Vol. 08, No. 01, January 2024, pp. 60-68

INTERNATIONAL JOURNAL OF INNOVATION IN ENTERPRISE SYSTEM

Journal homepage: https://ijies.sie.telkomuniversity.ac.id
e-ISSN: 2580-3050, DOI: https://doi.org/10.25124/ijies.v8i01.275

A Systematic Literature Review: Design and Control of Warehouse Order Picking in Development of E-commerce Transaction

Dida Diah Damayanti[1*], Prafajar Suksessanno Muttaqin[2], Erlangga Bayu Setyawan[3], Nia Novitasari[4]

[1]School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
didadiah@telkomuniversity.ac.id

[2]School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
prafajars@telkomuniversity.ac.id

[3]School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
erlanggabs@telkomuniversity.ac.id

[4]School of Industrial and System Engineering
Telkom University, Bandung, Indonesia
novitasarinia@telkomuniversity.ac.id

[*]didadiah@telkomuniversity.ac.id

ARTICLE INFO

Article history:
Received 07 October 2023
Accepted 30 January 2024
Published 31 January 2024

Keywords:
Systematic Literature Review; E-commerce; Warehouse Management; Warehouse Order Picking; Logistics

ABSTRACT

Order picking is the process of retrieving items from storage to meet a specific customer order, which is known to be the most labor-intensive and costly function among all the warehouse functions. This function is also important in that it has a critical impact on downstream customer service especially in facing the current covid-19 pandemic. This research aims to provide information, description and more comprehensively identifies the design and control of warehouse order picking by using empirical literature review. In this research, the stages are Identification of potential study, Study Selection based on criteria, quality assessment, data extraction, and data analysis. Based on the literature review systematically compiled it is obtained 37 main articles that correspond to the purpose of research. From these 37 articles can be identified further research on design and control of warehouse order picking that provides increased transactions in e-commerce.

1. INTRODUCTION

The Covid-19 pandemic that has swept the world has not only had an impact on the economy of a country, but also on changes in consumption behavior for essential goods, both primary and secondary. Research by [1] explains that Covid-19 pandemic has resulted in government issuing rules for maintaining social distance between people, to large-scale social restrictions (PSBB) which have an impact on changing people's habits in buying and shopping activities. In 2019 the number of internet users in Indonesia is estimated to grow 12.6% compared to 2018, which is 107.2 million users.

Based on a report released by Google and Temasek, e-commerce is one of the sectors with the largest value in Southeast Asia [3]. The number of transactions in e-commerce also continues to increase. In 2025, Indonesia is predicted to have top rank and reach a value of 82 billion dollars. As penetration rate of number of e-commerce users in Indonesia in 2017 reached 139 million users, then it continued to increase to 154.1 million users [3].

The increase in e-commerce users has an impact on the logistics industry, especially warehouse industry, including choosing the warehouse location, accustomed to processing bulk orders to individual items, unpredictable buying patterns, increased return product, 24/7 shift operations, and adoption of warehouse technologies [4], [5] and [6]. Although e-commerce has only been around for a short time, its impact has already brought significant changes to the warehouse industry. So, we should pay more attention to optimizing to boost warehouse efficiency. The development of e-commerce in Indonesia is certainly in line with challenges faced. The challenges of e-logistics in developing countries include an unstable economic system, unequal infrastructure, trust and privacy from consumers, obstacles in logistics delivery process, security problems, and geographical barriers. Lack of infrastructure, namely telecommunications infrastructure that is not optimal and short computer access creates obstacles in electronic logistics. The cost of internet access also creates bottlenecks in electronic logistics. Among the many types of business models in e-commerce, business to consumer (B2C) has experienced a significant increase in Indonesia, especially with pandemic conditions that have occurred since last year. This is because people are currently making purchases online more often to avoid infection during the pandemic. The increasing number of e-commerce users in Indonesia, especially B2C model, has become focus of industry players to make efficiency in warehouse operational activities. Significant e-commerce developments certainly have an impact on warehousing. It starts with attracting more companies into the online retail world, and warehouse operations were forced to adapt to rapidly increasing need for single-item fulfillment. Besides that, consumers who shop at retail stores have different behavior from consumers who shop online. Consumers who buy online tend to return goods at a higher rate than those who shop in stores. In addition to online sales there are unexpected sales patterns that can arise with purchases by consumers, thus requiring a quick response from the distribution center.

Order picking is one of important warehouse activities related to retrieve stock keeping units (SKUs) from their storage locations to satisfy a given demand specified by one or more customer orders. These SKUs are then sent to the sorting process for shipment of each order. Generally, order picking accounts for about 60% of total labor cost in warehouse, while 90% of picking time is spent on travelling [7]. Therefore, warehouse operations by improving efficiency, such as minimize response time and travelling distance. There are numerous factors affecting efficiency of order picking, such as warehouse design, storage location allocation and picking policy. As for order picking, warehouse design mainly refers to the design of a picking system. If a picker travels to storage location to pick SKUs, the system is defined as a 'picker-to-part' system. If SKUs are brought to pickers, which means there is no interface between storage position and pickers, the system is defined as a 'part-to-picker' system. 'Part-to-picker' system is relatively new taking orders related to taking SKUs from their storage locations to fulfill certain requests determined by one or more customer orders, this is certainly one of activities that needs to be done efficiently from costs and processes. Automated storage and retrieval system (AS/RS) and shuttle-based storage and retrieval system (SBS/RS) are one of systems which are included in 'part-to-picker' system. Due to high investment costs to implementing automated system not many companies that can use these systems. Warehouses of most online retailers prefer to adapt 'picker-to-part' system. One of the picking strategies used in practice of electronic commerce is order batching policy, to allocate a set of orders into several subsets named order batch. The order batching strategy is not only a short-term, but also a long-term and strategic one because it involves both operating process (e.g. routing for order pickers) and strategic decision such as warehouse layout. Order batch also can be related to maximum order quantity can be stored in the capacitated warehouse [8], [9], and [10]. According to [11] the objective of the order batching strategy is to minimize the picking route distance in a manual sorting system particularly. In a multi-block warehouse, SKUs in a batch can be picked either by several workers in distinct blocks at one time [12] single picker crossing different zones.

Thus, this study conducts a systematic literature review of design and control of warehouse picking that expand before by [13]. 37 papers related to design and control of warehouse picking have been collected from peer-reviewed international journals, articles, and theses. The rest of this study is structured as follows: section two presents the methodology of this article, section three maps the results of the literature review of design and control of warehouse picking themes and timeline. At the end of article, we conclude and identify some potential issues and future research directions related to warehouse order picking model especially in single picker problem and 'picker-to-part' system in warehouse.

2. METHOD

Systematic reviews and traditional reviews are both types of literature reviews, but they differ in terms of their methodologies, objectives, and rigor. Systematic review is a research method to identify, evaluate, and interpret all relevant research results related to certain research statements, certain topics, or phenomena of concern [14] and [15]. In

*didadiah@telkomuniversity.ac.id

principle, a systematic review is a research method that summarizes the results of primary research to present more comprehensive and balanced facts. While the traditional review is a review method in which the method of collecting facts and the synthesis technique does not follow the standard methods as systematic reviews. The aim of systematic literature review is tightly specified with the research topics and objectives with a specific review question, while the aim of traditional literature review is to gain broad understanding and give descriptions about the research topics.

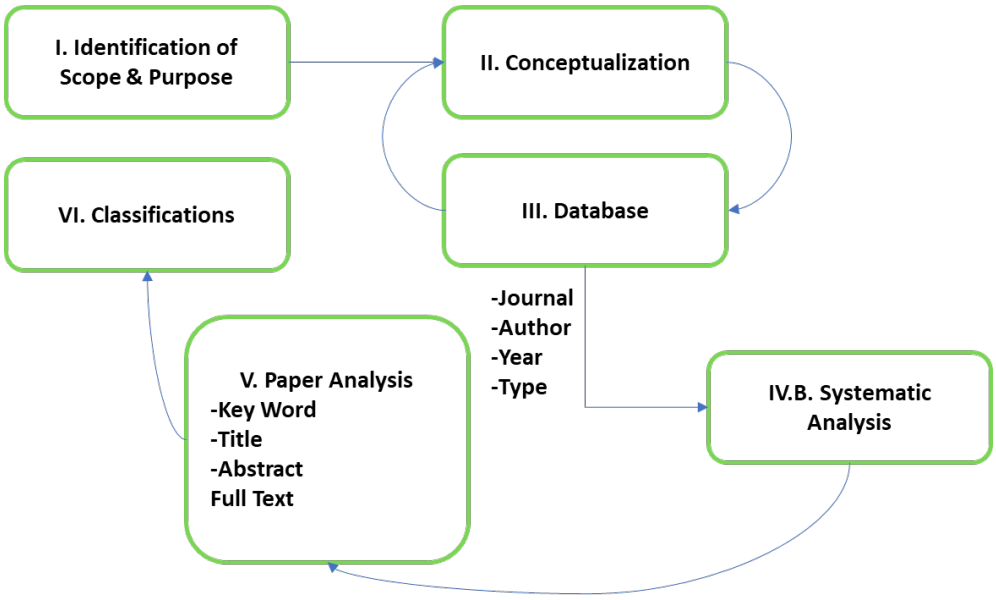

Figure 1 - Framework for Literature Analysis

2.1. Identification of Scope and Purpose

This research aims to collect and investigate research trends in design and control of warehouse order picking agenda and identify the most used methods in related topics. Accuracy is needed while design the research questions so there will be related match between paper and topic to be researched by give more attention to important component in each criterion of PICOC [16]. The framework of population, intervention, comparison, outcome, and context (PICOC) is applicable to determine the research scope. According to [17]. PICOC framework together with the definition of each concept and it applies to each systematic literature review step. Table 1 shows the (PICOC) structure of the research questions.

Table 1 – PICOC Structure

Population	Warehouse Design, Warehouse Control, Batching, Zoning, and Sorting
Intervention	Proposing Design and Control of Warehouse Order Picking Model
Comparison	n/a
Outcome	Optimal model for Design and Control of Warehouse Order Picking
Context	Studies in companies that implement Design and Control of Warehouse Order Picking Model

With referring to PICOC criteria above then further can be identified specific research questions. The following research questions (RQs) are raised that shows in Table.2

Table 2 – Research Question

ID	RQ	Motivation
RQ1	The most significant in reviewing Design and Control of Warehouse Order Picking Model	Identify the most significant journal which reviewing Design and Control of Warehouse Order Picking Model
RQ2	The most often discussed Design and Control of Warehouse Order Picking Model	Identify the research trends in Design and Control of Warehouse Order Picking Model
RQ3	The most often variables discussed in Design and Control of Warehouse Order Picking Model	Identify the most used variables in Design and Control of Warehouse Order Picking Model

2.2. Conceptualization

Conceptualization is to specify exactly what we mean and dont mean by the terms we use in our research. The purposes of the search process was the identification of the journal articles that investigated design and control of warehouse order

*didadiah@telkomuniversity.ac.id

picking model and it focuses on the variables that has not been considered in join design and control of warehouse order picking model especially in batching, zoning, and sorting. A search strategy is generated to get a study that addresses only certain issues of design and control of warehouse order picking model. Search is done by using Boolean AND to the word "warehouse" and "design" and “control” and “batching” and “zoning” and “sorting”. After carrying out a series of investigations and classifications based on search strategies, 37 related main studies were obtained as illustrated in Figure 2.

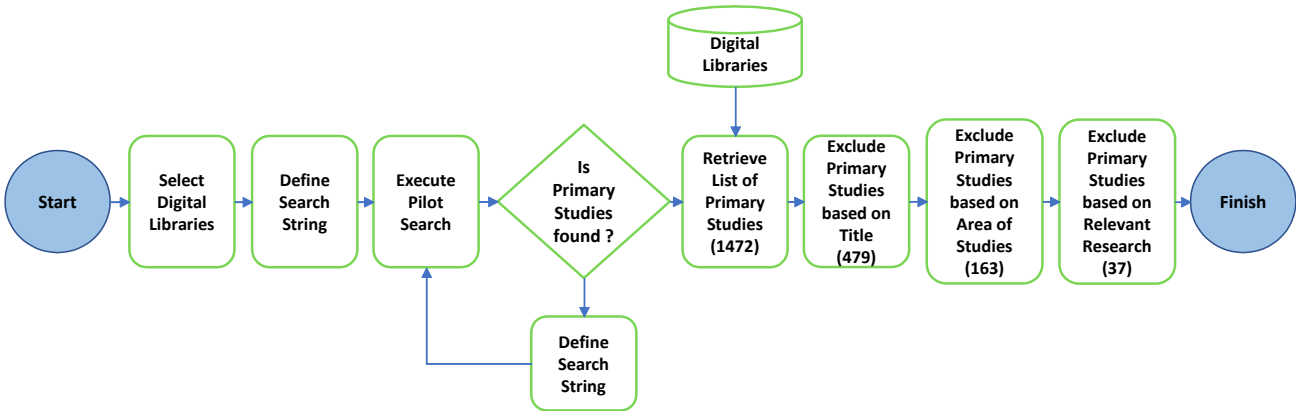

Figure 2 - Search & Selection of Primary Studies

2.3. Database

The searches conducted to find relevant research in this survey are limited by searching only for journal articles and conference papers in order to obtain valid results. The query strings were applied titles, abstract and body of studies, the search was conducted between 2010-2021 using the online scientific database. Online database included Scopus & Web of Science.

2.4. Systematic Analysis

The next step is doing study selection that focuse more on attributes ot each journal after we find the relevant journals which have obtained from online database or journal publisher, In the process of selecting the primary studies, we used insertion and rejection criteria. Insertion criteria is attributes of subjects that are essential for their selection to praticipate while rejection criteria is responses of subjects that require their removal subjects These criteria are shown in Table 3.

Table 3 – Insertion and Rejection Criteria

Insertion Criteria	For research or studies that have both the conference and journal versions
	For duplicate publications of the same research or studies, only the most complete and newest one will be included
	For research or studies that published between 2010 until 2021
Rejection Criteria	Publication is written in a language other than English

2.5. Paper Analysis

In this survey, we used Mendeley (https://www.mendeley.com) as software that used to store and manage the search results. For the next Figure, we will detail search process and tumber of studies identified at each phase. The final list of selected studies for the first stage had 1472 primary studies. Selected studies were selected using the insertion and rejection criteria with removed similiar studies by same authors in order to find specific research questions.

2.6. Classification

Classification is the action or process of classifying something according to shared qualities or research characteristics. This survey are limited by classify topics related to design and control of warehouse order picking model especially in single picker problem and ‘picker-to-part’ system in warehouse. This is as explained in the previous section because not all companies can implement ‘part-to-picker’ system in warehouse due to high investment. On the other picker assignment is a problem that the company focuses on because of the increasing number of ecommerce users especially in business to consumer (B2C) model.

*didadiah@telkomuniversity.ac.id

3. RESULT AND DISCUSSION

The process of determining the topic and type of research classification was obtained based on analysis of research on related topics and systematic reviews on similar topics. The process of obtaining primary articles can be seen in figure 2. The number of articles obtained in the initial search step from Scopus and Web of Science based on the title of articles were 1472 articles respectively. From those articles obtained from both databases, there are 110 duplicate articles. Moreover, out of 479 articles obtained, 234 articles were excluded from this study since it didn't match with the criteria, while from 245 articles obtained from Web of Science. Therefore, there were 163 articles from both databases that would be further reviewed to perform quality assessment and data extraction process and the primary articles for this study were obtained. Therefore, there are 163 articles in total from both databases to be further reviewed and screened to obtain primary articles. Finally, 37 articles were selected as primary articles to be analyzed in this study. The summary of 37 selected articles can be seen in Table 4.

Table 4 – The Summary of Primary Articles

Topics	Type	Reference
Order Picking Systems	Picker-to-Parts	[18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39]
	Parts-to-Picker	[40], [41], [42], [43]
Operative Planning Issues	Storage Assignment	[29], [38], [41], [42], [44]
	Zoning	[22], [26], [43]
	Order Consolidation	[20], [21], [28], [45]
	Routing	[18], [19], [21], [24], [27], [32], [36], [44], [45]
Batching	Pick-and-sort	[22],[25], [43], [45]
	Pick-by-Article	[20], [33]
	Pick-by-order	[18], [14], [23], [27], [28], [30], [31], [32], [35], [37], [42], [44], [21], [45], [46]
Order Batching	Static	[18], [19], [21], [23], [25], [26], [27], [28], [33], [34], [36], [37], [38], [44] ,[46]
	Dynamic	[26], [30], [42]
Zoning	Synchronized	[16], [42], [23], [41], [45]
	Progressive	[19], [25], [30], [34], [35], [36], [38], [44], [46]
Order Release	Discrete	[21], [42]
	Continuous	[19], [25], [28], [30], [34], [36], [37], [44], [45], [46]
Warehouse Dimensionality	1 (one)	[26], [43], [44], [45]
	2 (two)	[18], [19], [20], [23], [25], [28], [29], [30], [33], [34], [35], [36], [37]
	3 (three)	[41], [42]
Routing Method	Analytic	[27], [29], [33], [37], [38], [46]
	Heuristics	[21], [27], [28], [39], [43], [45], [46]
	Metaheuristics	[18], [19], [22], [23], [24], [28], [36], [44], [45], [47]
	Simulation	[25], [26], [34], [35], [39], [41],
Storage	Dedicated	[25]
	Class Based	[20], [21], [22], [23], [27], [29], [33], [35], [37], [44]
	Random	[23], [26], [36], [38], [39], [41], [45]
Objectives	Travel Time	[20], [21], [22], [26], [29], [32], [34], [36], [38], [39]
	Travel Distance	[18], [19], [24], [25], [31], [37], [44], [46]
	Search Time	[20], [27], [33], [44], [45]
	Picking time	[23], [24], [31], [35], [45]
	Cycle Time	[42], [42], [43]

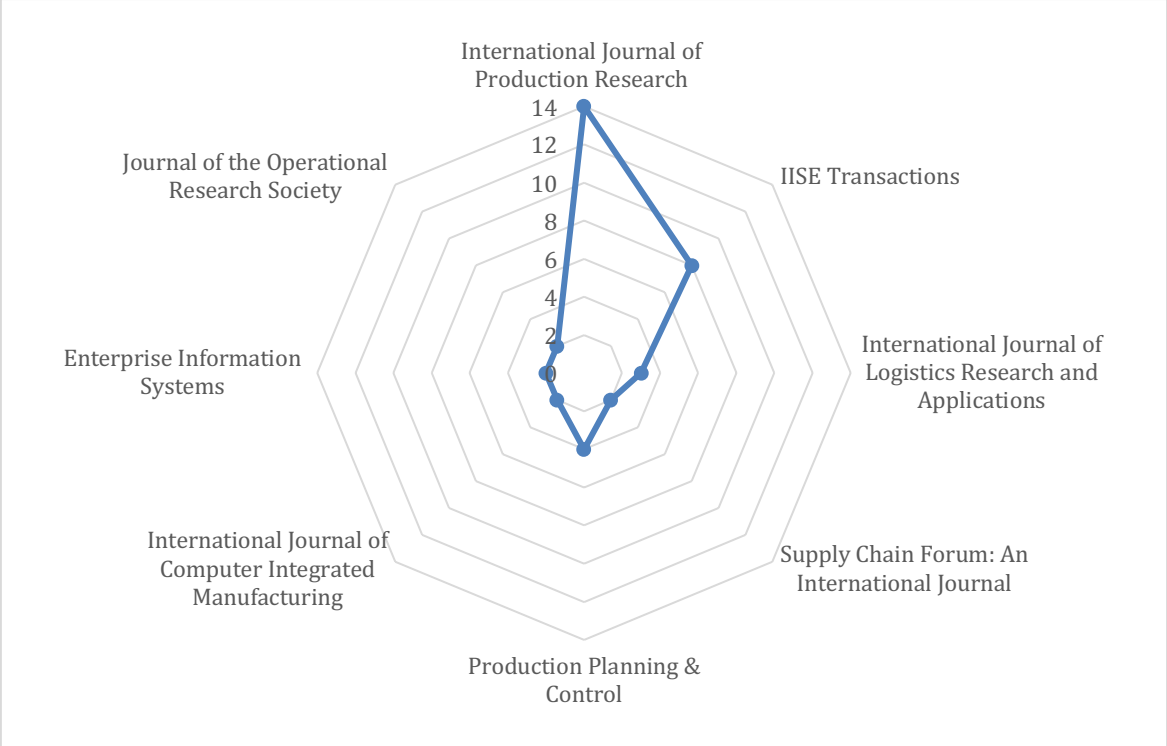

Figure 3 - The Distribution DCWOP Article in Journals

3.1. Significant Journal Publication

The distribution of the 37 selected publications form journals that explain the design and control of warehouse picking model can be shown in figure 2. It is shown in figure 2 that the most journal sources of the selected publications discussing the design and control of warehouse picking model from International Journal of Production Research (14 articles), Production Planning & Control (4 articles), International Journal of Logistics Research and Applications (3 articles), Supply Chain Forum: An International Journal (2 articles), IISE Transactions (8 articles), International Journal of Computer Integrated Manufacturing (2 articles), Enterprise Information Systems (2 articles), and Journal of the Operational Research Society (2 articles).

3.2. Research Topics in Design and Control of Warehouse Order Picking

3.2.1. Order Picking Systems

According to [48] order picking method can divide into two categories namely (1) picker-to-parts' that assign picker travels to storage location to pick SKUs which conveyed by research from [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], and [39]. (2) Part-to-picker' that taking orders related to taking stock storage units (SKUs) from their storage locations to fulfill certain requests determined by one or more customer orders that conveyed by research from [40], [41], [42], and [43].

3.2.2. Operative Planning Issues in order Picking

Operative planning issues in order picking based on literature can divide into (1) storage assignment that conveyed by research from [29], [38], [41], [42], and [44]. (2) Zoning that conveyed by research [22], [26], and [43]. (3) order consolidation that conveyed by research from [20], [21], [28], and [45]. (4) Routing that conveyed by research from [18], [19], [21], [24], [27], [32], [36], [44], and [45].

3.2.3. Batching

Batching can divide into three categories, namely (1) pick and sort that conveyed by research from [22],[25], [43], and [45]. (2) pick by article that conveyed by research from [20] and [33]. (3) pick by order that conveyed by research from [18], [14], [23], [27], [28], [30], [31], [32], [35], [37], [42], [44], [21], [45], and [46].

3.2.4. Order Batching

Order batching can divide into two categories namely, (1) static that conveyed by research from [18], [19], [21], [23], [25], [26], [27], [28], [33], [34], [36], [37], [38], [44], and [46]. (2) dynamic that conveyed by research from [26], [30], and [42].

3.2.5. Zoning
Zoning can divide into tqo categories namely, (1) synchronized that conveyed by research from [16], [42], [23], [41], and [45]. (2) progressive that conveyed by research from [19], [25], [30], [34], [35], [36], [38], [44], and [46].

3.3. Research Topics in Design and Control of Warehouse Order Picking

In E-commerce environment, consumers have higher requirement on rapid order processing, therefore, how to optimize the efficiency of picking operation in order to shorten the order processing time is the emphasis and difficulty for warehouse management of E-commerce enterprises. E-commerce orders are in small batch and high frequency, therefore, the order batching strategy is more suitable to optimize the picking operation efficiency. In the era of big data, the E-commerce enterprises need to face massive customer orders, which makes it necessary for the E-commerce enterprises to adopt big data analysis methods such as data mining to process orders and design the batching algorithm

3.3.1. Order Release Mode
Order release mode can divide into two categories namely (1) discrete that conveyed by research from [21], and [42]. (2) continuous that conveyed by research from [19], [25], [28], [30], [34], [36], [37], [44], [45], and [46]

3.3.2. Warehouse Dimensionality
Accroding to [48] warehouse dimensionality commonly classified into (1) one dimensionality (e.g vetical carousel) which conveyed by research from [26], [43], [44], and [45]. (2) two dimensionality (e.g single-aisle AS/RS) which conveyed by research from [18], [19], [20], [23], [25], [28], [29], [30], [33], [34], [35], [36], and [37]. (3) three dimensionality (e.g many aisles, each several storage levels) which conveyed by research from [41], and [42]

3.3.3. Routing Method
According to [49] routing method that commonly used in solving problems in warehouses are, (1) analytic that use exact theorems to present formulas that can be used to present numerical solutions to mathematical problems with or without the use of numerical methods that conveyed by research from [27], [29], [33], [37], [38], and [46]. (2) heuristics that was problem dependent techniques that are usually adapted to the problem at hand that conveyed by research from [21], [27], [28], [39], [43], [45], and [46]. (3) metaheuristics that was problem independent techniques that can be used as black boxes and can be applied to solve a wide range of problems. That conveyed by research from [18], [19], [22], [23], [24], [28], [36], [44], [45], and [47]. (4) simulation that was imitation of the operation of a real-world process or system over time. Simulations require the use of models; the model represents the key characteristics or behaviors of the selected system or process, whereas the simulation represents the evolution of the model over time that conveyed by research from [25], [26], [34], [35], [39], and [41],

3.3.4. Storage
According to [40] storage policy classified into three categories i.e (1) dedicated storage specific locations for each SKU within the warehouse that conveyed by research from [25]. (2) class base storage that different classes of homogeneous SKUs according to a specific criterion, e.g. the turn index measured for each SKU that conveyed by research from [20], [21], [22], [23], [27], [29], [33], [35], [37], and [44]. (3) random storage that assigned SKU to the first available location in warehouse and conveyed by research from [23], [26], [36], [38], [39], [41], and [45]

3.3.5. Objectives
Research related to design and control of warehouse order picking into several research objectives can be identified, namely: (1) objectives travel time that conveyed by research from [20], [21], [22], [26], [29], [32], [34], [36], [38], and [39]. (2) travel distance that conveyed by research from [18], [19], [24], [25], [31], [37], [44], and [46]. (3) searching time that conveyed by research from [20], [27], [33], [44], and [45]. (4) picking time that conveyed by research from [23], [24], [31], [35], and [45]. (5) cycle time that conveyed by research from [42], [42], and [43].

4. CONCLUSION

This research provides a systematic literature review on design and control of warehouse picking. 37 papers related to design and control of warehouse picking have been collected from peer-reviewed international journals and articles. From the research we can deduce that research related to parts-to-picker has less research compared to picker-to-parts. This is because there are not many companies in the industry implemented picker-to-parts system due to high investment, with the result that research related to picker-to-parts still can be developed further. On the other hand, research related to picker-to-part also has opportunities for further development, for example to handle the development of e-commerce, which is currently growing massively, especially coupled with changing public spending patterns. It can be identified that the number of publications related to storage assignment, zoning, order consolidation is still limited. It can be clearly

identified that research related to routing has been done by previous researchers. However, not many researchers have combined the two problems in one research.

On the other part we can identified that pick by order system on batching method quite a lot has been done compared to pick by articles and pick and sort. However, in this part all batching methods still can be developed further. Furthermore, research related to dynamic order batching has become a more interesting discussion and can be developed compared to static order batching. Discrete order release is still lacking compared to continuous order release. As well as three dimensional of warehouse can be developed further compared to one and two dimensional of warehouse. In the Routing method section, we can identify that metaheuristics and simulation can be more developed compared to analytic and heuristics methods. Random storage can be more developed compared to class based and dedicated storage. Also related to objective, we can identify that picking time, search time, and cycle time can be more developed further compared to travel time and travel distance.

REFERENCES

[1] J. Sheth, "Impact of Covid-19 on consumer behavior : Will the old habits return or die ?," *J Bus Res*, vol. 117, pp. 280–283, 2020, doi: 10.1016/j.jbusres.2020.05.059.

[2] S. Liu, "• Operating systems for software development worldwide 2021 | Statista." Accessed: Oct. 24, 2021. [Online]. Available: https://www.statista.com/statistics/869211/worldwide-software-development-operating-system/

[3] Temasek and Google, "e-Conomy SEA 2019." Accessed: Oct. 24, 2021. [Online]. Available: https://www.blog.google/documents/47/SEA_Internet_/

[4] Cyzerg, "Technology for Warehouses & Distribution Centers," https://cyzerg.com/.

[5] T. P. Sari, A. Y. Ridwan, and R. Aurachman, "Designing Floor Tile Warehouse Layout Using Heuristic Approach Method to Increase Warehouse Capacity and Reduce Travel Distance," *International Journal of Innovation in Enterprise System*, vol. 1, no. 01, pp. 44–52, Dec. 2017, doi: 10.25124/ijies.v1i01.8.

[6] I. Dembińska, "The Impact of E-Commerce Development on the Warehouse Space Market in Poland," *Economics and Culture*, vol. 13, no. 2, pp. 5–13, 2016, doi: 10.1515/jec-2016-0020.

[7] T. Sprock, A. Murrenhoff, and L. F. Mcginnis, "A hierarchical approach to warehouse design," *Int J Prod Res*, vol. 7543, no. October, pp. 1–13, 2016, doi: 10.1080/00207543.2016.1241447.

[8] Y. A. Hidayat, V. N. Riaventin, and O. Jayadi, "Economic Order Quantity Model for Growing Items with Incremental Quantity Discounts, Capacitated Storage Facility, and Limited Budget," *Jurnal Teknik Industri*, vol. 22, no. 1, pp. 1–10, Feb. 2021, doi: 10.9744/jti.22.1.1-10.

[9] D. Diah Damayanti, N. Novitasari, E. Bayu Setyawan, and P. Suksessanno Muttaqin, "Intelligent Warehouse Picking Improvement Model for e-Logistics Warehouse Using Single Picker Routing Problem and Wave Picking," *JOIV : International Journal on Informatics Visualization*, vol. 6, no. 2, p. 418, Jun. 2022, doi: 10.30630/joiv.6.2.1006.

[10] Ç. Cergibozan and A. S. Tasan, "Order batching operations : an overview of classification , solution techniques , and future research," *Journal Intelligent Manufacturing*, 2016, doi: 10.1007/s10845-016-1248-4.

[11] A. J. R. M. noud Gademann, J. P. Van Den Berg, and H. H. Van Der Hoff, "An order batching algorithm for wave picking in a parallel-aisle warehouse," *IIE Transactions (Institute of Industrial Engineers)*, vol. 33, no. 5, pp. 385–398, 2001, doi: 10.1080/07408170108936837.

[12] D. M. Lambert, J. R. Stock, and L. M. Ellram, "Fundamentals of Logistics Management," *New York Irwin*. MC Graw Hill, Boston, pp. xvii, 892 p., 1998.

[13] H. Davarzani and A. Norrman, "Toward a relevant agenda for warehousing research : literature review and practitioners ' input," *Logistics Research*, vol. 8, no. 1, 2015, doi: 10.1007/s12159-014-0120-1.

[14] B. Kitchenham and S. Charters, *Guidelines for performing Systematic Literature reviews in Software Engineering Version 2.3*, vol. 45, no. 4ve. 2007. doi: 10.1145/1134285.1134500.

[15] P. S. Muttaqin, "Joint Optimization of Inventory and Preventive Maintenance : Systematic Literature Review and Research Agenda," *International Conference on Industrial Engineering and Applications*, 2018.

[16] J. Jesson, L. Matheson, and F. M. Lacey, *Doing Your Literature Review Traditional ans Sistematic Techniques*. 2011. doi: 10.1017/CBO9781107415324.004.

[17] A. Booth, D. Papaioannou, and A. Sutton, *Systematic Approaches to a Successful Literature Review*, Second edi., no. October 2019. London: Sage, 2012.

[18] O. Kulak, Y. Sahin, and M. E. Taner, "Joint order batching and picker routing in single and multiple-cross-aisle warehouses using cluster-based tabu search algorithms," *Flex Serv Manuf J*, vol. 24, no. 1, pp. 52–80, 2012, doi: 10.1007/s10696-011-9101-8.

[19] A. M. Tenahua, "A methodology to solve the Order Batching Problem to the Batching Problem A methodology methodology to solve solve the Order E .**, Batching," *IFAC-PapersOnLine*, vol. 48, no. 3, pp. 1380–1386, 2015, doi: 10.1016/j.ifacol.2015.06.279.

[20] C. H. Glock *et al.*, "Maverick picking : the impact of modifications in work schedules on manual order picking processes," *Int J Prod Res*, vol. 7543, no. November, p. 0, 2016, doi: 10.1080/00207543.2016.1252862.

[21] B. Menéndez, E. G. Pardo, A. Alonso-ayuso, E. Molina, and A. Duarte, "Variable Neighborhood Search strategies for the Order Batching Problem," *Computers and Operation Research*, pp. 1–13, 2016, doi: 10.1016/j.cor.2016.01.020.

[22] C.-L. Yang, T. Phuong, and Q. Nguyen, "Constrained clustering method for class-based storage location assignment in warehouse," 2016.

[23] A. Scholz and G. Wäscher, "Order Batching and Picker Routing in manual order picking systems : the benefits of integrated routing," *Cent Eur J Oper Res*, 2017, doi: 10.1007/s10100-017-0467-x.

[24] D. D. Damayanti, E. B. Setyawan, L. Andrawina, and B. Santosa, "Warehouse picking model for single picker routing problem in multi dimensional warehouse layout using genetic algorithm approach to minimize delay," *Advances in Intelligent Systems and Computing*, vol. 700, no. 2018, pp. 124–134, 2018, doi: 10.1007/978-3-319-72550-5_13.

[25] A. Burinskienė, V. Davidavičienė, and J. Raudeliūnienė, "Simulation and order picking in a very-narrow- aisle warehouse," *Economic Research-Ekonomska IstraŽivanja*, vol. 31, no. 1, pp. 1574–1589, 2018, doi: 10.1080/1331677X.2018.1505532.

[26] S. A. Altarazi and M. M. Ammouri, "Concurrent manual-order-picking warehouse design : a simulation-based design of experiments approach," *Int J Prod Res*, vol. 7543, no. January, pp. 1–19, 2018, doi: 10.1080/00207543.2017.1421780.

[27] C. A. Valle, J. E. Beasley, and A. Salles, "Optimally solving the joint order batching and picker routing problem," *Eur J Oper Res*, 2017, doi: 10.1016/j.ejor.2017.03.069.

[28] C. Cheng, Y. Chen, T. Chen, and J. J. Yoo, "Using a hybrid approach based on the particle swarm optimization and ant colony optimization to solve a joint order batching and picker routing problem," *Intern. Journal of Production Economics*, pp. 1–10, 2015, doi: 10.1016/j.ijpe.2015.03.021.

[29] R. Manzini, R. Accorsi, M. Gamberi, and S. Penazzi, "Modeling class-based storage assignment over life cycle picking patterns," *Int J Prod Econ*, pp. 1–11, 2015, doi: 10.1016/j.ijpe.2015.06.026.

[30] V. Giannikas, W. Lu, B. Robertson, and D. Mcfarlane, "An interventionist strategy for warehouse order picking : Evidence from two case studies," *Int J Prod Econ*, vol. 189, no. April, pp. 63–76, 2017, doi: 10.1016/j.ijpe.2017.04.002.

[31] D. Battini, M. Calzavara, A. Persona, and F. Sgarbossa, "Order picking system design : the storage assignment and travel distance estimation (SA & TDE) joint method," *Int J Prod Res*, no. August, pp. 37–41, 2014, doi: 10.1080/00207543.2014.944282.

[32] S. Henn, V. Schmid, and S. Henn, "Metaheuristics for Order Batching and Sequencing in Manual Order Picking Systems," Germany, 11, 2011.

[33] S. S. Rao and G. K. Adil, "Optimal class boundaries , number of aisles , and pick list size for low-level order picking systems Optimal class boundaries , number of aisles , and pick list size for low-level order picking systems," *IIE Transactions*, no. December 2014, pp. 37–41, 2013, doi: 10.1080/0740817X.2013.772691.

[34] M. Çelk and H. Süral, "Order picking under random and turnover-based storage policies in fishbone aisle warehouses Order picking under random and turnover-based storage policies in fishbone aisle warehouses," *IIE Transactions*, no. November 2014, pp. 37–41, 2013, doi: 10.1080/0740817X.2013.768871.

[35] B. Bahrami, E. Aghezzaf, and V. Limère, "Enhancing the order picking process through a new storage assignment strategy in forward- reserve area," *Int J Prod Res*, vol. 7543, 2019, doi: 10.1080/00207543.2019.1567953.

[36] A. H. Schrotenboer *et al.*, "Order picker routing with product returns and interaction delays," *International Journal of Production Research ISSN:*, vol. 7543, no. July, 2016, doi: 10.1080/00207543.2016.1206982.

[37] C. H. Y. Lam, K. L. Choy, G. T. S. Ho, and C. K. M. Lee, "An order-picking operations system for managing the batching activities in a warehouse," *Int J Syst Sci*, no. November 2014, pp. 37–41, 2013, doi: 10.1080/00207721.2012.761461.

[38] M. Khachatryan and L. F. Mcginnis, "Picker travel time model for an order picking system with buffers Picker travel time model for an order picking system with buffers," *IIE Transactions (Institute of Industrial Engineers)*, no. January 2015, pp. 37–41, 2014, doi: 10.1080/0740817X.2013.823001.

[39] S. Hong, A. L. Johnson, and B. A. Peters, "Large-scale order batching in parallel-aisle picking systems," *IIE Transactions (Institute of Industrial Engineers)*, no. November 2014, pp. 37–41, 2012, doi: 10.1080/0740817X.2011.588994.

[40] R. Manzini, M. Gamberi, A. Persona, and A. Regattieri, "Design of a class based storage picker to product order picking system," *International Journal of Advanced Manufacturing Technology*, vol. 32, no. 7–8, pp. 811–821, 2007, doi: 10.1007/s00170-005-0377-2.

[41] Y. Yu, "Sequencing heuristics for storing and retrieving unit loads in 3D compact automated warehousing systems Sequencing heuristics for storing and retrieving unit loads in 3D compact automated warehousing systems," *IIE Transactions (Institute of Industrial Engineers)*, no. December 2014, pp. 37–41, 2014, doi: 10.1080/0740817X.2011.575441.

[42] T. Lerher, B. Y. Ekren, G. Dukic, and B. Rosi, "Travel time model for shuttle-based storage and retrieval systems European Federation of Materials Handling," *International Journal Advance Manufacturing Technology*, 2015, doi: 10.1007/s00170-014-6726-2.

[43] R. Andriansyah, L. F. P. Etman, I. Adan, and J. E. Rooda, "Design and analysis of an automated order-picking workstation," *Journal of Simulation*, vol. 8, no. 2, pp. 151–163, 2013, doi: 10.1057/jos.2013.24.

[44] M. Yousefi, N. Attari, A. E. Torkayesh, and B. Malmir, "Robust possibilistic programming for joint order batching and picker routing problem in warehouse management," *Int J Prod Res*, vol. 0, no. 0, pp. 1–19, 2020, doi: 10.1080/00207543.2020.1766712.

[45] T. L. Chen, C. Y. Cheng, Y. Y. Chen, and L. K. Chan, "An efficient hybrid algorithm for integrated order batching, sequencing and routing problem," *Int J Prod Econ*, vol. 159, pp. 158–167, 2015, doi: 10.1016/j.ijpe.2014.09.029.

[46] J. Li, R. Huang, and J. B. Dai, "Joint optimisation of order batching and picker routing in the online retailer ' s warehouse in China," *Int J Prod Res*, vol. 7543, no. May, 2016, doi: 10.1080/00207543.2016.1187313.

[47] S. Henn and G. Wäscher, "Tabu search heuristics for the order batching problem in manual order picking systems," *Eur J Oper Res*, vol. 222, no. 3, pp. 484–494, 2012, doi: 10.1016/j.ejor.2012.05.049.

[48] D. Koster, T. Le-duc, and K. J. Roodbergen, "Design and control of warehouse order picking : A literature review," *Eur J Oper Res*, vol. 182, pp. 481–501, 2007, doi: 10.1016/j.ejor.2006.07.009.

[49] M. Bashiri and H. Karimi, "Effective heuristics and meta-heuristics for the quadratic assignment problem with tuned parameters and analytical comparisons," *Journal of Industrial Engineering International*, vol. 8, no. 6, pp. 1–9, 2012.