

Manuscript Title	Bibliometric Analysis of the Journal of Construction in Developing Countries
Authors	Daniel Aristizábal Torres, Ana Sofía Ayala Herrera and Jhon Mario Gómez Cano
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EARLY VIEW

BIBLIOMETRIC ANALYSIS OF THE JOURNAL OF CONSTRUCTION IN DEVELOPING COUNTRIES

Abstract: The Journal of Construction in Developing Countries (JCDC) is an open-access journal indexed in Scopus and specialized in Building and Construction and Civil Engineering. This article proposes an analysis so far not done of the history of publications in the journal. In this document, we seek to contribute to the knowledge by answering the question: What are the journal's most influential countries, authors, and institutions? A bibliometric analysis is carried out through bibliographic information obtained from Scopus and scientometric tools, that includes annual productivity, authors, countries, and the most relevant institutions. The mapping of scientific production visualizes the networks of co-occurrence and co-authorship, thus identifying the collaboration networks between authors, countries, and institutions. The growth in the number of publications and citations was evidenced over time, which has allowed the journal to be among the best engineering journals in Malaysia and ranked 117 in the Building and Construction area worldwide.

Keywords: Bibliometric analysis; Bibliometrics; Co-authoring networks.

1. INTRODUCTION

The Journal of Construction in Developing Countries (JCDC) is an international academic publication journal focused on topics relevant to the built environment of developing countries. The journal publishes original research and application papers, case studies, brief communications, and discussion papers. The topics covered by JCDC are planning, urban economics, rural and regional development, housing, management and resource issues, sustainability, knowledge and technology transfer, construction procurement, facilities management, information and communication technologies, strategies and policy issues, design issues, conservation, and environmental issues.

The journal is published semi-annually by Penerbit Universiti Sains Malaysia in cooperation with the working Commission 107 (W107) of the International Council for Research and Innovation in Building Construction (CIB). Previously the journal was called the Journal of Housing Building and Planning, but as of volume 11, it changes the name to Journal of Construction in Developing Countries.

The journal is open access and allows the free download of its articles from its website. As of 2006, the journal is indexed in Scopus. This advance has allowed it to increase the number of citations for its publications. Currently, according to information obtained from Scimago Journal Rank, the journal is in quartile 3 with an h-index of 22. It currently occupies the fourth position of engineering journals in Malaysia and is among the 120 of the best journals worldwide in the area of Building and construction.

The term bibliometrics was used for the first time in 1969 by Alan Pritchard. He suggested that bibliometrics should replace the term statistical bibliography used internally in the literature since 1923 when E. Wyndham Hulme coined it as the title of his two special lectures on bibliography (Lawani, 1981). Bibliometry has become a tool for the analysis and evaluation of science (Escorcía Otálora, 2008; Moral-Muñoz et al., 2020; Noyons, 2001; Tomás-Górriz and Tomás-Casterá, 2018) and the management of research in recent decades. All major compilations of scientific indicators rely heavily on publication and citation statistics and other more sophisticated bibliometric techniques (Glänzel, 2003). Journals often modify their goals and scope due to the ever-changing scientific environment. Although mathematical methods have been applied to the study of scientific literature since the beginning of the century, they have become an essential part of the so-called bibliometrics. Moreover, the use of bibliometric indicators to measure the results of science in a country or organization should be considered, in turn, a series of economic, social, and demographic indicators that provide a broader approach to the analyzes carried out (Araújo Ruiz and Arencibia Jorge, 2002).

Bibliometric analysis is an important tool for deciphering and mapping the scientific knowledge accumulated over the years and the evolution of fields in a rigorous manner. Also, bibliometric studies aim to help "build firm foundations for advancing a field in novel and meaningful ways: it enables and empowers scholars to (1) gain a comprehensive overview, (2) identify knowledge gaps, (3) derive novel ideas for research, and (4) position their intended contributions to the field" (Donthu et al., 2021, p. 285).

It is important to highlight some authors who have focused on performing bibliometric analysis in engineering journals. Among them, the works of Liang et al., (2020), Yu et al., (2019b), and Srivastava et al., (2021) are included.

Next, a study of the publications to date in the JCDC journal is carried out. A bibliometric analysis is presented, including the annual productivity, authors, institutions, and most relevant countries. The most cited documents, co-authorship, co-citation, and co-occurrence networks, are also presented,

according to the bibliographic information of the documents published in the journal from 2006 to 2020, obtained from the Scopus database.

2. METHODOLOGY

The methodological procedures followed in this research can be organized in three stages, which are detailed in the sequence:

2.2. Stage 1: Search criteria

Every year it is easier to access scientific information due to access to databases. As a result, researchers can consult relevant information. Scopus is considered the most extensive research database globally and is selected for the breadth and depth of its contents (Schotten et al., 2017). By this appreciation, a query was made by source name "Journal of Construction in Developing Countries" in the Scopus database. The query covered all the years of scientific production, from 2006 to 2020, and yielded 211 documents.

2.2. Stage 2: Bibliometric analysis

The search results of the previous stage were exported from Scopus to a .bib file, including the cited references. The bibliometric analysis was developed by importing bibliographic data from the database using the open-source tool bibliometrix (Aria and Cuccurullo, 2017). Bibliometrix allows to evaluate bibliometric indicators such as the most relevant authors, the annual scientific production, the most cited documents, the leading countries, and most relevant institutions. Finally, the resulting data was analyzed and presented using Microsoft PowerBi.

2.3. Stage 3: Visualization of co-authorship networks and co-citations

VOSviewer software was used for the visualization of the networks (van Eck and Waltman, 2010). Vosviewer allowed to present the connections in the networks of scientific publications, researchers, research organizations, countries, keywords, or terms based on co-authorship, co-occurrence, citation, bibliographic coupling, or co-citations. The importance of these analyzes is that they allow us to know the dynamism between collaboration networks (Shafiq et al., 2015).

3. RESULTS

It was found that the journal JCDC, according to information obtained from Scopus, published 211 documents from 2006 to 2021, with the participation of 470 authors and the use of 7578 references. The average number of citations per year is 110.13, and there is an average number of citations per document of 8.18.

Table 1 and Figure 1, constructed from the Scimago Journal & Country Rank information, show that the JCDC has kept its H-index constant over time and an average of 84.7 articles published between 2013 and 2019. It is highlighted that since 2012 the journal has been among the six best journals in the area of Engineering in Malaysia, obtaining the third position repeatedly. In the world ranking in engineering, its best place has been 1736, in 2019, coinciding with the year with the most significant number of articles published. The table shows other categories such as Building and Construction, which best year was 2019, ranking 103. In the world ranking of Civil and Structural Engineering, it obtained the best position in 2016, ranking 191. In addition, in the world ranking in open access engineering journals, it had its best position in 2016, occupying position 222.

Table 1. Registry of publications and ranking of the Journal Construction Developing Countries, according to Scimago Journal & Country Rank

Year	H Index	Total Documents	Rank Malaysia (Engineering)	Word Ranking (Engineering)	Word Ranking (Building and Construction)	Word Ranking (Civil and Structural Engineering)	Word Ranking (Engineering Open Access)
2012	22	32	4	2886	142	234	268
2013	22	12	6	2810	147	239	282
2014	22	15	5	2749	144	243	317
2015	22	9	4	1998	119	208	243
2016	22	16	3	1804	116	191	222
2017	22	22	4	2055	134	215	268
2018	22	10	3	1765	110	196	240
2019	22	29	3	1736	103	199	259
2020	22	18	4	2057	117	218	363



Figure 1. SJR Ranking

3.1 Annual scientific production

Figure 2 shows the publication history of the JCDC journal, which corresponds to 225 articles, showing that the first record of the journal's publications was presented in 2006 with ten published articles. It is noteworthy that there is a positive trend regarding the number of publications, with 2019 being the most significant year for the journal with 29 publications, which correspond to 14.4% of the total number of published articles.

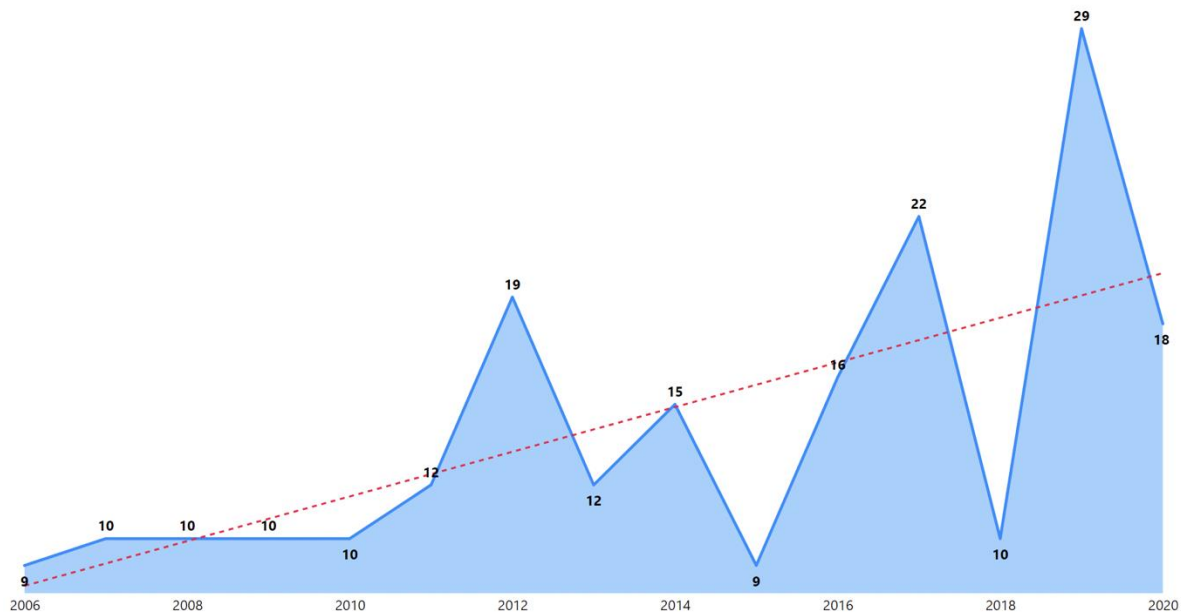


Figure 1. Annual scientific production

Table 2 illustrates the evolution and growth that the journal has had during 15 years of scientific work, with 225 articles published to date, divided into 15 volumes and 30 issues. In addition, the table shows the distribution of documents by number of authors. Articles from a single author and up to seven authors have been obtained. Lastly, the average number of numbers published per year is 2, this being a constant that has been maintained over the years.

Table 2. Scientific production according to the number of issues

Year	Volume	1	2	3	4	5	6	7	TP	AP	TI	AI
2006	Volume 11	6	2	2					10	10	4	4
2007	Volume 12	3	4	1	2				10	20	6	10
2008	Volume 13	1	5	1	2	1			10	30	7	17
2009	Volume 14	2	1	1	1				5	35	6	23
2010	Volume 15	1	7	2					10	45	5	28
2011	Volume 16	4	5	2	1				12	57	6	34
2012	Volume 17	6	5	6	1	1			19	76	11	45
2013	Volume 18	1	3	6	2				12	88	6	51
2014	Volume 19	2	4	5	5	5	6	7	34	122	6	57
2015	Volume 20	1	5	6	1		1		14	136	7	64
2016	Volume 21		5	6	4	1			16	152	11	75
2017	Volume 22	3	7	5	3	3			21	173	8	83
2018	Volume 23	5	2	5	1	1			14	187	7	90
2019	Volume 24	2	4	8	1	3		1	19	206	9	99
2020	Volume 25	1	8	7	2	1			19	225	3	104

Notes: Abbreviations: TP: total papers; AP: accumulated publications; TI: total issues; AI: accumulated issues. The numbers 1-7 represent the distribution of documents by the number of authors

Table 3 indicates the number of citations concerning the years of publications obtained during its 15 years of scientific growth in the Scopus database. A total of 1652 citations corresponding to 167 articles were obtained, for an average of 8.18 citations per article. The maximum number of citations was presented in 2013, with 243 citations equivalent to 14.7% of the total citations of the journal and relation of total citations per document of 20.25; this also represents the best relation of citations document. It is highlighted that of the 211 articles found in Scopus, 79.15% have been cited at least once.

Table 3. Structure of annual JCDC citations according to Scopus 2006-2020

Year	TC	TP	≥50	≥40	≥30	≥20	≥10	≥5	≥1	=0	TC/TP
2006	156	9	1	1		1	1	1	3	1	17,33
2007	111	10			1	1	2	3	1	2	11,10
2008	81	10					4	2	3	1	8,10
2009	121	10	1			1	2	3	2	1	12,10
2010	173	10	1		1	1	2	2	2	1	17,30
2011	130	12			1	1	4		5	1	10,83
2012	143	19				4	1	2	10	2	7,53
2013	243	12	1		1	3	4	1	2		20,25
2014	108	15			1		3	3	7	1	7,20
2015	116	9			1	1	2	3	2		12,89
2016	137	16				2	4	4	5	1	8,56
2017	75	22					1	5	11	5	3,41
2018	24	10							9	1	2,40
2019	32	29						1	17	11	1,10
2020	2	18							2	16	0,11
Total	1652	211	4	1	6	15	30	30	81	44	
PP (%)	100		1,90	0,47	2,84	7,11	14,22	14,22	38,39	20,85	
AP			4	5	11	26	56	86	167	211	
APP (%)	100		1,90	2,37	5,21	12,32	26,54	40,76	79,15	100,00	

Notes: Abbreviations: TP and TC: total papers and citations; ≥50, ≥40, ≥30, ≥20, ≥10, ≥5, ≥1 y =0: number of papers with equal or more than 50, 40, 30, 20, 10, 5, 1 y 0 citations (without accumulating documents from previous thresholds); H = h-index; TC/TP: number the citations per paper; IF: impact factor of the Journal Citation Reports; PP (%): Percentage papers; AP: Accumulated papers; APP (%): Percentage accumulated papers.

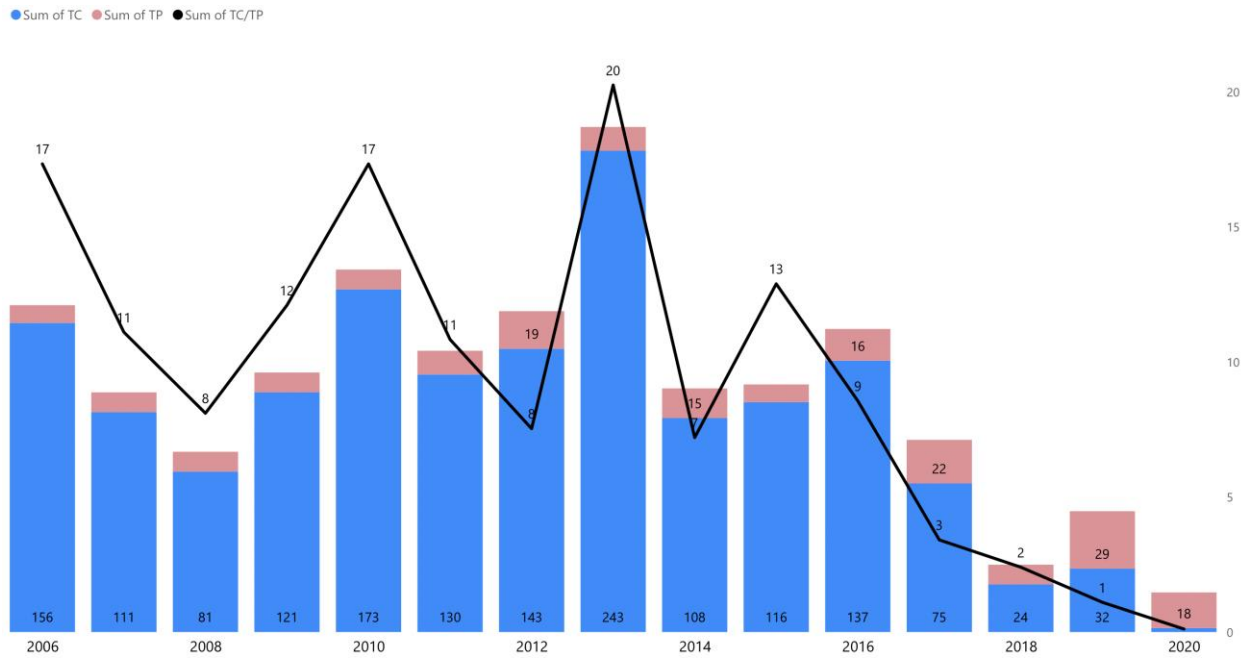


Figure 3. Relationship between TC (Total citations) and TP (Total papers)

Table 4 shows the historical consolidated of the number of authors present in each published issue. 2,3 or 4 authors present 74.88% of the articles published, and 18% correspond to documents by a single author. The number of publications in co-authorship has been growing remarkably since 2011. In 2019, it reached its highest rate of co-authors with a value of 23 articles and an ACR of 3.9, being the maximum average ratio of co-authors. TAY is obtained by multiplying the number of articles by the number of authors of each one. ACR is obtained by multiplying the number of articles in coauthored by the number of authors and dividing by CR.

Table 4. Author distribution by article

Year	TP	1	2	3	4	5	6	7	CR	TAY	ACR
2006	10	5	3	1					4	14	2,3
2007	10	3	4	2	1				7	21	3,0
2008	10	1	5	2	1	1			9	26	3,6
2009	10	5	3	1	1				5	18	3,3
2010	10	1	7	2					9	21	2,2
2011	12	3	4	3	1	1			9	29	3,7
2012	19	6	5	6	1	1			13	43	3,4
2013	12	1	3	7	1				11	32	3,1
2014	34	2	6	6	1				13	36	2,8
2015	14	1	2	5		1			8	25	3,4
2016	16		4	6	4	2			16	52	5,2
2017	21	3	8	5	3	3			19	61	4,5
2018	14		3	5	1	1			10	30	3,8

2019	19	6	9	9	1	3	1	23	77	3,9
2020	19	1	8	6	2	1		17	48	3,4
Total	225	38	74	66	18	14	1	173	533	51,4

Notes: Abbreviations: TP: total papers; CR: research with co-authorship (sum of papers with two or more researchers, do not include singles authors); TAY: total authors by years; ACR: Average number of authors per year in manuscript with coauthored

3.2 Author productivity in terms of h-index, total citations (TC), and total publications (TP)

JCDC has 211 documents published according to the Scopus database, of which 470 authors were part, from which 8.09% were participants in documents by a single author, and 91.91% were participants in documents by several authors. Table 5 and Figure 4 show the 20 authors with the highest productivity regarding the number of publications, h-index, and total citations. The Palestinian researcher Enshassi Adnad has the highest number of publications and citations, with 8 and 112 representing 6.78% and 3.79% of the accumulated publications and citations. In addition, Adnan is the author with the highest h-index with a value of 5. The journal also has two well positioned authors regarding the number of citations, which are Ofori Geoge with a total of 95 citations and Odusami Koleola Tunwase with 98 citations.

Table 5. Author productivity in terms of h-index, total citations (TC), and total publications (TP)

Authors	h_index	TC	TP
Enshassi Adnan	5	112	8
Idoro Godwin	4	61	6
Ofori Geoge	5	95	5
Jaafar Mastura	3	40	4
Mohamed Sherif	3	84	4
Alinaitwe Henry	3	86	3
Alinaitwe Henry Mwanaki	2	55	3
Hadikusumo Bhw	3	54	3
Kwofie Titus Ebenezer	2	8	3
Odusami Koleola Tunwase	3	98	3
Ogunlana Stephen O	3	45	3
Sanga Samwel Alananga	2	6	3
Adinyira Emmanuel	1	5	2
Afolabi Adedeji	2	10	2
Aigbavboa Clinton	1	1	2
Aksorn Thanet	2	35	2
Al Nasser Hammad	1	4	2
Ameh Oko John	2	72	2

Aulin Radhlinah	1	4	2
Chan Toong Khuan	2	6	2

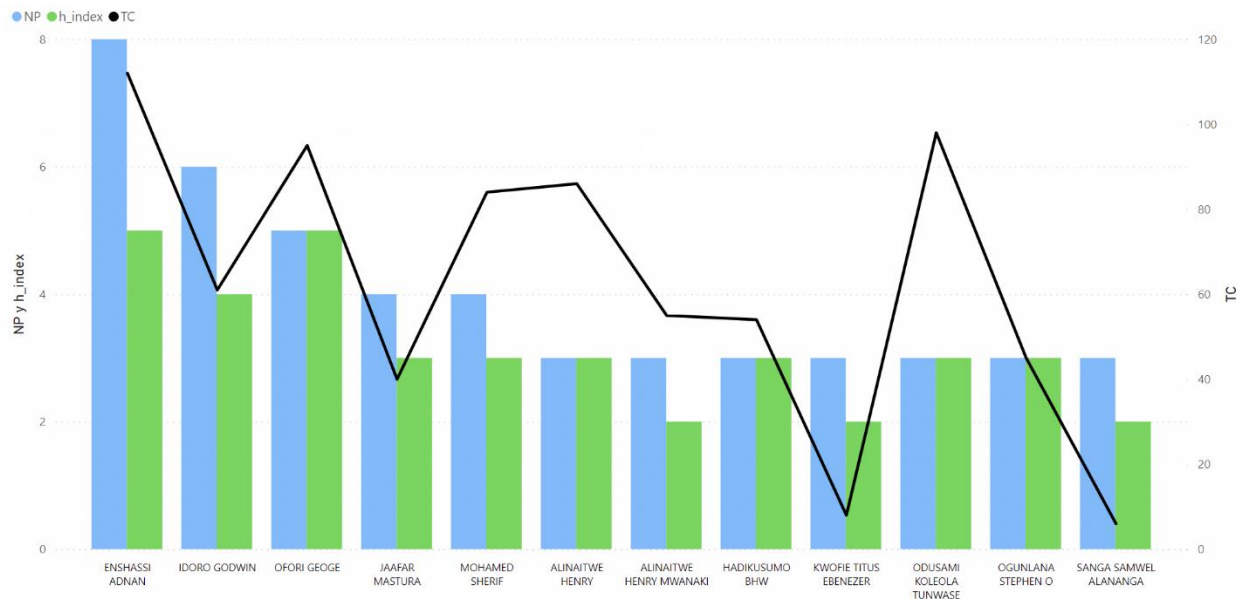


Figure 4. Authors according to h-index, TC and NP

3.3 Most relevant institutions

Figure 5 shows the top 20 most relevant affiliations of the JCDC by the number of publications. First, with a total of 13 publications, is the University Sains Malaysia institution. This university was founded in 1969; it is among the oldest higher education institutes in northern Malaysia; and has three campuses. The engineering campus is located in Nibong Tebal. The second position is Universiti Teknologi Malaysia, with 11 articles. This university was founded in 1972 and is one of the leading public universities in Malaysia. In the research area is ranked 187 in the world. Finally, in the third position is the University of Lagos, with 11 articles. This university was founded in 1962, and it is one of the five first-generation universities in Nigeria.

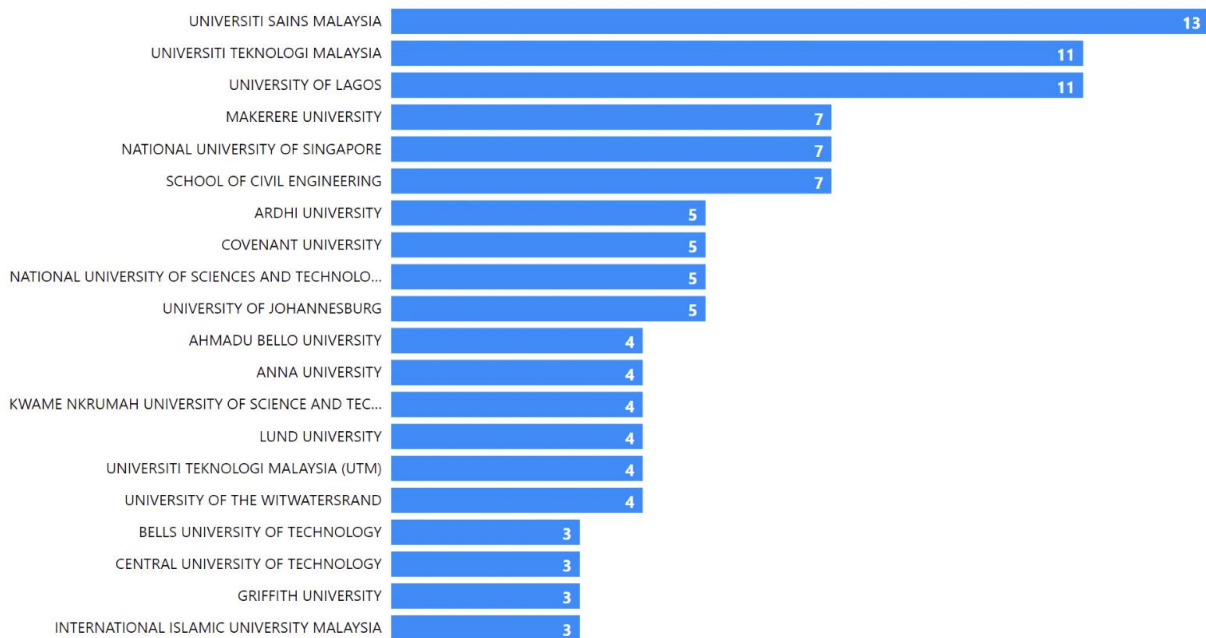


Figure 5. Most relevant institutions

3.4 The twenty most cited publications

Table 6 shows the Top 20 of the most cited publications in JCDC. The first place is the publication written by Ameh et al. (2010) and has 68 citations. The article consisted of the benefits and risks of telecommunications projects. It also made a study of how to mitigate these risks and their respective recommendations. In second place is the article by the authors Apolot et al. (2011) with 66 citations. This article focuses on identifying the causes of delays and cost overruns and classifying them according to their frequency, severity, and importance. Third, Enshassi et al. (2006), with 54 citations. This paper is focused on the construction industry, taking into account the economy of each sector and the political environment. Fourth, Alinaitwe (2009) expresses the benefits and risks of tight construction, companies' functions, and the proportion of graphics for decision-making. In the fifth place, the author's Jin et al. (2019) focused on developing research in construction safety.

Table 6. The twenty most cited publications

R	TC	Title	Author/s	Year	C/Y
1	68	Significant Factors Causing Cost Overruns in Telecommunication Projects in Nigeria	Okoro John Ameh; Aliu Adebayo Soyingbe; Koleola Tunwase Odusami	2010	5,67

2	66	Investigation into the Causes of Delays and Cost Overruns in Uganda's Public Sector Construction Projects	Henry Alinaitwe; Ruth Apolot; Dan Tindiweni	2013	7,33
3	54	Causes of contractor's business failure in developing countries: the case of Palestine	Enshassi Adnan; Al-Hallaq Khalid; Mohamed Sherif	2006	3,38
4	50	Prioritising Lean Construction Barriers in Uganda's Construction Industry	Henry Mwanaki Alinaitwe	2009	3,85
5	45	A science mapping approach-based review of construction safety research	Ruoyu Jin; Patrick XW Zou; Poorang Piroozfar; Hannah Wood; Yang; Libo Yan; Yu Han	2006	2,81
6	38	The Identification and Management of Major Risks in the Malaysian Construction Industry	Cheng Siew Goh; Hamzah Abdul-Rahman	2013	4,22
7	37	The Effect of Geometric Shape and Building Orientation on Minimising Solar Insolation on High-Rise Buildings in Hot Humid Climate	Chia Sok Ling; Mohd. Hamdan Ahmad; Dilshan Remaz Ossen	2007	2,47
8	36	Nature of the Construction Industry, Its Needs, and Its Development: A Review of Four Decades of Research	George Ofori	2015	5,14
9	33	Selection of Project Managers in Construction Firms Using Analytic Hierarchy Process (AHP) and Fuzzy Topsis: A Case Study	Fatemeh Torfi; Abbas Rashidi	2011	3,00
10	33	An Assessment of the Role of Government Agencies in Public-Private Partnerships in Housing Delivery in Nigeria	Eziyi Offia Ibem	2010	2,75
11	30	Analysis of Project Failure Factors for Infrastructure Projects in Saudi Arabia: A Multivariate Approach	Dubem I. Ikediashi; Stephen O. Ogunlana; Abdulaziz Alotaibi	2014	3,75
12	29	Comparing Occupational Health and Safety (OHS) Management Efforts and Performance of Nigerian Construction Contractors	Godwin Iroakpo Idoro	2011	2,64
13	28	Factors Influencing Construction Labour Productivity: An Indian Case Study	Anu V. Thomas; J. Sudhakumar	2015	4,00
14	27	An Assessment of Risk Identification in Large Construction Projects in Iran	Mehdi Tadayon; Mastura Jaafar; Ehsan Nasri	2012	2,70
15	27	The Unsafe Acts and the Decision-to-Err Factors of Thai Construction Workers	Thanet Aksorn; B.H.W. Hadikusumo	2007	1,80
16	26	Data exploration of social client relationship management (CRM 2.0) adoption in the Nigerian construction business	Rapheal A. Ojelabi; Adedeji O. Afolabi; Opeyemi O. Oyeyipo; Patience F. Tunji-Olayeni; Bukola A. Adewale	2016	4,33

17	26	Leadership and Construction Industry Development in Developing Countries.	Ofori George; Toor Shamas-ur-Rehman	2012	2,60
18	25	Studying the Reasons for Delay and Cost Overrun in Construction Projects: The Case of Iran	Samarghandi Hamed; Mousavi Seyed; Taabayyan Pouria; Mir Hashemi Ahmad; Willoughby Keith	2016	4,17
19	25	Construction safety assessment framework for developing countries: a case study of Sri Lanka	Kanchana Priyadarshani; Gayani Karunasena; Sajani Jayasuriya	2013	2,78
20	25	Analysis of Non-Excusable Delay Factors Influencing Contractors' Performance in Lagos State, Nigeria	Olajide Timothy Ibironke; Timo Olugbenga Oladinrin; Onaopepo Adeniyi; Idowu Victor Eboreime	2013	2,78

3.5 Top 20 countries with the most publications

Figure 6 shows the twenty most relevant countries according to the number of publications. Malaysia tops the list with 56 documents, corresponding to a 26.54% share of published articles. Quite far from the first place are in second and third place, Nigeria and the United Kingdom. The low participation in the journal of some European powers is evident. On the other hand, countries from the American continent such as Colombia, Brazil, and the USA have the presence.



Figure 6. Most relevant countries

3.8 Keywords

In Figure 7, based on the font size and its centrality, the frequency and importance of this in research environments can be appreciated. For example, it is clear that in all the articles of the JCDC, the most used word is Construction, with a frequency of 25. Its importance, interest, and use are associated with new trends in Civil Engineering. Similarly, the word Developing countries, with a frequency of 15, and Nigeria, with a frequency of 12, are the most relevant words in the publications. This last word because that country is one of the most significant contributors of articles to this journal. This relevance is closely related to some of the fundamental issues of civil engineering, such as structures and the nature of construction materials.



Figure 7. Keywords cloud

3.9 Keyword trends

Figure 8 shows the importance, trend, and permanence of the most representative keywords of the scientific information consulted by the JCDC in the SCOPUS database. The frequency of use of keywords has risen over the years. It is appreciated how the word Construction begins with a low frequency in 2006 and has increased over the years. This situation is the most relevant, and its frequency increases significantly, showing the highest growth and

sustainability during 2016- 2020. Although the graph shows that the Construction Industry in previous years (2006 - 2016) was cataloged as the primary search source word of the journal, it should be emphasized that it remains among the main ones since in the second most frequently per year.

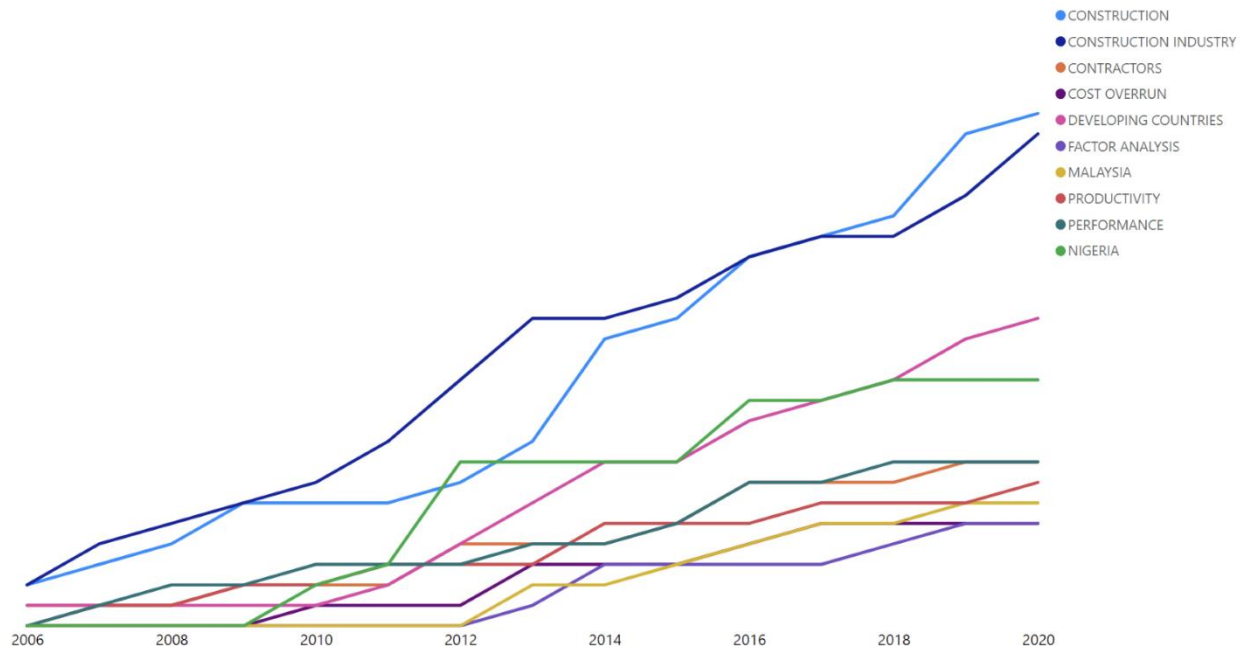


Figure 8. Keyword trends

4. NETWORK ANALYSIS OF PUBLICATIONS

4.1 Country co-authorship

Figure 9 shows the network of co-authorship between countries. The node's size is related to the number of publications, and the thickness of the link depends on the number of documents co-authored between countries. Malaysia is the country with the most documents. Also, it presents links with the most important countries that act as a bridge with the other remaining countries, specifically the strong relationship with Nigeria, South Africa, Australia, Indonesia, USA, UK, and Pakistan. Nigeria is the second country with the most co-authorship and has relationships with Malaysia, Hong Kong, and the UK. Yemen ranks third in publications and only has Australia and Malaysia links. The independent links to the central node are vast, with 16 countries, of which we can highlight Canada, India, China, Germany, among others.

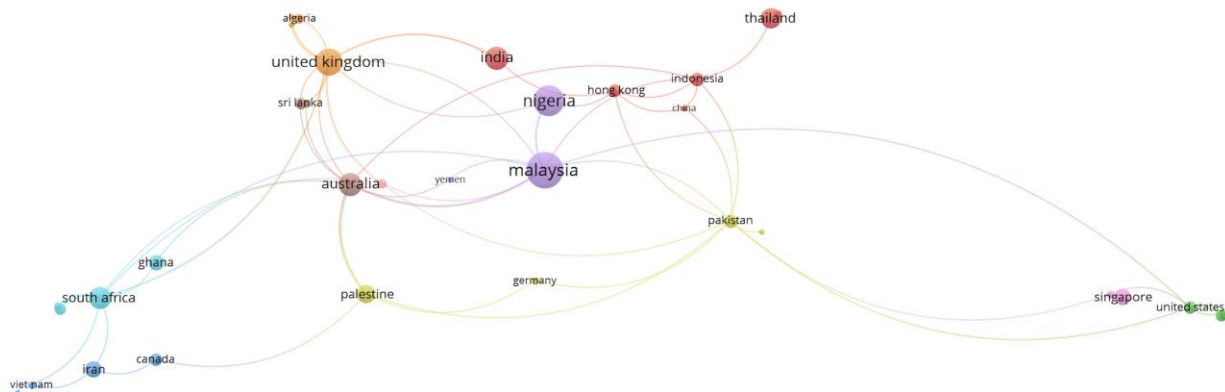


Figure 9. Co- authorship of countries

4.2 Authors' co-authorship analysis

Figure 10 shows the collaboration network between authors. The node's size depends on the number of articles published by each author within the JCDC, and the thickness of the link is related to the number of co-authorship. The network shows three main clusters, appearing within the red cluster as the central node is Enshassi Adnan, which has links with all the clusters except for the blue cluster. He is the author with the most significant publications and the highest number of links with 12. The other authors presented on the network have some co-authorship equal to or less than 6. Furthermore, the strong relationship between Enshassi A. and Mohamed is evident. In the green cluster, the contribution of the author Choudhry RM stands out. In the blue cluster, the author with the most contributions is Gabrel H.F.

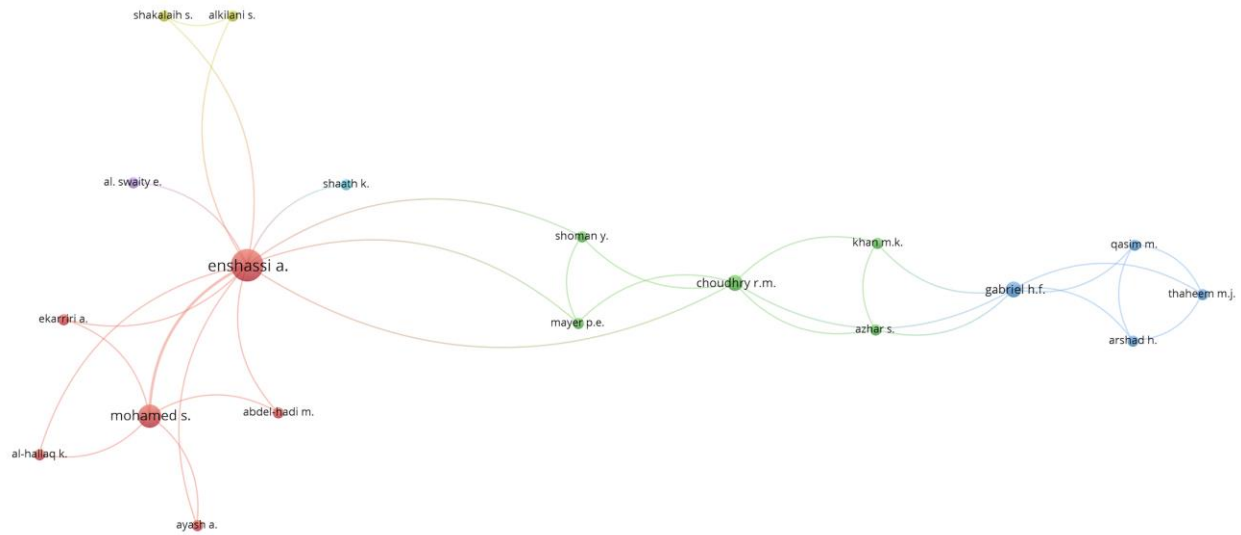


Figure 10. Co- authorship of authors

4.3 Analysis of co-citations

Figure 11 shows the network of co-citations between documents of the JCDC. Within the network, filtering by a minimum of one citation per document, only 33 articles are cited by other documents within it. Ameh O.J has the highest number of citations with 68 and has a link to another journal document. However, Ofori G. and Ozumba A.O. Despite having only 26 and 1 citations, respectively, they present the highest number of links with 9 and 5.

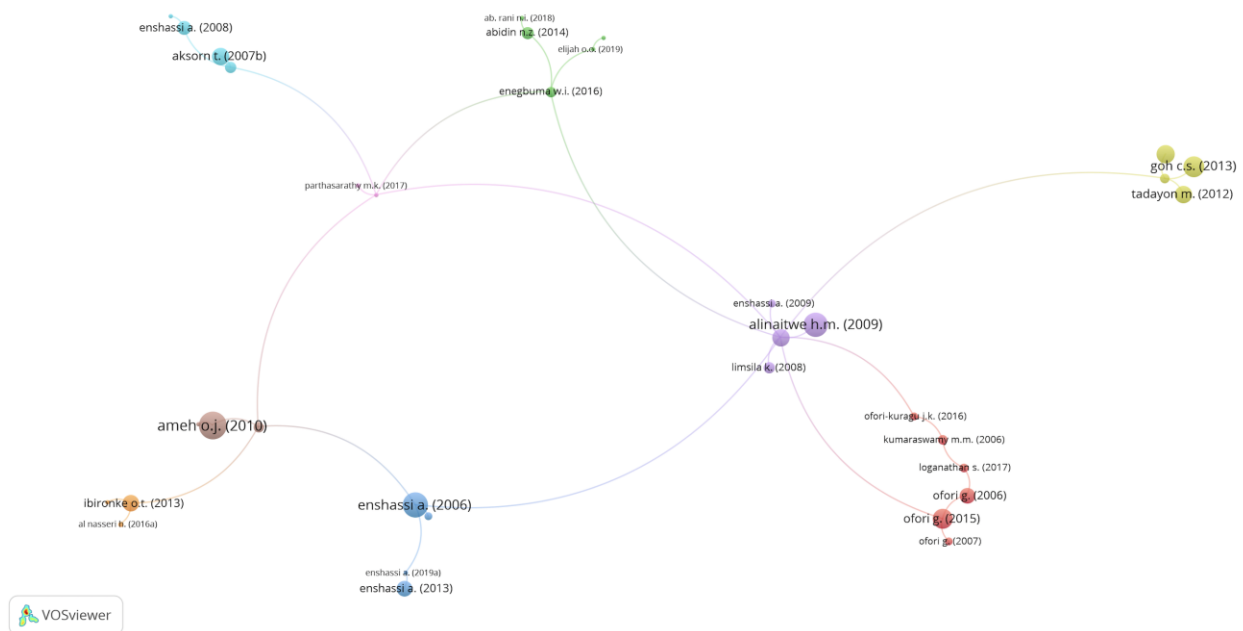
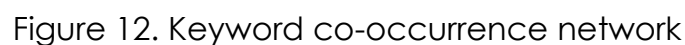


Figure 11. Co-citation network

Figure 12 shows the co-occurrence of author keywords, filtering by a minimum of 3 occurrences and identifying only 39 words that met the criteria. From this condition, the words are grouped into 9 clusters. The first cluster, with seven items, is represented by the Construction keyword with 25 occurrences and 22 links is the most relevant in occurrence and frequency; the second cluster, with five items, records the word Construction Projects with four occurrences and four links. In cluster number 3, with five items, Cost, with four occurrences and five links. Cluster 4, with five items, highlights the importance of the keyword Uganda, with four occurrences and six links. Cluster 5 has four items; the keyword is Developing Countries, it has 15 occurrences and 13 links, positioning it as the third most important. To conclude, cluster 9 has two items, and the keyword is Construction Industry. It has 24 occurrences and 16 links, ranking it as the second most important keyword in the journal.



Collaboration among organizations improves and increases the level of citations of a publication and demonstrates the strength of research networks between researchers and scientific communities. In Figure 13, it can be seen that the most

important institution is the School of Civil Engineering. This university was founded in 1972 and is one of the leading public universities in Malaysia in research. It is ranked 187 in the world. Figure 13 lists 2 clusters of interest, the School of Civil Engineering. It is related to 4 other universities that make up the totality of organizations presented in the figure, so it is necessary to highlight that it contains a direct relationship with the rest of the universities involved. On the other hand, there is a relationship between the Ministry of Public Work and HO, College of Civil Engineering, Project Management, and Building institutions.

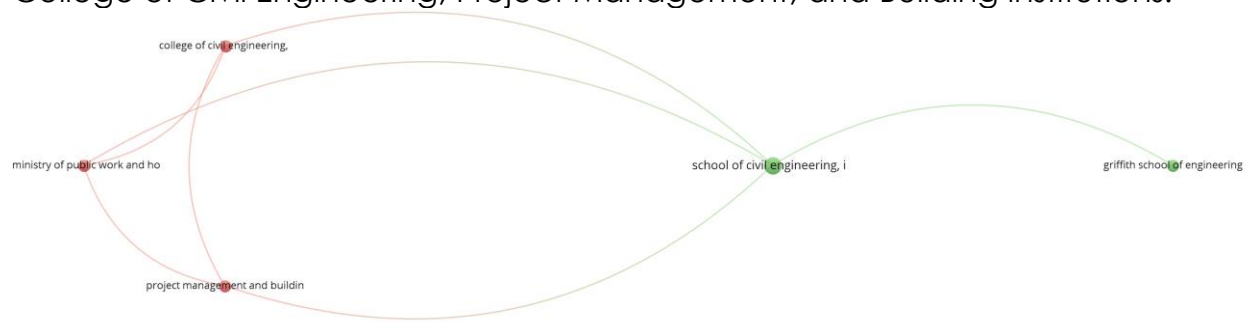


Figure 13. Co-authorship between Institutions

5. CONCLUSIONS

The JCDC journal is focused on civil engineering, mainly on the development through constructive engineering of countries searching for it. In its fifteen years of existence, it has managed to establish itself as a benchmark for this investigative section and has importance in terms of open access journals.

JCDC has been active for 16 years publishing two issues and one volume per year, which has generated 25 volumes with 211 articles in total to date.

The journal has maintained a constant H-index over time. JCDC is one of the best engineering journals in Malaysia and is ranked 117 in the Building and construction area, according to the growth in the number of publications and citations over time.

Based on annual productivity, JCDC reached the highest number of publications in 2019 with 29. In addition, it was found that two or more authors make 74.88% of publications.

Regarding the most recognized authors, it was possible to identify that Enshassi Adnan has the highest number of citations, with a total of 112, representing 6.78% of the total (1652 citations). Regarding the analysis of the universities, it was evidenced that the university with the most publications is the School of Civil Engineering. It is also important to highlight that it has a direct relationship with the rest of the important institutions of the journal. Likewise, about the 20 most

cited documents, it can be concluded that the thematic axis Construction and Developing Countries takes place in the first three most cited publications.

The analysis of networks between countries allowed us to identify that Malaysia is the country with the most documents, this we can deduce due to the origin of the journal; on the other hand, to say that it presents links with the vast majority of related countries in the journal's publications. Nigeria ranks second in co-authorship, followed by Yemen. There are 7 clusters of co-authorship between countries due to the scope and impact of the journal worldwide. However, its presence in countries on the Asian and African continents is noteworthy.

In terms of collaboration networks and the number of publications, the best performing author is Enshassi Adnan, with 25 documents. Enshassi has a strong relationship with Choudhry and Gabriel.

Among the twenty most relevant institutions, 90% correspond to Asian and African universities, with the highest participation being Malaysian, Nigerian, and South African universities with a participation of 55%. Collaboration networks between institutions in Malaysia are evident, but cooperation ties with universities in other countries are scarce.

After analyzing the author keywords, it was observed that the Construction keyword is the one with the highest relevance and frequency in publications, followed by the words Construction Industry and Nigeria. In this same sense, but with an emphasis on the historical growth trend, the word Construction Industry presents the best performance, showing the highest growth and sustainability during 2006-2016. Likewise, the word Construction has evolved since 2016, staying in the first position until now.

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