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Research Development of Lean Construction Journal: A Bibliometric Analysis

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Abstract

Question: Q1: What is the current status of lean construction publications in LCJ? Q2: What should be expected when the publications in LCJ are analyzed by the authors?

Purpose: The purpose of this article is to gather the technical papers and the case studies published in Lean Construction Journal between 2004 and 2018 and to observe the connections between them. In this way, further researches can be conducted on a more systematic basis.

Research Method: The raw data obtained manually was organized by using spreadsheet software, and this organized data was processed using bibliometric analysis.

Findings: Annual publication and number of citation per year, annual number of publications and citation outputs, the most cited publications, number of authors per publication, the most contributive authors, TreeMap of authors' keywords, the most contributive countries, the map of the most contributive countries, publications according to international collaboration, countries having the highest number of internationally collaborative publications, country collaboration table, country collaboration map, the most contributive institutions, the most popular research topics

Limitations: Only the technical papers published in Lean Construction Journal were included in the research. Although this may reflect a small portion of the publications in the field of lean construction, the reason for the limitation is to obtain a uniform research database and that LCJ is a well-known and an open access journal that can represent the overall trends in the past few decades.

Implications: The current understanding of lean construction will be comprehended better after this analysis.

Value for authors: This paper is the most comprehensive bibliometric analysis that reviews and gathers all the technical papers and case studies published in the last fifteen years in Lean Construction Journal. Also, it has a property as the first bibliometric

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analysis paper that analyzes all technical papers published in LCJ. Therefore, this paper is expected to be well studied by the lean construction practitioners and scholars in order to see the summary of LCJ publications.

Keywords: Bibliometric analysis, Lean Construction Journal, keywords analysis, content analysis, Lean Construction

Paper type: Full paper

Introduction

Several types of management structures have been applied to the construction industry, and each of them has advantages and disadvantages from their point of view. Although they have been used in different areas of application that minimizes such disadvantages, these systems are still incapable of considering the efficient use of collaboration and resources, giving the least amount of negative impact on the environment and having an efficient waste disposal system. As an example to such disadvantages, Ma, Zhang, & Li (2018) stated that collaboration in traditional project delivery methods which are commonly adopted in construction projects is prevented by goal inconsistency and implementation fragmentation among project participants.

Additionally, Chidambaram (2019) supports that argument by pointing out that the traditional approach does not allow engineers to carry out reinforcement optimization and it leads to the generation of reinforcement steel waste. In order to create a solution for such environmental problems and efficiency concerns, 'Lean Construction' has been implemented by the construction companies in several countries (Bajjou, Chafi, & Ennadi, 2019); therefore, its importance should be well-understood by the readers. As the authors of this paper, we believe that the way to this objective passes through analyzing the database of LCJ because of its accessibility and credibility. For this reason, the previous publications, under the limitations that will be explained in 'Methodology' section, are processed employing bibliometric analysis so that a summary of the trends and keywords can be presented to the enthusiasts in the field of lean Construction.

About LCJ

Lean Construction Journal (LCJ) is a prestigious journal which has been published by Lean Construction Institute. It is an open-access journal being registered with the Directory of Open Access. So far, more than a hundred papers in the field of Lean Construction research and practice have been published in LCJ; in this study, 77 technical papers are considered. The database of the journal itself was chosen as it is easier to access the open-access publications, and the information is more reliable. The reviewers come from different constituencies within the industry/academia and the market at which LCJ is aimed, following a strict 'double-blind review' procedure. In this study, a comprehensive analysis of the publications of LCJ was conducted from the perspective of bibliometric analysis.

About bibliometric analysis

Bibliometric analysis is a commonly used method for processing the data of publications in a specific field. This analysis technique provides a quantitative examination

on large data sets and shows the relations between the contents of publications in a digital and visual format. Although the data that is used in this research cannot be considered as large since the database was the publications of a single journal, such analysis helped to gather the data; therefore, more comprehensive results have been obtained.

Literature Review

Many researchers have studied Lean Construction for years. In 2004, it was stated that as a production management tool, Lean Construction theory describes a system that delivers a finished product free from defects to a customer, in zero time, and with nothing left in inventory (Farrar, AbouRizk, & Mao, 2004). After fifteen years, in 2019, it was also pointed out that in the new global economy, Lean Construction has become an effective way to design construction systems, which aims at reducing all forms of waste and creating the maximum of value for the customer (Baijou, Chafi, & Ennadi, 2019). It can be inferred from these definitions that Lean Construction adapts to various conditions perfectly and evolves as it is used since construction is an industry sector of great diversity in technology, complexity, value proposition, organization and performance (Pasquire, 2012). Therefore, being a perfectly-adaptable project delivery system, Lean Construction is beneficial to the customer since it has fewer defects, to the contractor since it uses less resources, and to the external systems such as environment since it decreases the waste.

It can be seen that the lean concept has gained significant importance in the last decades, so several types of researches have been conducted, and a significant number of articles have been written about it. Quoting Li, Li, Li, & Wu (2019), as for global collaborations, Lean Construction research has been widely pursued throughout the world. Therefore, this study aims to gather such publications in LCJ employing bibliometric analysis.

Methodology

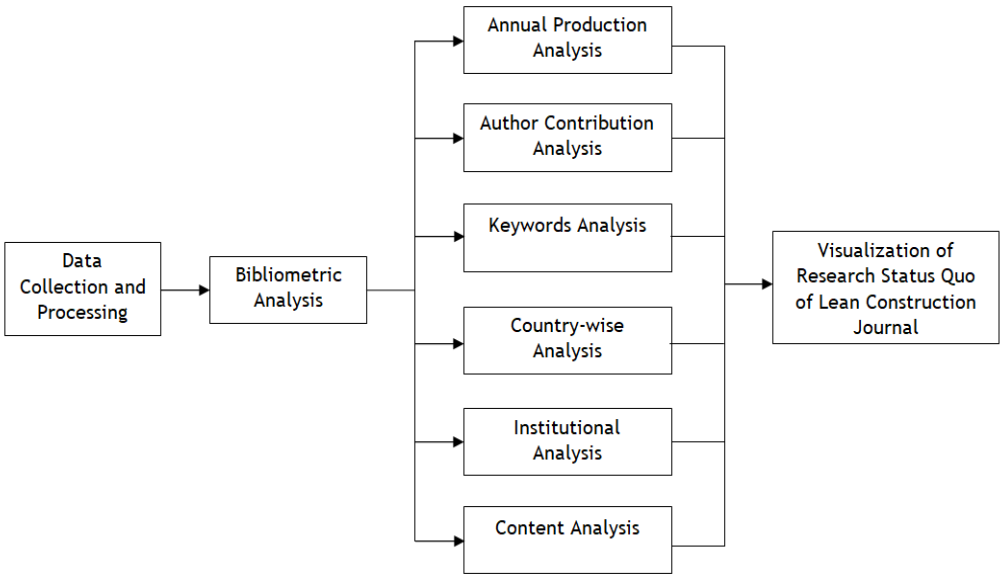

Figure 1: Outline of the Research Process

This study analyzes 77 papers that were published in Lean Construction Journal between 2004 and 2018. Figure-1 shows the outline of the research process of this paper. Within the scope of this bibliometric study, only technical papers, including full-length articles and case studies, were analyzed. Forum papers, reviews, research benchmarks, and notes were not included. Since Lean Construction Journal is an open-access journal, scientific databases like Scopus or Web of Science were not used to obtain scientific summaries of the publications. Results were directly obtained from the official website of the LCJ.

The following steps were taken to obtain the data used in this study. Firstly, back issues of the journal having publication dates from 2004 to 2018 were downloaded from their official website on June 23, 2019. Published papers were studied one by one, and useful information for bibliometric analysis was transferred to a spreadsheet software manually. This information includes publication years, volume and issue numbers, document types, titles, name of the authors, author affiliations, author's keywords, and abstracts.

Citation outputs of the publication were analyzed to measure the performance of publications. Information about citations was taken from Scopus database on June 29, 2019. It is necessary to remark that information in the Scopus database is updated on a daily basis, and this may cause some fluctuations in the number of citations.

Collected data was analyzed, and the results were illustrated in ranking tables and figures. This study also developed a map for visualization of the most frequently used author keywords. In content analysis, abstracts of all publications were studied to point out the predominant research topics in LCJ. Not only the first authors' but all authors' affiliations were analyzed to consider their contributions to the publications. Institutions, where researchers conducted their studies, were added to the datasheet. Also, regions of these institutions were added to show the consistency between such results.

The term "Single Country Publication (SCP)" was assigned to the publications if all the authors' institutions are located in a single country or region. Otherwise, they are considered under the term of "internationally collaborative publication (ICP)." "Single Institute Publication (SIP)" was assigned if the study was conducted in a single institution. If the authors conducted the study in more than one institution, the term "Inter-institutionally Collaborative Publication (IICP)" was assigned to the corresponding publications. Contribution of institutions and countries were evaluated by assigning one point for each authors' institution and country. The total frequency of institutions and countries become 199 since the analyzed 77 publications were co-authored by 2.58 authors on average.

Results and Discussion

The results that will be provided in this section are divided into five main groups, and each group is explained in a detailed way.

The first group shows the output related to the annual production and citations, with the support of Table-1, Table-2 and Figure-2, which are 'annual number of publications and citation outputs,' and 'the most cited publications.'

The second section emphasizes the author details by using Table-3, Table-4, and Figure-3, which are 'the number of authors per publication,' 'the most contributive authors' and 'TreeMap of authors' keywords.'

Furthermore, country-wise data are explained with Table-5, and Figure-4, which are 'the most contributive countries' and 'the map of the most contributive countries.'

Then, the collaboration between the countries given in the previous section is examined with the help of Table-6, Table-7, Table-8, and Figure-5, which are 'publications according to international collaboration', 'countries having the highest number of internationally collaborative publications', 'country collaboration table', and 'country collaboration map'.

Institution details are given with Table-9, which is 'the most contributive institutions. Finally, as a result of content analysis, 'the most popular research topics' are listed in Table-10.

Annual production and citation distribution per year

The total number of documents, which were specified in the 'Methodology' section, and the yearly distribution were provided in Table-1. The table consists of the annual number of publications, total citations, total citations per year, citable years, and the ratio of total citations per publication per year. The term 'citable years', indicates the time period starting from the publication year to 2019. Clearly, the year of 2011 consists of the largest publication number, 14. On the other hand, the largest citation number per publication per year belongs to 2008 with a value of 6.30. The two peak value can also be obtained visually from Figure-2. The line indicates the yearly distribution of total citations per publication per year; similarly, the bars show the number of publications in that particular year. By examining Table-1 and Figure-2, one can obtain the other values for the last 15 years of LCJ.

Table 1: Annual Publications and Number of Citations per Year

Year	Annual Number of Publications	Total Citations	Total Citations per Year	Citable Years	Total Citations per Publication per Year
2004	4	150	37.50	15	2.50
2005	10	329	32.90	14	2.35
2006	0	0	0.00	13	0.00
2007	4	140	35.00	12	2.92
2008	3	208	69.33	11	6.30
2009	4	56	14.00	10	1.40
2010	8	89	11.13	9	1.24
2011	14	124	8.86	8	1.11
2012	9	96	10.67	7	1.52
2013	3	41	13.67	6	2.28
2014	1	2	2.00	5	0.40
2015	3	2	0.67	4	0.17
2016	5	12	2.40	3	0.80
2017	4	5	1.25	2	0.63
2018	5	1	0.20	1	0.20
Total	77	1255	16.29	-	-

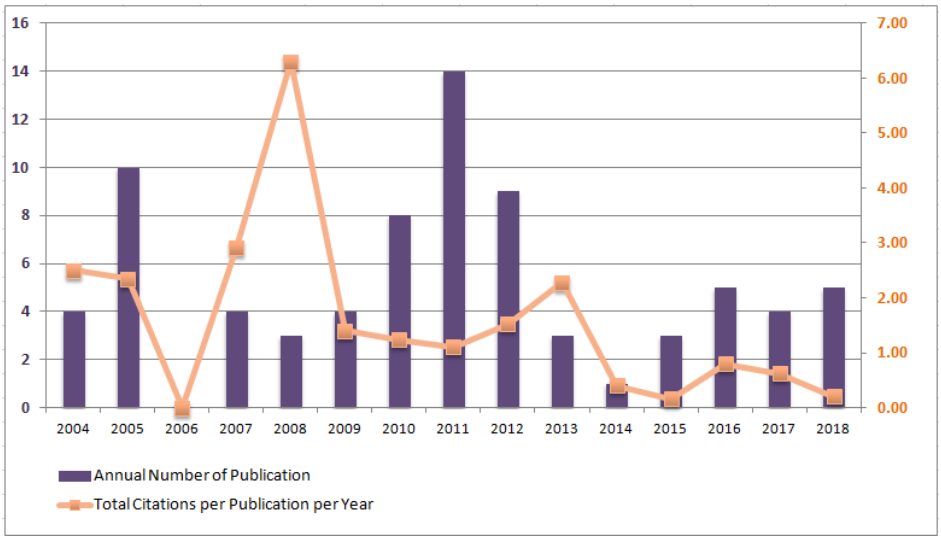

Figure 2: Annual Number of Publications and Citation Outputs

The most cited publications are also shown in Table-2. The publication years, the number of citations, the title of the publications, and the authors were stated in the table. Obviously, 'The Lean Project Delivery System: An Update' by G. Ballard has been cited by the largest number of publications with a peak value of 127. Following, 'Integrated Project Delivery an Example of Relational Contracting' by O. Matthews and G. A. Howell has the citation number of 111, and the rest of the 10 most-cited publications are shown in Table-2.

Table 2: Most Cited Publications

Year	Citations	Title	Author 1	Author 2	Author 3	Author 4
2008	127	The Lean Project Delivery System: An Update	G. Ballard			
2005	111	Integrated Project Delivery An Example of Relational Contracting	O. Matthews	G. A. Howell		
2005	70	Site Implementation and Assessment of Lean Construction Techniques	O. Salem	J. Solomon	A. Genaidy	M. Luegring
2011	70	Transitioning to Integrated Project Delivery: Potential barriers and lessons learned	R. Ghassemi	B. Becerik-Gerber		
2005	56	Sutter Health: Developing a Contracting Model to Support Lean Project Delivery	W. A. Lichtig			
2010	56	The combination of the last planner system and location-based management system	O. Seppanen	G. Ballard	S. Pesonen	
2004	55	Competing Construction Management Paradigms	G. Ballard	G. A. Howell		
2005	52	Project Alliancing: A Relational Contracting Mechanism for Dynamic Projects	M. W. Sakal			
2007	51	A Lean Modeling Protocol for Evaluating Green Project Delivery	L. Klotz	M. Horman	M. Bodenschatz	
2008	49	Lean principles in industrialized housing production: the need for a cultural change	M. Höök	L. Stehn		

Author contribution

Author-wise output includes the number of authors per publication and the most contributive authors.

Table-3 analyses the number of authors per publication. Since the largest number of authors in one publication is ten, the rows have values up to ten. There are 32 publications having only two authors, while no publications exist having 6, 7, 8, or 9 authors. Also, there is one paper with ten different authors, which is 'How to Make Shared Risk and Reward Sustainable' published in 2015 by G. Ballard, B. Dilsworth, D. Do, W. Low, J. Mobley, P. Phillips, D. Reed, Z. Sargent, P. Tillman, and N. Wood. Frequency values for each row are also shown in the last column of Table-3.

Table 3: Number of Authors per Publication

Number of Authors	Number of Publications	Frequency
1	10	10
2	32	64
3	23	69
4	9	36
5	2	10
6	0	0
7	0	0
8	0	0
9	0	0
10	1	10
Total	77	199

The most contributive authors having at least two publications are listed in Table-4. Glenn Ballard has the lead with seven publications in LCJ between the years of 2004 and 2018. After Ballard, Christine Pasquire and Farook Hamzeh are the second-most- contributive authors with an equal number of publications, 5. The other 16 authors with their publication numbers can also be seen in Table-4.

Table 4: Most Contributive Authors

Author	Number of Publications
Glenn Ballard	7
Christine Pasquire	5
Farook Hamzeh	5
Lauri Koskela	4
Anders Björnfot	3
Gregory A. Howell	3
Iris D. Tommelin	3
Thais da C. L. Alves	3
Claus Nesensohn	2
Isabelina Nahmens	2
Jardar Lohne	2
Jose Fernandez-Solis	2
Lars Stehn	2
Laura H. Ikuma	2
Olli Seppanen	2
Penny-Anne Cullen	2
Richard Hickman	2
Sven Bertelsen	2
Yong-Woo Kim	2

Related with the authors, a treemap showing the most frequently used author's keywords is created manually by using the same data. As it can be observed in Figure-3, 'Lean Construction', 'Last Planner System ®', 'Theory', and 'Lean' are the most-preferred keywords throughout the publications in the range of research.

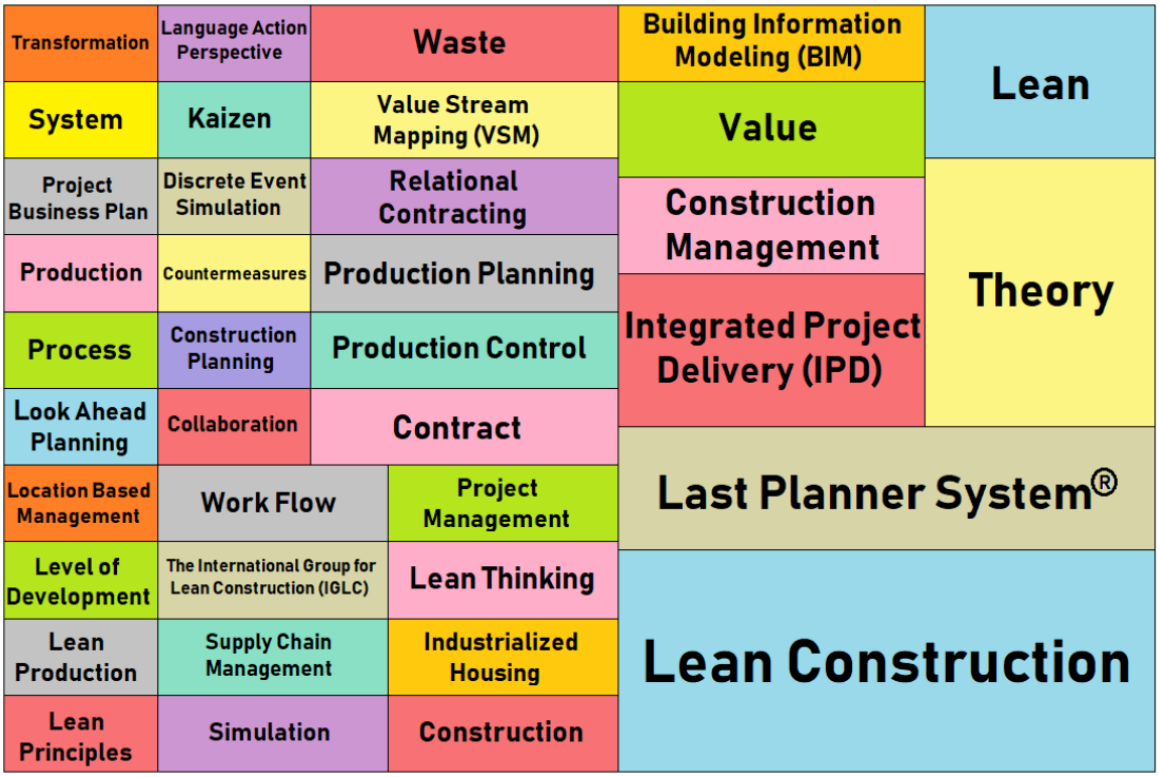

Figure 3: TreeMap of Authors' Keywords

Country-wise analysis

After analyzing the data output in terms of annual contribution and author contribution, the results were sorted so that country-based contribution can be obtained. Table-5 puts an emphasis on the data related to the author's countries. In this table, 22 countries, their flags, their frequency and frequency percentages, the number of publications produced in that country, and their percentages were included. The data in the table is sorted in descending order of publication percentage, which is the last column. The first rank belongs to the USA with a frequency of 82, and with 34 publications. In the table, it can also be seen that the percentage frequency of the USA is 41.21% (in terms of the total frequency of 199), and the percentage of the number of publications produced by the USA is 38.20% (in terms of total publication number of 77). Having a significant difference from the USA, the UK has the second rank with a frequency of 36, and with 17 publications. Following countries include Sweden, Lebanon, Norway, and Brazil with 7, 4, 4, and 3 publications, respectively. It can be inferred from Table-5 that the country-wise distribution of contribution is not homogeneous; instead, most of the publications are a product of the USA, and the UK.

Although the significant contribution of research to LCJ papers came from developed countries, this contribution has shown a decline in the last few years. This might be a result of the reduction in their interest to lean construction research, or researchers found more accessible outlets for their research.

Table 5: The Most Contributive Countries

Rank	Country	Frequency of Countries	%	Number of Publications Produced by the Country	%
1	USA	82	41.21	34	44.16
2	United Kingdom	36	18.09	17	22.08
3	Sweden	19	9.55	7	9.09
4	Lebanon	7	3.52	4	5.19
5	Norway	11	5.53	4	5.19
6	Brazil	5	2.51	3	3.90
7	Canada	5	2.51	2	2.60
8	Denmark	3	1.51	2	2.60
9	Finland	3	1.51	2	2.60
10	Germany	4	2.01	2	2.60
11	Czech Republic	1	0.50	1	1.30
12	India	3	1.51	1	1.30
13	Iran	2	1.01	1	1.30
14	Israel	5	2.51	1	1.30
15	Kuwait	2	1.01	1	1.30
16	Peru	3	1.51	1	1.30
17	South Korea	1	0.50	1	1.30
18	Singapore	2	1.01	1	1.30
19	Sri Lanka	2	1.01	1	1.30
20	South Africa	1	0.50	1	1.30
21	United Arab Emirates	1	0.50	1	1.30
22	Venezuela	1	0.50	1	1.30
	Total	199	100	77	

Figure-4 is provided with the purpose of supporting the output in Table-5. In the figure, the most contributive country, the USA, is highlighted with dark-blue, and the rest of the countries are colored in a way that is shown in the legend on the right-hand side of the map. The contribution data of other countries can also be obtained from Table-5.

Figure 4: World Map of the Most Contributive Countries

Collaboration between countries

Table 6, 7, and 8 analyze the collaboration between the countries that have one or more than one publication between the years of 2004 and 2018.

In Table 6, the publication statistics, according to international collaboration, is shown. The first row shows the number of publications produced by a single country, which is composed of 66 publications. The other 11 publications were written through an international collaboration of two or three countries. 10 out of 11 publications are considered as two country publications, whereas there is one publication which is a product of three countries. Although the number of publications produced by collaboration is not the majority, the 11 collaborative publications were analyzed to see the network.

Table 6: Publications According to International Collaboration

Publication Type	Number
Single Country Publications	66
Internationally Collaborative Publications	11
i) Two Country Publications	10
ii) Three Country Publications	1
Total Number of Publications	77

The result of this analysis is the countries and the corresponding number of internationally collaborative publications. Table-7 shows 13 countries and the numbers of multiple country publications. Again, the USA has the lead in terms of international collaboration with eight different countries. Although the gap is significant, Brazil, Germany, and the UK have the second rank, each having collaboration with two different countries.

Table 7: Countries Having the Highest Number of Internationally Collaborative Publications

Country	Number of MCP
USA	
Brazil	
Germany	
United Kingdom	
Czech Republic	
Finland	
Iran	
Lebanon	
Norway	
South Korea	
South Africa	
Sweden	
Venezuela	

The relationships between the countries are shown in Table-8 and Figure-5. In Table-8, the group of collaborative countries is written in one row. Since there were 11 internationally-published documents, there are 11 groups in the table. It should be noted that Table-8 is not sorted by any parameters, and the rows of groups are written randomly. In order to support Table-8, Figure-5 is provided, showing the same collaboration relationship in a world map. The different colors of lines show the specific collaborations between the countries in Table-8. As it was previously mentioned, the role of the USA in international collaboration can be observed better.

Table 8: Country Collaboration Table

Country 1	Country 2	Country 3
Iran	South Africa	Czech Republic
United Kingdom	Germany	
Brazil	USA	
USA	Venezuela	
Brazil	USA	
USA	Finland	
USA	United Kingdom	
Lebanon	USA	
Sweden	Norway	
Germany	USA	
South Korea	USA	

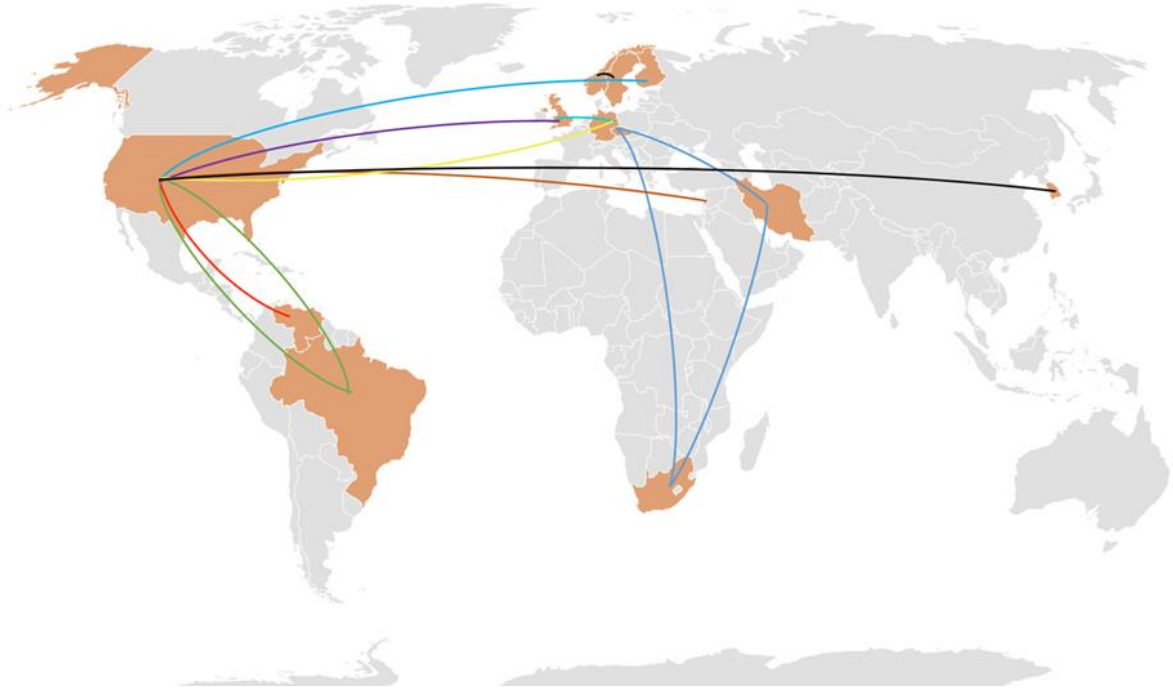

Figure 5: Country Collaboration Map

Contribution of institutions

Table-9 dwells on the contribution output of institutions in descending order of percentages of publication number. In the table, the name of the institutions, their region, frequency of institutions, number of publications, and the corresponding percentages are stated. The University of California, Berkeley (UC Berkeley) has the lead with nine publications and with a percentage of 11.69%. In the second rank, there is Luleå University of Technology (LTU) with six publications. Although its frequency is higher than UC Berkeley, since the publication number is smaller, LTU has the second rank. The table is composed of other 23 institutions from different countries, and their percentages with the number of publications can also be obtained from Table-9.

Table 9: Most Contributive Institutions

Rank	Institution	Country	Frequency	Number of Publications	%
1	University of California, Berkeley	USA	14	9	11.69
2	Luleå University of Technology	Sweden	16	6	7.79
3	American University of Beirut	Lebanon	7	4	5.19
4	University of Salford	UK	5	4	5.19
5	Norwegian University of Science and Technology	Norway	9	3	3.90
6	Nottingham Trent University	UK	5	3	3.90
7	Lean Construction Institute	USA	4	3	3.90
8	Loughborough University	UK	6	2	2.60
9	Liverpool John Moores University	UK	5	2	2.60

10	Louisiana State University	USA		5	2	2.60
11	Texas A&M University	USA		5	2	2.60
12	University of Cincinnati	USA		5	2	2.60
13	The Pennsylvania State University	USA		4	2	2.60
14	Federal University of Ceará	Brazil		2	2	2.60
15	San Diego State University	USA		2	2	2.60
16	Israel Institute of Technology	Israel		5	1	1.30
17	University of Warwick	UK		5	1	1.30
18	Federal University of Rio Grande do Sul (UFRGS)	Brazil		3	1	1.30
19	Linneaus University	Sweden		3	1	1.30
20	Michigan State University	USA		3	1	1.30
21	National Institute of Construction Management and Research (NICMAR)	India		3	1	1.30
22	North Carolina State University	USA		3	1	1.30
23	Technical University of Munich	Germany		3	1	1.30
24	University of Washington	USA		3	1	1.30
25	US Air Force Institute of Technology	USA		3	1	1.30

Content Analysis

Table-10 shows the most popular research topics that were studied within the scope of papers published in Lean Construction Journal. The table is composed of 35 main research topics of Lean Construction. These research topics and their frequencies were obtained as a result of the content analysis carried out by reading the abstracts of the 77 papers published in LCJ. Among the research topics, the Last Planner System® (LPS) is the most studied topic of research with 11 publications. In the second rank, there is Contractual Issues and Relational Contracts with 10 publications. Integrated Project Delivery (IPD) was positioned in the third rank with 9 publications. The rest of the popular research topics were listed in the following rows of the table.

Table 10: Most Popular Research Topics

Rank	Research Topics	Number of Publications
1	The Last Planner System® (LPS)	11
2	Contractual Issues/ Relational Contracts	10
3	Integrated Project Delivery (IPD)	9
4	Discussion, Assessment, Criticism or Testing of Lean Construction Principles in Project Environments or Countries	8
5	Value Chain/ Value Delivery/ Value Management/Value Stream Mapping (VSM)	8
6	Construction Planning/ Project Planning/ Production Planning/ Location-Based Planning/ Project Scheduling and Control	6
7	Process Improvement / Level of Development	5
8	Site Implementation of Lean	5
9	Building Information Modeling (BIM)	4
10	Implementing Lean in Simulation	4

11	Lean Implementation/ Practices	4
12	Construction Management/ Project Management/ Management Science	3
13	Lean Project Delivery	3
14	Supply Chain Management	3
15	Content Analysis/ Bibliometric Analysis	2
16	Discrete Event Simulation	2
17	Implementing Lean Principles in Health and Safety	2
18	Lean Construction Education	2
19	Lean Modeling/ Lean Mapping	2
20	Antecedents, Behaviors, and Consequences (ABC) model	1
21	Activity-based Costing	1
22	Agile-Based Modeling	1
23	Fuzzy Cognitive Map (FCM)	1
24	Green Project Delivery	1
25	Institutional Waste	1
26	Integrated 5D System	1
27	Investigation of Productivity	1
28	Kaizen and Job Satisfaction	1
29	Lean Six Sigma	1
30	Management Cybernetics	1
31	Project Delivery Systems	1
32	Risk Management	1
33	Sustainability	1
34	Target Value Design (TVD)	1
35	Virtual First Run Study (Decision Analysis)	1

Concluding Remarks

Lean Construction is a modern way of managing construction projects. It considers the budget of the parties in a project, saves time, and increases the quality by decreasing the waste disposal, using the resources carefully, and increasing the team performance. In the last fifteen years, 77 different technical papers and case studies were published in lean construction journal, and the bibliometric analysis that we have conducted connects all these publications and converts them into common knowledge. It shows the lean construction trends, statistics, and dispersion throughout the world in quantitative ways.

The results of this analysis that is provided in the previous pages are summarized below in order to have a general idea about lean construction. When the raw data is analyzed in terms of annual contribution, Table-1 and Figure-2 revealed that the most productive year is 2011 in terms of publication number. On the other hand, the highest citation number belongs to 2008. Furthermore, 'The Lean Project Delivery System: An Update' published by Glenn Ballard in 2008 is the most cited-publication between the years of research, according to the data in Table-2.

In terms of author contribution, Table-3 shows that most of the publications were produced by a collaboration of two authors. One more time, Glenn Ballard has the highest rank in Table-4 with seven publications. A treemap is provided to the readers in Figure-3 to observe the most-preferred keywords. The most frequent keyword by the authors is 'lean construction,' unsurprisingly.

From the country contribution point of view, the USA is the leading country with nearly 45% of the publications in the Lean Construction Journal (Table-5). The results are supported by a world map provided in Figure-4.

Table-6 dwells on the statistics in terms of international collaboration and reveals that the majority of the products are single country publications. Table-7 provides the analysis of the minor portion, i.e., collaborative publications, and shows one more time that the USA has the first rank with eight multiple country publications. Table-8 and Figure-5 also support this result.

In the following section, the institutions are sorted in descending order of their publications. The University of California, Berkeley, one of the most prestigious institutions of the USA, is in the first row of Table-9 with 9 out of 77 (11.69%) publications.

In the last section, the most popular research topics are listed in Table-10. As a result of this content analysis, the Last Planner System® is the most commonly studied research topic among the publications in Lean Construction Journal.

Results of the bibliometric analysis carried out in this paper show the publication status of Lean Construction in a detailed manner. Different research individuals, groups, organizations, and countries that made the most significant contributions to Lean Construction Journal and Lean Construction research were clearly mentioned in this paper. Also, tree-map of the authors' keywords and results of content analysis are the most valuable findings of this study because they show the research trends of Lean Construction Journal. This review also helps people to understand the general view of the lean concept in the construction sector. As a bridge between the publications of Lean Construction Journal, this review will be the basis of further researches and the progress of Lean Construction.

Majority of the research studies published in LCJ was conducted in western countries, especially in the USA, the UK, and Sweden. In developing countries, Lean Construction research showed less progress. There is a definite need to motivate developing countries to start conducting more research on this topic and applying lean principles in the construction industry. The need to eliminate waste and increase productivity in such countries is much more than the ones in developed countries. The motivation for this study arose from our wish to change this situation in developing countries by promoting lean construction research by showing research gaps and popular areas. For example, The Last Planner System (LPS), Contractual Issues and Relational Contracts, and Integrated Project Delivery (IPD) is the most popular three areas of research. On the other hand, there are many less published areas such as Target Value Design (TVD) and Lean Construction Delivery. The fewness in the number of research on these areas can be a guide for new researchers that are planning to start conducting studies in the lean construction field. Lean Construction Journal perceived as the locomotive of the Lean Construction research for years, and there is more need than ever to promote Lean Construction in the industry.

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