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SUPPLY CHAIN OPTIMIZATION USING GENETIC ALGORITHM IN INDUSTRY MANUFACTURE: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

One of the supply chain and exchange of material information from suppliers to final consumers is the supply chain idea. Customer needs fluctuate or go unnoticed as a result of the increase, decrease, and cancellation of consumer interest, and supply chains play a role in market competition. The thorough literature review aims to find a more accurate and efficient application of genetic algorithms in the manufacturing industry for supply chain optimization. from the journal search results, 171 journals were found for the period 2016-2021, after review, 118 journals that were relevant to the research were selected, from these relevant journals there were 23 selected journals. Of these 23 journals, there are still gaps in the criteria for research questions, based on search strings, process criteria, so that further research on supply chain optimization using genetic algorithms can still be done.

Keywords: *Genetics, Algorithms, Supply Chain, Optimization, Effective, Efficiency, Accurate*

1. INTRODUCTION

In the business world, the activity that determines the success or failure of a business is how the supply chain runs in the business [1]. To ensure that the supply chain runs effectively, one of the factors is the determination of the distance between the supplier and the business location, the price of raw materials purchased, and the availability of stock from the supplier [2] So far, in our hypothesis, the supply chain in several business fields have not been running optimally. To find out how far the research carried out by researchers on the supply chain, we made a systematic literature review.

One of the supply chains and the interchange of material information from suppliers to end consumers is the supply chain idea. Customer needs fluctuate or are unknown as a result of rises, reductions, and cancellations in consumer interest [3], and the supply chain plays a role in market rivalry. 1st.

A Genetic Algorithm is a problem-solving strategy that uses genetic algorithms to identify the best answer. Genetic Algorithms [3]–[6] are commonly utilized to solve scheduling optimization problems. One of the most useful and evolutionary algorithms is the genetic algorithm [7]

Zaqi Sarwani and colleagues demonstrated how genetic algorithms can be used to reduce the cost of a multi-stage supply chain. They explore numerous approaches to determine which is the most efficient in the multi-stage supply chain challenge they are working on. By running numerous experimental simulations, the parameters of the genetic algorithm can yield almost optimal solutions for multi-stage distribution issues [4].

Given that logistics is one of the most important industries in the world, genetic algorithms

will continue to evolve [5]. Genetic algorithms, one of the many AI methodologies, can provide solutions to general optimization problems, according to some literature on AI as an approach to logistics process optimization.

By doing a systematic literature review to select journals and following the methods that have been established [8]–[10]. The Kitchenham approach will be utilized to compile this systematic literature review. When used as a supply chain optimization tool in the manufacturing industry, the genetic algorithm can help develop a complicated supply chain system that is beneficial to the manufacturing industry.

2. LITERATURE REVIEW METHODOLOGY

A review of multi-objective optimization utilizing a genetic algorithm strategy to improve inventory management is provided by Joo N. C. Gonçalves, M. Sameiro Carvalho, and Lino Costa [3]. NSGA-II is utilized to provide a non-dominant solution set for the suggested multi-objective optimization problem, according to his book, because there are various hurdles in the simulation process to provide method comparison analysis.

The Kitchenham method was used in the preparation of this systematic literature review. The following is a schematic in a systematic literature review.

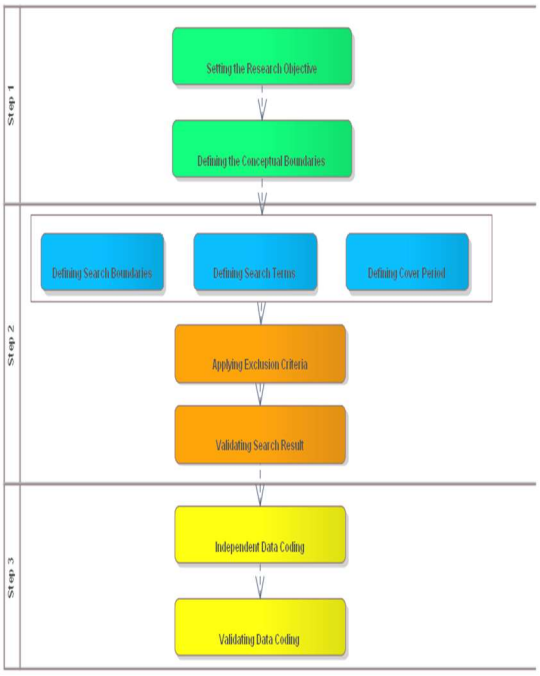

Figure 1: Schematic systematic literature review

This method has 3 stages in its preparation, the following is an explanation from figure 1

Step 1:

1) Setting the research objective, the goal is to find out how far the research carried out by previous researchers is on supply chain optimization
2) Defining the conceptual boundaries

Step 2:

1) Applying inclusion criteria will discuss defining search boundaries, defining search terms, and defining cover period.
2) Applying exclusion criteria, namely determining several criteria in the search for papers
3) Validating search result, at this stage, validation of the journal search results will be carried out based on predetermined criteria

Step 3:

1) Independent data coding,
2) Validating data coding

2.1 Problem Statement

Algorithms have been used to support supply chains in the manufacturing, chemical, and other industrial sectors [11]–[16]. Several inquiries will be focused on looking for related journals on the need for how genetic algorithms can optimize supply chains in the manufacturing business to find out how genetic algorithms can optimize supply chains in the manufacturing industry.

2.2 Research Question

It must be remembered that the purpose of a systematic literature review is to seek more accurate and efficient application of genetic algorithms for supply chain optimization in the manufacturing industry and to seek inspiration and input for further research. Research questions are outlined for the SLR for the needs of the chosen topic. The following are the questions in this research.

RQ1. How to do cross-over?
RQ2. How to do mutation?
RQ3. How to prepare raw materials?
RQ4. How to produce finished goods?
RQ5. How to find accurate data?

2.3 Research Process

The first step is to create a list of key terms related to the subject of interest. These terms are algorithm, genetic, supply chain, cross-over, mutation, schedule, manufacture, efficiency, effective. The

search process is used to obtain relevant sources for the answer. On the first search conducted using the above string, it was found that the results contained incorrect references to the genetic algorithm. Therefore, the string is modified as follows: "Supply chain optimization OR supply chain OR forecast OR schedule OR scheduling" AND "genetic algorithm OR cross over OR mutation" AND "manufacture OR manufacturing OR effective OR efficiency OR accurate".

2.4 Study Selection and Criteria Process

To be able to decide whether the data is suitable for use in systematic literature review research, it is necessary to determine criteria, the following criteria are:

1) Paper used as a reference in Indonesian and in English
2) Paper published for the period 2016-2021
3) The paper format in pdf format
4) Paper obtained from IEEE, Google Scholar, Science direct. Research Gate,

In this structural literature review, the evaluation will be based on a quality assessment, the quality assessment is as follows:

QA1. Does the paper discuss cross-over?
QA2. Does the paper discuss mutations?
QA3. Does the paper discuss the provision of raw materials?
QA4. Does the paper discuss how to produce a finished good?
QA5. Does the paper discuss data accuracy?

3. IMPLEMENTATION LITERATURE REVIEW

Literature that has been obtained from various sources as many as 171 journals as resources and criteria are only used as candidates for the study of research questions as many as 118 journals, after reviewing, re-selected journals relevant to supply chain optimization using genetic algorithms there are only 23 journals and similar which can be used for this research.

Table 1: Journal Search Obtained

Source of Paper	Found	Relevant	Selected
IEEE	27	11	3
Google Scholar	25	23	3
Science Direct	44	21	9
Research Gate	75	63	8
Total	171	118	23

Table 2 describes the author countries in the selected papers, mostly from China which contributed 5 papers with 13 authors, then the United States and Iran had the same number of 4 journals with 12 and 15 authors respectively, the remaining 13 countries out of a total of 23 journals. whose journals were selected with the criteria of this study. The largest percentage for authors is in Iran with 20.83%.

Table 2: Country of the Authors

Country of the Author	Paper	%	Author	%
USA	4	17%	12	16,67%
China	5	22%	13	18,06%
Iran	4	17%	15	20,83%
Canada	1	4%	4	5,56%
Hongkong	1	4%	3	4,17%
Portugal	1	4%	5	6,94%
Finland	1	4%	3	4,17%
Bangladesh	1	4%	2	2,78%
Turkey	1	4%	2	2,78%
Poland	1	4%	2	2,78%
Singapore	1	4%	3	4,17%
Portugal	1	4%	4	5,56%
India	1	4%	4	5,56%
Total	23	100%	72	100%

In table 3 it can be seen that these 188 relevant journals are grouped by year of publication, the most relevant journals published in 2020 are 36 journals with the highest percentage of 27% in 2020.

Table 3: Grouping Journal Relevant by Years Publication

No	Source	Years	Amount	%
1	[1], [19], [21], [25], [29], [30], [31], [32], [33], [34], [36],	2016	15	13%

No	Source	Years	Amount	%
	[38], [41], [43], [44],			
2	[4], [6], [17], [7], [20], [23], [24], [26], [27], [28], [35], [37], [38], [40], [42], [117], [126]	2017	17	14%
3	[45], [51], [55], [56], [57], [58], [59], [61], [63], [66], [67], [69], [70], [71], [72], [73], [74], [76], [77], [79], [80], [81]	2018	22	19%
4	[18], [22], [46], [47], [47], [49], [50], [52], [54], [60], [62], [64], [65], [68], [75], [78], [97], [111], [117], [118], [121], [120], [122], [123], [124], [127]	2019	26	22%
5	[82], [84], [86], [87], [88], [89], [90], [91], [94], [95], [96], [98], [99], [100], [101], [102], [103], [104], [105], [106], [107], [108], [109], [110], [112], [113], [113], [115], [116], [118], [119], [125],	2020	32	27%
6	[5], [53], [83], [85], [92], [93]	2021	6	5%
Total			118	100%

In table 4 explains the results of the journals that have been obtained in table 1, they are selected again using the quality assessment or (QA) that has been determined previously so that only a few enter the selection., The results of the search process above will pass the selection stage again based on the boundary and input criteria. This process only leaves 23 journals or articles, then proceeds with scanning the data. Table 4 below will show the data on the results of the quality assessment.

Table 4: Quality Assessment Journal

Critical Success Factor	Source
QA1 – Cross over	[3], [6], [5], [7], [84], [91], [103]
QA2 – Mutations	[6], [5], [7], [17], [18], [25], [51], [86], [91], [100], [103]
QA3 – Provision of Raw Materials	[6], [17], [22], [23], [24], [25], [51], [83], [86], [91], [100]
QA4 – Produce Finish Goods	[24], [51], [54], [86]
QA5 – Accuracy Data	[38], [83], [100], [51], [75], [86], [95], [105], [109]

In the critical success factor column in table 4, there are 5 quality assessments and the source column. Of the 23 selected journals, 7 journals discuss cross-over, 11 journals discuss mutations, 11 journals discuss the provision of raw materials, 4 journals discuss the production of finished goods, and 9 journals discuss data accuracy.

4. CONCLUSIONS

According to the findings of a structural literature review from journals published between 2016 and 2021, 171 journals could be found. After a review, 118 relevant journals were found and then selected again based on the predetermined assessment questions. Only five journals discussed crossover, seven journals discussed mutation, twelve journals discussed raw materials, four journals discussed finished goods, and ten journals discussed supply chain data accuracy. The number of selected journals is only 23 journals that explore several journal research issues or papers that are searched based on predetermined criteria and search strings. There are still gaps in previous research and further research can be done on supply chain optimization using genetic algorithms.

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