Systematic Literature Review on Troubleshooting Delivery of Production Product Using *n*-Vehicle with Vogel Total Difference Approach Method

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ABSTRACT

The product delivery strategy using *n*-vehicle is the application of optimization for transportation problems. The product delivery strategy using *n*-vehicle is useful for minimizing the shipping costs of a company's production. This article presents a peer-reviewed bibliometric analysis based on the topic of production delivery strategies using *n*-vehicle. Overall, there are 91 articles from the Dimension, Science Direct, and Google Scholar databases in 2013-2021 that use the topic of production delivery strategies using *n*-vehicle based on the keywords "Capacitated transportation problem" and "cost" and "vehicle" and" optimal solutions". The researcher presents the relationship of each cited article so that it can show the collaboration of all the cited articles. This article aims to generate and review analysis results through Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) and State of The Art. Bibliometric analysis, PRISMA, and State of The Art show how the development of research on production delivery strategies using *n*-vehicle. So, it can produce suggestions in conducting the latest research related to studies on the topic of production delivery strategies using *n*-vehicle. Based on PRISMA's analysis, 91 articles were obtained, of those 91 articles, 11 articles discussed the strategy of delivering production products using *n*-vehicle in depth. The State of The Art also shows how the development of research on production delivery strategies using *n*-vehicle is developing. It can be seen that apart from the classical method, other methods are also emerging to solve transportation problems. One of them is Vogel Total Difference Approach Method (VTDM).

Keywords:
Optimization; *n*-Vehicle; Bibliometric Analysis; PRISMA Analysis; VTDM

How to Cite:

1. Introduction

Buying and selling that occurs from time to time continue to develop. Starting from barter, the use of a medium of exchange in the form of gold coins, the use of a medium of exchange in the form of paper money, to the use of a medium of exchange in the form of electronic money. Barter is a buying and selling activity by not using other means

of exchange other than the goods owned by each person. A Barter System is the first type of buying and selling in the world. This system was implemented because at that time no other medium of exchange had been found [1]. Along with the times, this barter system is no longer used. Now, it has been used as a medium of exchange in the form of paper money and even electronic money. In addition to the medium of exchange, the development of buying and selling also occurred in the number of goods to the delivery of goods. This delivery aims to meet consumer demand. This is an activity carried out in the industrial sector.

The industrial sector is constantly changing. Changes occur because of the increasingly complex problems that exist in the industrial sector. One of these problems relates to the number of goods to be sent to the consumer's place or from source to destination in such a way that shipping costs can be minimized, or what is called a transportation problem. Transportation problem-solving uses decision parameters such as availability, demand, and shipping costs. Shipping costs must be fixed for easy calculation. However, in reality, shipping costs can be variable. Shipping costs can be affected by the number and capacity of the vehicle itself. If the number of goods that must be delivered is small, then only a vehicle with a small capacity is needed. Meanwhile, if the number is large, a vehicle with a large capacity is needed [2].

Transportation problems relate to the delivery of products from various sources to various destinations. Transportation problems can be more complicated or more complex when the number of requests exceeds the number of goods produced. In addition, it could also be due to insufficient vehicle capacity to accommodate the goods to be sent. On the other hand, it could also be due to the capacity of the vehicle that exceeds the number of goods to be sent. The way to overcome this is by operations research. Operations research is something that seeks to provide the best (optimal) course of action from a decision problem under limited resources or goods produced [2]. That is, even though the resources are limited, optimal results can still be obtained [3].

There are various methods developed to solve transportation problems. One of them is the classical method, such as Least Cost Method (LCM), North West Corner (NWC), Russell's Approximation Method (RAM), and Vogel's Approximation Method (VAM). The four methods function to determine the allocation of delivery of goods so that all goods from the source are allocated to the destination and a feasible solution is obtained. In addition, there is also the Modified Distribution (MODI) method and the Stepping Stone method which function to test whether the feasible solution obtained is an optimal solution or not, so that the optimal solution is obtained [4].

The number of requests from various destinations for the delivery of products requires a company to find ways to minimize shipping costs. One way is to use *n*-vehicle. The purpose of *n*-vehicle is the number of the vehicle as many as *n*-types. This means that each type of vehicle has a different capacity or shipping cost. For example, the first type of vehicle has less capacity and cheaper shipping costs when compared to the second type of vehicle. Then, the second type of vehicle has less capacity and cheaper shipping costs when compared to the third type of vehicle, and so on. The purpose of one vehicle is the number of the vehicle of one type. The search for a feasible solution with one vehicle and an *n*-vehicle must have a difference. Thus, it is necessary to examine these differences.

This study uses a bibliometric analysis method that collects articles on the topic of

production delivery strategies using *n*-vehicle, to obtain the optimal solution [5]. The next section describes the materials and methods used for the comprehensive analysis in this study. Then, the researcher summarized the data of all articles on the topic, including the PRISMA analysis, state of the art, and linkages with other topics presented [6]. The relationship with other topics presented aims to find research gaps that can be used as novelties in making further research. In addition, this systematic review can be used to identify the strengths and weaknesses of a study [7]. Because a properly designed systematic review can provide the best scientific evidence [8] and can be a simple pragmatic solution to show the research flow [9]. Then the data was analyzed using the open-source software *R Programming* using the bibliometric package [10]. Combining data from several articles can increase the chances of detecting the real effect of the problem being solved [11]. The last section is the closing section in the form of conclusions and suggestions.

2. Methods

The method used is bibliometric analysis. Bibliometric is a quantitative analysis methodology to assess a study from several indicators such as year, scope, keywords, and others. In addition, the analysis was carried out using several related data publications, as suggested by bibliometric experts for many years [12]. Meanwhile, the literature review was carried out using the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) [13]. PRISMA is a method for including or excluding articles [14]. PRISMA provides a structured and systematic flow, making it easier to conduct a literature review [15]. Thus, it can be used to investigate a study [16]. In the first stage, a literature search was carried out. The articles used as material in this literature review are limited by four criteria, namely:

1. peer-reviewed articles,
2. article manuscripts published by journals,
3. available full-text article manuscripts, and
4. articles using English and Indonesian.

These criteria are applied throughout the stages of PRISMA. To obtain articles that meet criteria (1) and (2), namely peer-reviewed articles, the Dimensions database, Science Direct, and Google Scholar were used in this study. Furthermore, to fulfill criteria (3) and (4), the keywords used in this article search were: "Capacitated transportation problem" and "cost" and "vehicle" and "optimal solution".

After conducting a literature search, the next step is to identify the articles that have been obtained. After that, the screening stage is carried out. At the screening stage, the availability of full-text manuscripts was checked. Then, the article is re-selected at the eligibility stage. At this stage, the selection process is carried out in two stages in stages. The first step of eligibility selection is based on the title and abstract of the article. Articles that pass the first step of selection are then re-selected in the second step, wherein the second step eligibility is based on the full-text manuscript of the article. These two steps are carried out by taking account criteria (3) and (4). In other words, articles that do not meet any of these criteria are excluded. Meanwhile, articles that meet all the criteria are included as material for the discussion of the literature review in this study. The articles that were included as material for the discussion of the literature review in this study were then entered into State of The Art's table. State of The Art is a table that presents a collection of articles used for research which includes the name of the author, the content

of the study, and the method used. State of The Art is usually used to compare one research with another, so that you can find out more about the study being studied.

3. Results and Discussion

3.1. PRISMA Analysis

There are two things that were done in this research, the first was to examine articles from 2013-2021 using the Dimensions database, Science Direct, and Google Scholar. Next, research articles from 1962-2022 using the Google Scholar database only. The first stage in PRISMA is identification, namely the search for research articles published in peer-review in the Dimensions database, Science Direct, and Google Scholar in 2013-2021. The search keywords used were "Capacitated transportation problem" and "cost" and "vehicle" and "optimal solution". Through the first stage, there were 91 articles obtained. The second stage is screening. At this stage, the availability of the full-text manuscripts of the 91 identified articles was checked. The election results showed that among the 91 articles identified, there were 52 full-text manuscripts available, so 39 articles were not used. Then, the 52 articles were re-selected in the third stage, namely eligibility. At this stage, the selection process is carried out in two stages in stages. The first step of eligibility selection is based on the title and abstract of the article. Articles that pass the first step of selection are then re-selected in the second step, wherein the second step eligibility is based on the full-text manuscript of the article. As a result, in the first step of eligibility, 25 articles did not meet the criteria, so 27 articles were selected. Then the 27 articles were re-selected in the second step of eligibility. In the second step, as many as 16 articles did not meet the criteria, so 11 selected articles were obtained. The eleven articles were then included as material for the discussion of the literature review in this study. The summary of the PRISMA flowchart of this research is presented in Figure 1.
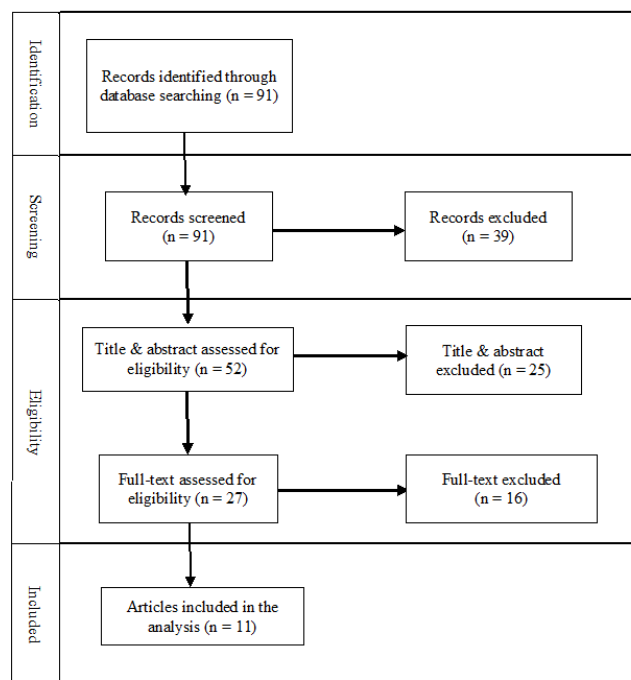
Figure 1. PRISMA Flowchart

3.2. Paper Publication Summary

This section shows articles on production delivery strategies. One database is used to see its progress, namely Google Scholar. The articles collected from Google Scholar only until 2022 are 87 articles. The number of articles published every year tends to increase. This shows that the field of research that focuses on production delivery strategies has developed quite well. The topic of production delivery strategy began to develop in 1962, and the highest occurred in 2017 (Figure 2).
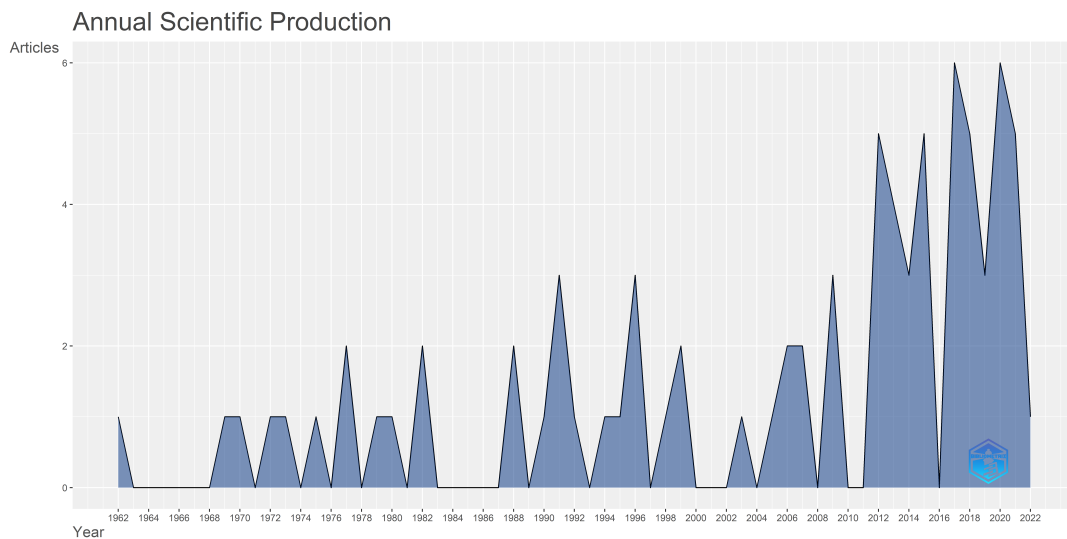
Figure 2. Development of articles on product delivery strategy in google scholar database

The following is the main information on data processing related to the product delivery strategy obtained from the R-studio programming.

Table 1. Main information of articles on product delivery strategy

Description	Result
Timespan	1962 : 2022
Sources	53
Documents	83
Average years from publication	16.40
Average citations per document	152.20
Average citations per year per doc	3.688
References	1

Based on Table 1, it can be seen that as many as 53 journal publishers have contributed to publishing 83 documents from 1962 to 2022, with an average of 152.20 citations per document.

3.3. The Most Productive Authors

This section provides information about prolific writers who write articles on production delivery strategies. Altogether 147 authors have addressed this topic in their research. More details can be seen in Table 2.

Of the 147 authors, the one most relevant to the topic of production delivery strategy is

Table 2. Authors related to the articles of product delivery strategy

Description	Result
Authors	147
Author Appearances	168
Authors of single-authored documents	31
Authors of multi-authored documents	116
Single-authored documents	33
Documents per Author	0.565
Authors per Document	1.77
Co-Authors per Documents	2.02
Collaboration Index	2.32

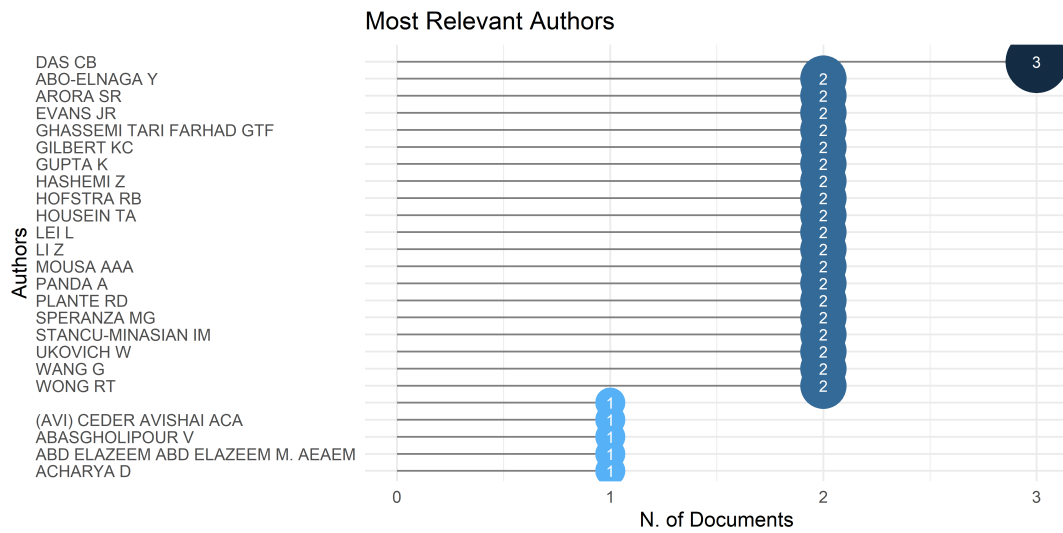Das CB, who has published 3 articles (Figure 3).

Figure 3. The most relevant authors

Das CB has written on the topic of production delivery strategy from 2015 to 2017. Meanwhile, other authors have written on the topic of production delivery strategy in the year as shown in Figure 4.
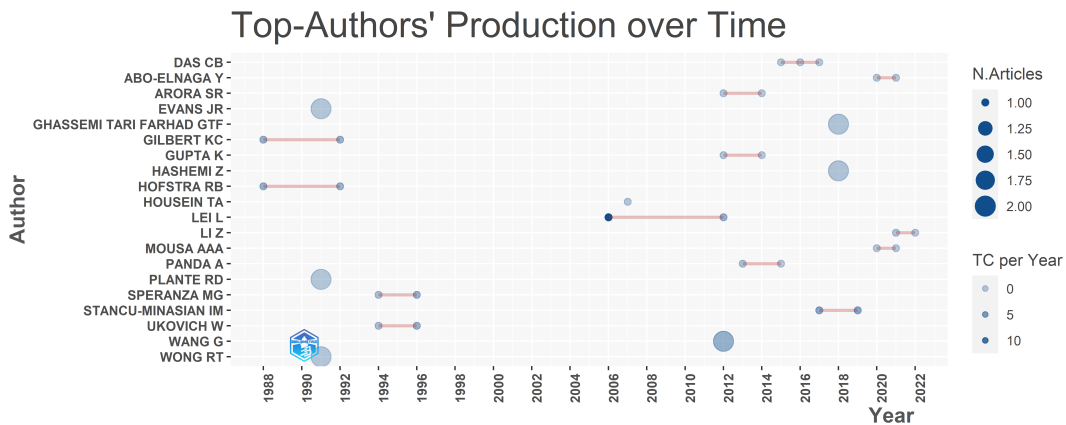

Figure 4. Top-authors' production over time

3.4. Research Citation Pattern

This section provides information on citations to articles on the topic of production delivery strategies. To date, a total of 12632 articles on this topic have been cited based on the Google Scholar database. The 20 most cited articles on this topic are shown in Figure 5. The research conducted by Bellman R. E. received the highest number of citations, as it was one of the earliest published studies.
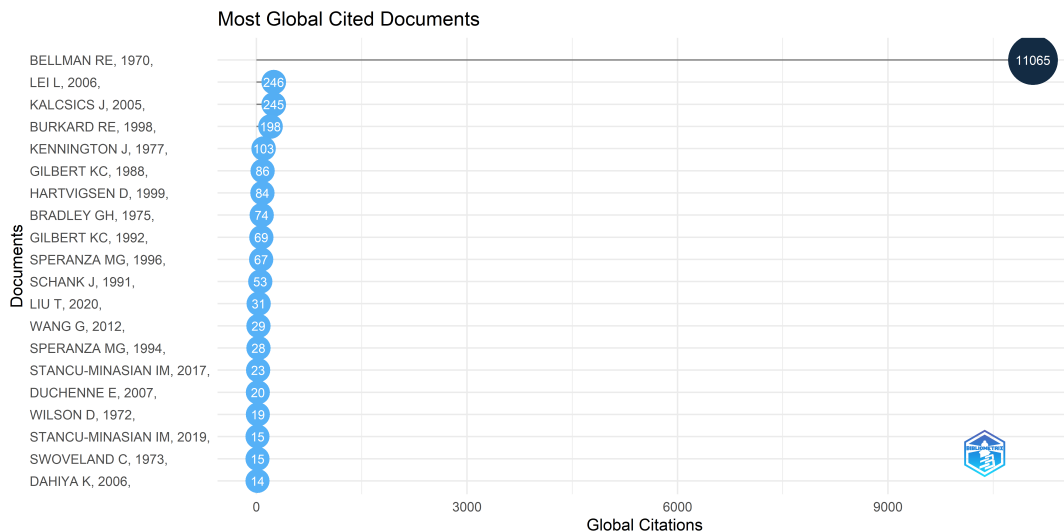

Figure 5. Most global cited documents

3.5. Main Research Themes

This section describes a conceptual analysis based on the main research theme that discusses production delivery strategies. This analysis uses the Louvain Cluster method [17], which is a method for identifying objects in a large network. Using this method, the topic of production delivery strategy is divided into 7 clusters (Figure 6). Each cluster has its terms such as "transportation, cost, optimization, delivery, vehicle, applications, algorithm, multi-objective, and others". The term that is most closely related to the others is "transportation". The term "transportation" is most closely related to other terms except with the terms "delivery, vehicle, and algorithm". The term "delivery" is the orange cluster, the term "vehicle" is the pink cluster, and the term "algorithm" is the brown cluster. This orange, pink, and brown cluster is a great opportunity for new research.

3.6. State of the art production delivery strategy using n-vehicle

In the 2013-2021 period using the Dimensions database, Science Direct, and Google Scholar, 91 articles discussed the issue of product delivery. Then with the PRISMA flow, 11 articles were obtained that became references in this study. A summary of the 11 articles can be seen in Table 3.

State of the art with the topic of product delivery strategy using n-vehicle obtained based on PRISMA analysis there are 11 articles. These articles focus on discussing minimizing shipping costs to meet product delivery strategies. Judging from its development, the topic of product delivery strategy using n-vehicle is trying to find the best model and best method to minimize shipping costs. Starting from models using
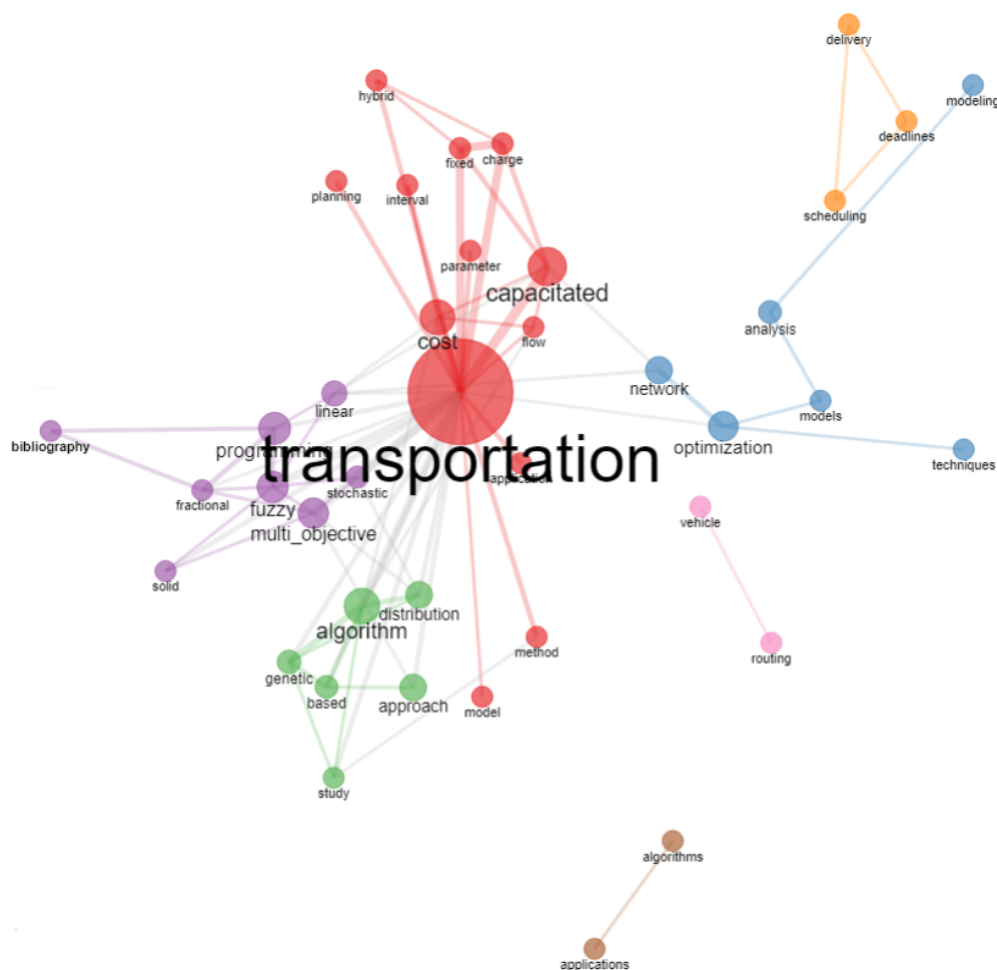
Figure 6. Clusters of term based on Louvain's method

one-vehicle, two-vehicle, to *n*-vehicle. Even the optimization method for this transportation problems does not only use the classical method has been widely developed. Thus, it takes the best combination of models and methods used. Based on the 11 articles above, the optimization method for transportation problems developed is still using the one-vehicle model. Thus, it becomes an opportunity to be able to combine optimization methods for transportation problems developed using the *n*-vehicle model. In addition, based on the 11 articles above, it is known that there is an efficient method for minimizing shipping costs, namely VTDM.

3.7. Discussion

This section discusses the result of the analysis obtained from the literature review. Many literature reviews have been conducted on the topic of product delivery. The combination of each model and optimization method for transportation problems is also widely used to find the optimal solution to this topic. Thus, several studies can be used as references in this study, one of which was carried out by Panda [2] with the title "N-Vehicle Cost Varying Transportation Problem". The research focuses on discussing determining the optimal solution to the transportation problem using *n*-vehicle. The results of the study show that the minimum cost with the first type of vehicle is 205, the minimum cost with

Table 3. State of the art problems with delivery of production results

Ref	Writer	Year	Topics	Optimization Method
[18]	Paul	2019	Minimize the cost of shipping products using one vehicle with a new method compared to the classic method	North West Corner Method, Row Minimum Method, Column Minimum Method, Least Cost Method, Vogel's Approximation Method, Modified Distribution, etc.
[19]	Amaliah, *et al.*	2019	Minimize the cost of shipping products using one vehicle with a new method	Vogel's Approximation Method, Juman and Hoque Method, Total Difference Method 1, Total Opportunity Cost Matrix – Minimal Total
[3]	Panda, *et al.*	2014	Minimize the cost of shipping products using two-vehicle with the classic method	North West Corner Method
[20]	Das	2013	Minimize the cost of shipping products using n-vehicle with the classic method and the new method	North West Corner Method, Modified Row-Minima Method, Modified Column-Minima Method, Modified Matrix-Minima Method, and Modified Vogel's Approximation Method
[21]	Das	2016	Development of a model for minimizing the delivery of transportation products using n-vehicle with classic and new methods	North West Corner Method, Row-Minima Method, Column-Minima Method, Matrix-Minima Method, and Vogel's Approximation Method
[22]	Goswami, *et al.*	2014	Minimize the cost of shipping products using two-vehicle with the classic method	North West Corner Method
[23]	Hosseini	2017	Minimize the cost of shipping products using one vehicle with a new method	Total Difference 1 & 2
[4]	Hussein, *et al.*	2020	Minimize the cost of shipping products using one vehicle with the development of the VAM. method	North West Corner Method, Minimum Cost Method, Vogel's Approximation Method, and Al-Saeedi 2
[24]	Ahmadi	2018	Minimize the cost of shipping products using one vehicle with a modification of three classic methods	Modified North West Corner Method, Modified Least Cost Method, and Modified Vogel's Approximation Method
[2]	Panda, *et al.*	2013	Minimize the cost of shipping products using n-vehicle with the classic method	North West Corner Method
[25]	Rodrigo	2018	Minimize the cost of shipping products using one vehicle using the classic method and the new method	North West Corner Method, Minimum Cost Method, and Regret Method

the second type of vehicle is 299, and the minimum cost with n-vehicle is 25. So that the research shows that the use of n-vehicle is better than using one-vehicle. The next research used is research conducted by Hosseini [23] with the title "Three New Methods to Find Initial Basic Feasible Solution of Transportation Problems". The research focuses

on discussing methods to find a feasible solution. The results of the study show that the minimum cost with NWC is 670, the minimum cost with LCM is 650, the minimum cost with VAM is 650, and the minimum cost with VTDM is 630. So that the research shows that the use of VTDM is better than the use of NWC, LCM, and VAM. Meanwhile, other studies are used as a comparison to determine the best method and combination to solve transportation problems. The result of the bibliometric analysis based on the year of publication, citation years, papers cited, cites/year, cites/paper, authors/paper, and others.

One of the results of this literature review is regarding the conceptual analysis of terms using the Louvain method [17] presented in Figure 6, showing that there are 7 clusters. Cluster 1 is directly connected to the topic of transportation. Several keywords in this cluster, namely capacitated, cost, and model, are also directly related to keywords in clusters 2, 3, and 4. The keywords in cluster 2 such as linear, multi-objective, and fuzzy. While the keywords in cluster 3 such as network, analysis, optimization, and keywords in cluster 4 such as distribution, approach, and algorithm. That is, "transportation" with the aim of "optimization" is packaged in cluster 3 with the topic of sending production results. Clusters 5, 6, and 7 are studies that are still related but not directly related to the topics discussed.

4. Conclusion

The analysis in this study shows that the topic of production delivery strategy is a topic that is widely studied. Articles that have been published become material for researchers to be able to develop research on the topic. Based on PRISMA's analysis, 91 articles were obtained, of those 91 articles, 11 articles discussed the strategy of delivering production products using n-vehicle in depth. The results of the Stat e of The Art also show how the development of research on production delivery strategies using n-vehicle is developing. It can be seen that apart from the classical method, other methods are also emerging to solve transportation problems. One of them is VTDM. VTDM on production delivery strategy using n-vehicle is very feasible to be developed further. This creates many opportunities to create new research on VTDM in production delivery strategies using n-vehicle in all their complexities. In addition, development can also be done by collaborating with each method and type of problem that exists. For example, to date, there have been several studies combining VTDM with a single-vehicle optimization model. However, combining VTDM with the n-vehicle optimization model is a new opportunity to be developed. VTDM used in other studies is combined with solving transportation problems using one-vehicle. Meanwhile, from the results of the analysis of PRISMA and the State of The Art, combining VTDM with solving transportation problems using n-vehicle is a new opportunity to be developed.

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