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Systematic literature review for lean construction method current trends and issues

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Abstract. The development of construction management to eliminate waste from construction activities is not effective, in which the total cost of all resources is more than the supposed cost in construction project. The adopted method to solve this problem is using Lean concept. The implementation of Lean construction affects the performance of whole construction project and avoid the repetition of similar objects without any additional value. This research aims to maximize value and minimize waste for optimal utilization of Lean method to increase the efficiency of construction project. The methodology of this research is systematic literature review from Lean construction and Lean method topics. The result of this research are 2 articles published from Indonesia institution. Descriptive statistical analysis is the dominant method. Moreover, the case study about project construction is only 3 case study which are TOLL, High-rise building, and Bridge construction. Finally, the discussion about waste that main point in Lean construction concept limited on physical waste, which is material waste in this literature review research, whereas the impact factor from the waste such as cost overrun, delay time for the project is not specific discuss and mention whole in articles reviewed.

Keywords: Lean Construction, Systematic Literature Review, Waste Management

1. Introduction

Construction business is contributing to the construction services such as building or other physical construction which is public or private facilities. The roles of construction business are for support investor or developer for construct the building or other physical construction. There is a guideline or manual instruction for construction business that develop for several years from construction company experiences to make all the process of construction project running smoothly and to avoid massive or small problems that hinder the process of construction. The guideline also purposes to make the company uniformly in performance for running whole project.

The proper strategies and effectiveness is important for construction company to survive and competence in this global era [1], but on the implementation process of the fundamental guideline and some manual instruction of construction have some weakness in cost overruns part of the construction business. Most of the project that run by construction companies have waste which defined of the weakness in the fundamental guideline that not controlled wisely. The definition of waste is not effective and not efficient way to run the project based on using the tools, materials, human resources, and working capital which the total cost of all resources more than the cost that supposed to doing the construction project, or more that the predictive cost based on the fundamental guideline that agreed in the beginning of the project design [2]. The waste also definite on several variable as DOWNTIME

term which acronym of Defect, Overproduction, Waiting, Not Utilizing Employees, Transport, Inventory, Motion, Extra processing [3].

In development of construction management for eliminate the waste from construction activities, there are several research have done in manufacture industry and adopted in construction system is Lean Production [4]. Lean production or Lean manufacture initial development on automotive industry in Japan around 1950s [2]. The term of Lean as method philosophically is reduce the waste in minimal level for whole aspect of production activities that involved personnel, suppliers, technology, material and inventory management [4]. The approaches of Lean construction method are purpose to maximize value and minimize waste. The implementation of Lean construction affects to the performance of whole construction project and avoid to repetition of similar objects without any additional value [4,5] and significant change in construction business strategies to process development [6,7]. The Lean method is also impact on civil construction to reduce the project cost, accurate predictive of project to be done, the quality of construction result, and the relationship between supply chain system and the users [6,7].

The study conducted by Primayuda [8] for literature review in Lean Construction is to explore the implementation of Lean construction principal for house project to increase the performance of project management, so the delay time can be minimized. Lean method also implemented to assess the working performance management of lean construction (LCMP) for a project using analytic network process-fuzzy comprehensive evaluation (ANP-FCE). The method proposed for assess LCMP which is ANP-FCE, so the stakeholders of the project can be decided the strength and weakness of the running project for evaluation, this study conducted by Li & Wang [5,9].

This research aims to review the literature of Lean method and Lean construction recent work and give the widely view for maximal utilization of Lean method to increase the efficiency and reduce the waste. In this article also review about some object focuses of Lean construction and its waste analysis.

2. Methods

Based on the purpose of the study on this article, review the lean method and lean construction in current trend and bring the maximal utilization on both topics for increase efficiency and reduce waste on infrastructure project. The methodology of this research is systematic literature review that developed by Liberati et al [10].

The article searching have done using Google Scholar and Scopus as primary source, and the scientific article in form of journal have chosen to review. The time period in this research using double filter, first filter around 2016-2020. The keyword for searching article is "STRING: Lean Method” AND “Lean Construction".

Based on study of Lean construction in past two-decade method by Li et al [9]. The growth of the Lean construction in highest peak on 2015-2016, because of the reason, in this research filter the second phase for years only last two years (2019-2020).

The articles that collected filter for specific object for lean construction such as the project of house construction, toll, bridge, high-rise building, and industry building based on abstract and keywords. Then, the full article reviews to decide the best that fulfil the criteria in this research, and. The method to increase performance on Lean construction also become the major focus in this research. The diagram of the article selection shows on figure 1.

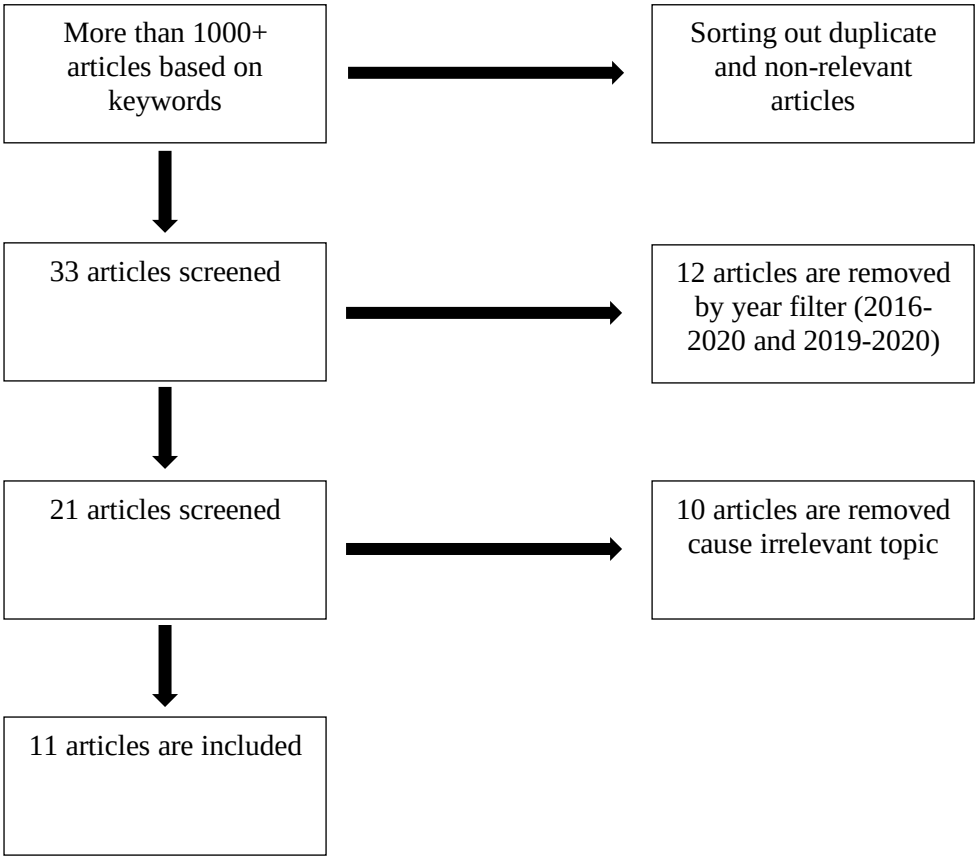

Figure 1. Flow of article selection.

3. Result and Discussion

Lean construction or Lean method have implemented and study for several years to optimize any project, especially on building construction. The optimization concern about increases the efficiency such as time, work performance, and reduce the waste defined by on several variable as DOWNTIME term which acronym of Defect, Overproduction, Waiting, Not utilizing Employees, Transport, Inventory, Motion, Extra processing.

Systematic literature review approach found that 11 articles matched with all the requirement about "Lean Construction" and "Lean Method", but most of the article have topic about the survey of the understand of stakeholders and workers for implemented the Lean Construction and Lean Method to the project. The articles are around 2019 and 2020, there are 7 articles from 2019 and 4 articles from 2020. There are 2 thesis study, 3 journal conference, and 6 journal articles for the type of articles for this literature review articles composition, and for Indonesia article is only one thesis article. The result of literature review shows on table 1.

Table 1. Systematic literature review of lean construction method.

No	References	Year	Methods	Description of Result of Lean Construction
1	Mardiansyah [11]	2019	Descriptive statistical analysis and survey from 6 key person	Building of infrastructure for TOLL using Lean Construction to increase the time performance. Lean concept implemented as crashing program by add more workers for building work. The time efficient increase by 4.5 days from initial schedule after implemented lean method.

No	References	Year	Methods	Description of Result of Lean Construction
2	Aghayev et al [12]	2020	Descriptive statistical analysis and using SPSS for statistic inference	Identification and measurement the Lean from construction industry on Azerbaijan with process, planning and control, customer relations, supplier relations, human resources, and top management leadership process. As the result, Azerbaijan construction industry is not ready to implement Lean methodology. The classification and cause of waste not mentioned on this study.
3	Albanna [13]	2019	Statistical analysis with *non-parametric test Kruskal-Wallis* and *pairwise Wilcoxon*	Developing tool that can be using as assessment the knowledge of workers about Lean concept in construction. The workers have not enough knowledge and implementation the concept about waste and its classification. The traditional method of construction still implemented in Lebanon as study case of this research. The classification and cause of waste not mentioned on this study.
4	Avelar & Meiriño [14]	2020	Qualitative and Quantitative	To explore implementation of Lean construction concept and tool for construction activities that is don't have additional value (No Additional value (NVA)) in company and other small company. Implementation of Lean construction tool on small company could be increasing productivities, guarantee of the project on time, reduce cost, and increase the quality, but in this research not mentioned about waste classification that successful to be controlled after the implementation of Lean construction tool.
5	Demirkesen & Bayhan [15]	2019	Descriptive statistical analysis and questioner survey from 106 members of Lean Construction Institute	Critical Success Factors of Lean Implementation and wisely consider the factors to increase the work performance. Commitment management, Lean training, and satisfaction of costumers are the significant factors for success of lean implementation. This research does not discuss about how to control waste according to classification and implementation on Lean construction, but only discuss about successful factors.
6	Ghosh & Burghart [16]	2019	Exploration approach and questioner survey from 72 USA contractors	Whole respondent agrees for implemented of Lean to support increasing the working performance to finish the project according to the budget and time schedule. This research did not discuss about controlled waste from Lean technique.
7	Issa, et al [17]	2020	Model building based on fuzzy logic concept	Design input-output Lean construction evaluation model (LCEM) as series evaluation that impact to lean. This evaluation aim to increase control level

No	References	Year	Methods	Description of Result of Lean Construction
				and implementation of lean as well as to reduce the waste level. This research only discusses about caused of waste and the implementation of Lean construction in form of expected level.
8	Andújar-Montoya, Garrigós, Iribarren, & Maestre [18]	2020	Comparative analysis from cost deviation between traditional paradigm and BIM & Lean paradigm	Giving the knowledge and proving BIM (Building Information Modelling paradigm) and Lean construction in empirical way. BIM directly support the purpose of Lean, facilitate of visualization, communication, transparency, reschedule, and proactive of control management. The controlled waste classification is not mentioned in this research in combination of BIM & Lean method.
9	Nowotarski, et al [19]	2019	Interview, Cycles method for definition and elimination the waste using *Define-Measure-Analyse-Improve-Control* (DMAIC)	Case study of high-rise building at Poland, the process to introduce the principal of Lean management for wall masonry. The discussion on the research limited on physical waste, which is material waste, and implemented on Lean Construction is not specific mentioned on this study.
10	Oguntona, Aigbavboa, & Mulongo [20]	2019	Descriptive statistical analysis using SPSS and Quantitative	Assess the practical use of Lean construction in effective way to increase productivities and work performance in construction industry. As continuity practical, Lean construction also face the obstacles which are hard to change, limited of knowledge and understanding of Lean construction practical, lack of policies and regulations. The classification of waste is not discussed in this study but focuses on assess of lean construction practical.
11	Sebastian [21]	2019	Qualitative analysis at two precast girder company in Indonesia	Increase production and prevent the waste in concrete and steel by conducted the training to improve the worker performance, tools maintenance, and implemented computer-based program. The discussion about waste limited only on physical which is material waste, and its implementation of Lean construction is not specific.

The method in this research found that descriptive and statistical analysis is dominant using in article list for Lean construction. Two articles with article that using descriptive and statistical analysis combine with survey method for stakeholders and the workers. Qualitative and quantitative method also dominant in this literature review for Lean construction. The method that conducted by Montoya, et al [18] is interesting that, because they compare the cost deviation between traditional method and BIM (Building Information Modelling paradigm) along with Lean paradigm which BIM directly support the purpose of Lean, facilitate of visualization, communication, transparency, reschedule, and proactive of control management. the key factors that indicated of successful for implemented Lean method bring result about commitment management, Lean training, and customer satisfaction is the

driving force of success implemented of Lean, but market share, government incentive, and regulation is not for key success implementation of Lean conducted by Demirkesen & Bayhan [15] on their study.

The object focuses on the most articles on the literature review is on construction industry to measure work performance and the knowledge about Lean construction method to the workers and manager levels. The industry of construction as case study is dominant on this research. there are only few specific cases study such as implemented Lean concept to increase time performance in TOLL project conducted by Mardiansyah [11], reduce the physical waste which is materials for high-rise building project by implemented Lean concept conducted by Nowotarski, et al [19], and increase the productivity while reduce the material waste such as concrete and steel by implemented Lan concept on Bridge project as case study conducted by Sebastian [21].

Furthermore, as the one of goals of implemented Lean construction method to run the project, waste is significant factor that need to reduce and the improvement on efficiency will be realized. The literature review that conducted on this study found that most of the articles is not mentioned and discuss about classification of waste as success factor for implemented Lean concept. There are only three articles mention about waste on their study which are Issa, et al [17] discuss about the cause of waste, Nowotarski, et al [19] mentioned about physical waste which is material of construction, and research conducted by Sebastian [21] discuss about the waste for bridge project only physical waste such as concrete and steel.

In this review can be found a wide range of challenges in implementing lean construction, with the most common issues were insufficient knowledge [22–24]; insufficient training [25,26]; cultural issues [22,25,27]; as well as workers mentality [28].

Based on the literature review can be seen that the implementation of lean construction in Indonesia has the potential. This is because in addition to minimize non value-added, applying this model could elevate the advantages in construction [29]. We can see that Indonesian workers mentality was still low and profit is still the top priority. These issues influence the implementation of lean construction in Indonesia. Improvement and time will be needed to applied lean construction in construction companies in Indonesia.

Indonesian Construction companies are still limited in implementing lean construction method. Even though this model has been introduced for a long time, it is still difficult to change the culture of workers. However, the implementation of lean construction is important, especially in developing countries such as Indonesia. By reducing the number of wastes, more value-added factors can be improved.

The implementation of lean construction in Indonesia is successful when we see from the excellent achievements point of view [30]. However, control is still needed to improve the culture of worker, management system, and the team functions. In addition, data found that companies which has applied lean construction method for more than ten years can compete better with foreign companies in Indonesia as well as obtain substantial profits [31]. A training to improve construction productivity and elevate the competitiveness will be needed [32]. The training is especially focus on enhancing workers' moral as well as improving workers' skills and abilities to be more productive.

4. Conclusion

As conclusion, this research method is literature review that filter articles based on years and topic, and 11 articles fulfil the requirement that can be the general reference because this study focuses on current trend about Lean construction for last 2 years. There only 2 articles that published from Indonesia institution that means the topic is rarely paying attention for Indonesian researcher. Descriptive statistical analysis is the dominant method using in this research, then the qualitative and survey method become the second dominant method. That method chosen because of most articles doing research about assess work performance and knowledge about implementation of Lean for project that most from construction industry. Moreover, the case study about project construction is only 3 case study which are TOLL, High-rise building, and Bridge construction. Finally, the discussion about waste that main point in Lean construction concept limited on physical waste which is material waste in this literature review research, whereas the impact factor from the waste such as

cost overrun or additional cost spend cause waste, delay time project or need more time for the project is not specific discuss and mention whole in articles reviewed, even the classification of waste also is not mentioned for whole reviewed articles on this research.

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