridor, and so on. Finally, Baker and Canessa (2009) interviewed companies to verify the steps that follow when designing a DC.

Rouwenhorst *et al*. (2000) and Bodner *et al*. (2002) indicate that there are a large number of studies on the analysis of DC project planning steps, such as layout and material handling; however, the literature presents scarcity of a basis for the overall DC project. Based on this context, from the BP reading, the analysis of the DC project planning steps is made, based on the steps of Gu *et al*. (2007), as detailed in Table 5. This stage has the largest number of articles published on the definition of the order picking process.

Order picking is one of the most laborious and time consuming processes on a DC (Franzke *et al.*, 2017). It can be defined as the process of retrieving products from storage locations to fulfill customer orders (De Koster *et al.,* 2007), and is a critical supply chain process that directly influences customer satisfaction. For the authors in the DC project stage, which is the definition of the DC operations, order picking is one of the processes to be defined and should include batch, sequencing and picking decisions.

The second most cited step, considering installation planning, is the location of a DC. The possible reason is that the location of a DC influences the choice of the supplier, and these sourcing decisions influence the total cost of distribution. In addition, supplier-related costs have become more significant in recent years with increasing market volatility (Nozick; Turnquist, 2001; Huang *et al.* 2012). Therefore, in addition to the overall DC project work being scarce, also considering the DC project steps, many phases also have few publications, such as equipment selection definitions and storage operation strategy, emphasizing the need for studies in all stages of project planning.

The second advanced variable analyzed contemplated the difficulties in implementing the DC project. Bodner *et al.* (2002) point out that research carried out in DC project is rarely applied in practice, as industry professionals often follow their experience and knowledge in project design. One of the justifications for such a gap between theory and practice is the lack of a procedure that integrates conceptual project structures with models for specific problems. Similarly, Gu *et al* (2007) point out that DC project research has focused heavily on order storage and collection, mainly because these are the two functions of a DC that have the greatest impact on overall operational performance. In addition, they argue that research results are insufficiently shared with industry professionals. Furthermore, Gu *et al.* (2010) suggest that the elaboration of more case studies supported by computational tools may help to bring academic questions closer to practical application.

Vieira *et al.* (2017) highlight as limitation the fact that each activity of the DC is independently analyzed and projected, leading to low-level and interrelated solutions. DC project is a highly complex task where trade-offs have to be analyzed at each stage. In this sense, the lack of a widely accepted system for analyzing the feasibility of DC projects characterizes an additional difficulty (Rouwenhorst *et al.,* 2000). For Baker and Canessa (2009), although there seems to be consensus on the overall structure of the approach, there is less consensus on the exact nature of the tools/methods to be used at each stage. The development of a comprehensive methodology for DC project, therefore, seems to be a latent opportunity for future research.

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Table 5. DC project steps and decisions and citation frequency

Stage Code	Stage	References	Decision Code	Decisions
E1	General structure	Nozick e Turnquist (2001); Chen (2001); Yang et al. (2007); Yazdiana e Shahanaghia (2011); Huang et al. (2012); Li et al. (2013); Salehi et al. (2015); Zhou et al. (2015); Hua et al. (2016); Zhuge et al. (2016); Brunaud et al. (2017); Gu et al. (2007, 2010)	E1.1	Material flow
			E1.2	Department Locations
E2	Sizing	Gu et al. (2007, 2010)	E2.1	Stocking Area Size
			E2.2	Size of departments
E3	Layout	Bassan et al. (1980); Daniels et al. (1998); Caron et al. (2000); Heragu et al. (2005); Huertas et al. (2007); Roodbergen et al. (2008); Cakmak et al. (2012); Çelk e Süral (2014); Cruz-Domínguez e Santos-Mayorga (2016); Gu et al. (2007, 2010)	E3.1	Pallet Stacking Pattern
			E3.2	Number, length and width of aisles
			E3.3	Door location
E4	Equipment Selection	Gu et al. (2007, 2010)	E4.1	Automation Level
			E4.2	Storage Equipment Selection
			E4.3	Selection of material handling equipment
E5	Operation Strategy	Jarvis e Mcdowell (1991); Hall (1993); Brynzér et al. (1994); Petersen (1999); Lin e Lu (1999); Won e Olafsson (2005); Ho e Liu (2005); Gademann e Velde (2005); Gue et al. (2006); Parikh e Meller (2008); Parikh e Meller (2009); Yu e De Koster (2009); Dallari et al. (2009); de Koster et al. (2012); Andriansyah et al. (2014); Lam et al. (2014); Guo et al. (2015); Pan et al. (2015); Kuo et al. (2016); Bahrami et al. (2017); Franzke et al. (2017); Yuan et al. (2017); De Santis et al. (2018); Purba e Aisyah (2018); Gill (2009); Choy et al. (2012); Gu et al. (2007, 2010)	E5.1	Dock Truck Assignment
			E5.2	Trucks Shipping Time
			E5.3	Assignment of Items to Departments
			E5.4	Space Allocation - SKU Assignment to Zones
			E5.5	Assignment of operators to zones
			E5.6	Storage strategy selection
			E5.7	Lot Size - Order Batch Assignment
			E5.8	Order Routing and Sequencing
			E5.9	Selection of Waiting Points
			E5.10	Selection of the Order Picking Method - Order Request Task
E6	Installation Location	Nozick e Turnquist (2001); Teo e Shu (2004); Yang et al.(2007); Shen e Qi (2007); Javid e Azad (2010); Accorsi et al.(2013); Salehi et al. (2015); Hua et al.(2016); Litomin et al. (2016); Zhuge et al. (2016); Brunaud et al.(2017)	E6.1	DC Quantity and Location
			E6.2	Customer Allocation

Source: Prepared from Gu *et al.* (2007)

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Theoretical Lens - Distribution Networks

The term "theoretical lens" is relatively new and is used by researchers in the processes of knowledge expansion. In validating an emerging theory, existing Theoretical Lenses can be used to explain how the theory is related to the literature (Birks *et al.*, 2013). The term theoretical lens does not require the lens itself to be a theory; however, it is necessary that the procedure of using a lens contributes in several ways to it (Holweg; Pil, 2008). Authors may introduce the term as a way of explaining or justifying the specific categories in which they classified data as part of the analysis process. Similarly, the theoretical lens a researcher chooses may explain why he or she has selected levels of analysis from a larger population to guide data collection (Pan; Tan, 2011; Niederman; March, 2019). Thus, the evidence found in BP was analyzed under the emphasis given to Distribution Networks (DN).

One of the key drivers of a supply chain's productivity and overall profitability is its DN, which can be used to achieve a variety of supply chain goals, from low cost to high service level (Javid; Azad, 2010). In distribution, DCs are often of high importance as they contribute to improving such distribution flows, from the factories where the goods are produced, to the points of consumption, usually distributors (Ambrosino; Scutella, 2005; Choy *et al*., 2012). The purpose of a DN analysis is to determine the best distribution system to minimize installation, storage, transportation and inventory costs, and to provide a high degree of customer service. DN types are classified according to the number of levels in the network and the type of routes between them (Zhao *et al.,* 2011).

Each establishment of a network is a node and each level can have one or more nodes. Nodes are grouped into up to five levels, such as factories (1st level), which ship products to one or more DCs (2nd level), which can transfer to regional depots and/or transit points, which are out of stock (3rd and 4th levels, respectively), and send to end customers (5th level). Figure 4 illustrates a DN and the five levels. In the connection between network nodes, in turn, the types of routes can be supplied directly from factories to DCs, from DC routes to regional depots or transit points, from DCs to small customers, and DC mixed routes to regional depots, transit points and customers (Ambrosino; Scutella, 2005). To facilitate the analysis of the literature, Figure 5 presents a codification of the existing types of networks and distribution routes.

Finally, Table 6 analyzes the network classification and distribution route of the BP studies and the DC project steps identified in the studies. In the analysis, the network classification and distribution route is related to the BP references that cite each type of classification. Likewise, these references relate to the DC project steps and decisions addressed in their studies. It is possible to identify that of the six stages of DC project, some stages (E2, E5 and E6) are mentioned in several studies; however, stages E1, E3 and E4 have low relation with the network type and distribution route, when analyzing by citation frequency. Moreover, studies address one or two decisions at each stage of the DC project, which points out that works addressing DN typically detail specific aspects of DC project.

5. FINAL CONSIDERATIONS AND RESEARCH DIRECTIONS

The objective of this work was to identify, from a systematic literature review, the main methods of project and planning of DCs, consolidating their characteristics, advantages and barriers. To this end, a quantitative (bibliometric) and qualitative (theoretical lenses) analysis of the content

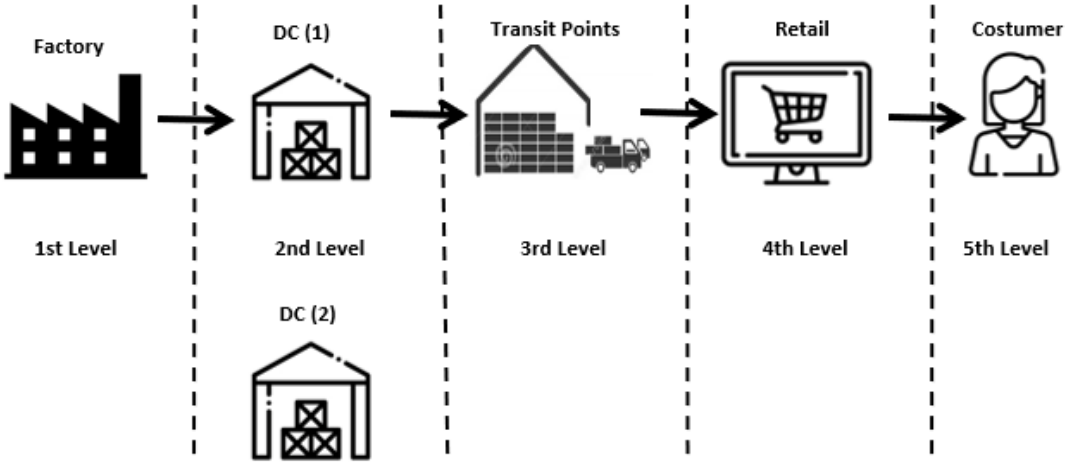

Figure 4. Types of Distribution Networks
Source: The authors

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available in the literature was performed, which enabled the identification of gaps and opportunities for future research on the subject. Although a large amount of work has been identified on the specific stages of DC project, the literature presents a shortage of a robust and common theoretical basis for the overall DC project.

Despite the results obtained, it is worth highlighting some limitations of this study. Firstly, it is important to highlight that the literature review does not present the tools used in the stages and decisions of the DC project, as each study and segment may present a way to implement these stages, which would greatly expand the scope of the research. The theoretical lens analysis is related to distribution networks and business segment of the companies; however, future studies could analyze the contents of the same bibliographic portfolio under the lens of other approaches, such as transport modes and the relationship between the DC project stages.

Lastly, in the stage of collecting the scientific articles to consolidate the bibliographic portfolio, the works were identified on the research available in the cited databases. However, on these bases, they can bring additional contributions to the results.

Based on the above, for future research opportunities, the paper identifies several gaps related to the implementation of a DC project planning. Thus, two main directions for future research are highlighted: (i) broad methodology for the DC project stages; and (ii) analysis of the DC project implementation in the distribution network.

Comprehensive methodology for DC project stages

Due to the scarcity of DC project proposals that structure a theoretical and practical project and planning methodo-

Code	Distribution network	Distribution Network Example	Code	Route Type
N5	5 levels	Factories - Central DCs - Regional DCs - Retail Stores - Customers OR Factories - Central DCs - Transit Points - Retail Stores - Customers	R0	Not specified
N4	4 levels	Factories - Central DCs - Regional DCs - Customers OR Factory - DCs - Retail Stores - Direct Customers	R1	Mixed
N3	3 levels	Factory - DCs - Direct Customer	R2	Customer DC
			R3	DC for retail stores
			R4	Transit Point DC

Figure 5. Network classification and distribution routes

Source: The authors

Table 6. Network classification and distribution route relationship and BP DC project stage

Network classification and distribution route	References	DC project step	DC project decisions
N4.R0	Salehi et al. (2015)	E2- E5 - E6	E2.1 - E5.1 - E6.1
N4.R1	Ambrosino e Scutella (2005)	E2- E5 - E6	E2.1 - E5.1 - E6.1
N4.R1	Litomin et al. (2016)	E6	E6.1
N4.R2	Teo e Shu (2004)	E5 - E6	E5.1 - E6.1 - E6.2
N3.R0	Accorsi et al.(2013)	E3 - E4 - E5	E3.2 - E4.2 - E5.4
N3.R0	Gill (2009)	E5	E5.1
N3.R0	Nozick e Turnquist (2001); Brunaud et al.(2017)	E2 - E6	E2.1 - E6.1
N3.R0	Yang et al.(2007)	E6	E6.1
N3.R1	Zhuge et al. (2016)	E6	E6.1
N3.R2	Shen e Qi (2007); Javid e Azad (2010)	E2- E5 - E6	E2.1 - E5.1 - E6.1 - E6.2
N3.R2	Hua et al.(2016)	E5 - E6	E5.1 - E6.1

Source: The authors

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logy, research developed in DC project is rarely applied in practice. As argued by Gu *et al.* (2007), survey results are poorly shared with industry professionals. In addition, Baker and Canessa (2009) point out that there is little consensus on the tools and methods to be used at each step. Thus, the development of a comprehensive methodology for DC project seems to be a latent opportunity for future research, identifying the tools and methods to be used for each step.

Added to this is the need for evidence of its practical application, which can be obtained from the development of case studies or research/action on the subject. The proposition of such methods could also contemplate the peculiarities of each type of industry, since few works from BP explicitly describe the analyzed context. In this sense, the inclusion of the effect of characteristics such as volume and added value of the products can lead to a better definition of the method used for the DC project.

Analysis of the DC project implementation in the distribution network

The success of a company's distribution strategy plays a critical role in supporting internal DC operations, and the way the internal activities of different DCs are organized is influenced by the characteristics of distribution operations (Vieira *et al*., 2017). Despite the above, few studies address the distribution network with relevance in the DC project stages (only 13 studies from BP). Existing works deal with the stages of internal (DC project) or external (DR) operations in isolation, quite possibly due to the complexity of simultaneous analysis of both operations.

As a recommendation, future research should detail the project stages of the DC taking into account the specific characteristics of DR. Such studies would quantify the relationship between DC project stages and decisions and the definition of the distribution network and route, providing practical arguments for the importance of these definitions in DC project decisions. In practical terms, continuing research on this topic could indicate how these relationships impact the organization as a whole.

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