Exploring Circular Economy Business Model for Construction: A Bibliometric Analysis

Nuraini Tutur[1,2], Eeydzah Aminudin[2]

[1]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, Pulau Pinang, [2]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, Selangor
Corresponding Author Email: nuraini.tutur@uitm.edu.my

Abstract
This study examines the integration of Circular Economy Business Models (CEBMs) in the construction sector through a bibliometric analysis of 120 research publications indexed in the Scopus database from 2020 to June 2024. Thus, this study aims to identify key research clusters and trends in CEBMs for construction and highlight areas with limited research through keyword analysis and co-citation maps. Using VOSviewer, this study analysis co-authorship networks, citation patterns, and keyword co-occurrences to identify key research trends, thematic clusters, and influential contributions. As of June 2024, the *Journal of Cleaner Production* leads in publishing research on CEBMs in the construction industry, with 13 articles accumulating a total of 807 citations. Bibliometric mapping identified four major thematic clusters based on 34 relevant keywords: (1) business models and sustainable development, (2) circular economy concepts in the building sector, (3) industrial economics and management aspects related to construction and demolition, and (4) circular business models and their practical applications within the construction industry. The results highlight how the concept of the circular economy is being embedded in construction-related business models, with a strong focus on strategies such as recycling, reuse, and life cycle thinking. This study provides valuable insights into research trends and the transformative potential of CEBMs in promoting sustainable and resource-efficient construction practices. By presenting a clear roadmap for future research, this study emphasizes the importance of scaling CEBMs to foster environmentally sustainable strategies in the construction sector while addressing the pressing challenges of resource depletion and waste management.
Keyword: Circular economy, Circular Economy Business Models (CEBMs), Sustainable Construction, Bibliometric Analysis, VOSviewer

Introduction
The construction industry is a vital contributor to global economic growth, providing necessary infrastructure and housing to support societal needs. However, this sector is also one of the most resource-intensive industries, with high levels of energy consumption,

material use, and waste generation. The construction industry remains a significant contributor to global environmental concerns, generating substantial amounts of construction and demolition waste. According to the United Nations Environment Programme (UNEP, 2022), the sector accounts for approximately 40% of global energy consumption. Additionally, data from the World Economic Forum (2021) indicates that nearly 70% of greenhouse gas emissions originate from construction-related activities. Recent market analysis by Research and Markets (2024) estimates the value of the global construction and demolition waste management industry at approximately USD 206.4 billion, with a compound annual growth rate (CAGR) of 6.9% from the previous year, highlighting the growing emphasis on waste management and sustainability in the sector. This rising environmental impact has led to a rapid interest in sustainable and resource-efficient practices across the industry.

In response, the concept of a Circular Economy (CE) has emerged as a transformative approach to tackle these environmental and resource-related challenges. The construction industry faces a significant challenge which is transitioning from a traditional, linear "take-make-dispose" model to a more sustainable approach of Circular Economy model as mentioned by Gasparri et al., (2023), Illankoon & Vithanage (2023), and Osei-Tutu et al., (2023). This linear model is largely dependent on virgin materials and produces significant quantities of trash while the Circular Economy (CE) emerges as a promising solution, promoting resource efficiency (Chen et al., 2022), waste reduction (Esa et al., 2017), and closed-loop systems (Tanveer et al., 2022). By embracing CE principles, construction companies can minimize waste, reduce emissions, and foster the sustainable management of resources, aligning their practices to the Sustainable Development Goals (SDGs).

Despite the growing interest in circular economy practices within construction, implementing these principles poses challenges, as it requires not only technological innovations but also shifts in business models and organizational culture. This has given rise to the concept of the Circular Economy Business Model (CEBM), which seeks to embed circular principles into business strategies and operations. For the construction industry, a CEBM involves strategies for extending the lifecycle of materials, promoting modular construction, prioritizing renewable resources, and facilitating systems for reclaiming and recycling materials. Transitioning to CEBMs in construction, however, demands an in-depth understanding of the financial, operational, and policy-related factors that can support or hinder circular practices. As highlighted by Lewandowski (2016), Circular Economy Business Models (CEBMs) hold the potential to empower construction companies to move away from linear practices and embrace circular approaches. This shift will fundamentally reshape how organizations create, capture, and deliver value.

To understand the current trend of research in this area, a systematic analysis is necessary. This paper employs a bibliometric analysis to explore the current state of knowledge on Circular Economy Business Models (CEBMs) in construction literature. The aim of this study is to identify key research clusters and trends in CEBMs for construction and highlight areas with limited research through keyword analysis and co-citation maps.

This study will provide a comprehensive bibliometric analysis of existing research on circular economy business models in the construction sector. The analysis will cover key

thematic areas, leading scholars and publications, and future research directions, providing a foundation for further advancements in sustainable construction practices. This study not only contributes to the academic understanding of circular economy applications in construction but also offers valuable insights for practitioners and policymakers aiming to foster a more sustainable, resource-efficient construction industry.

Methodology

A bibliometric analysis was carried out to investigate current research patterns in the adoption of business models in the circular economy within the construction industry. This study covered relevant and accessible scientific papers that were published from 2018 to 2024. The study identifies significant areas of knowledge and patterns using VOSviewer to study the bibliometric analysis. The systematic review process is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021). The process starts with the identification of keywords for data collection. Since Scopus is so well-known in scientific research, it was chosen as the database for data collection. The keywords Boolean used for this main search string were ("circular economy" OR "circularity" AND "business model*" AND "construction industry" OR "building industry" OR "built environment"). The circular economy and circularity were identified as synonyms through the literature findings. The search as of June 2024, 110 publications were initially retrieved from Scopus through the Title-Abstract-Keyword field. For initial screening process, 96 publications were considered after limiting the language to English and the type of source to the article, conference paper and review. 82 number of publications were considered after screening based on the abstract. Figure 1 shows the systematic literature review process.
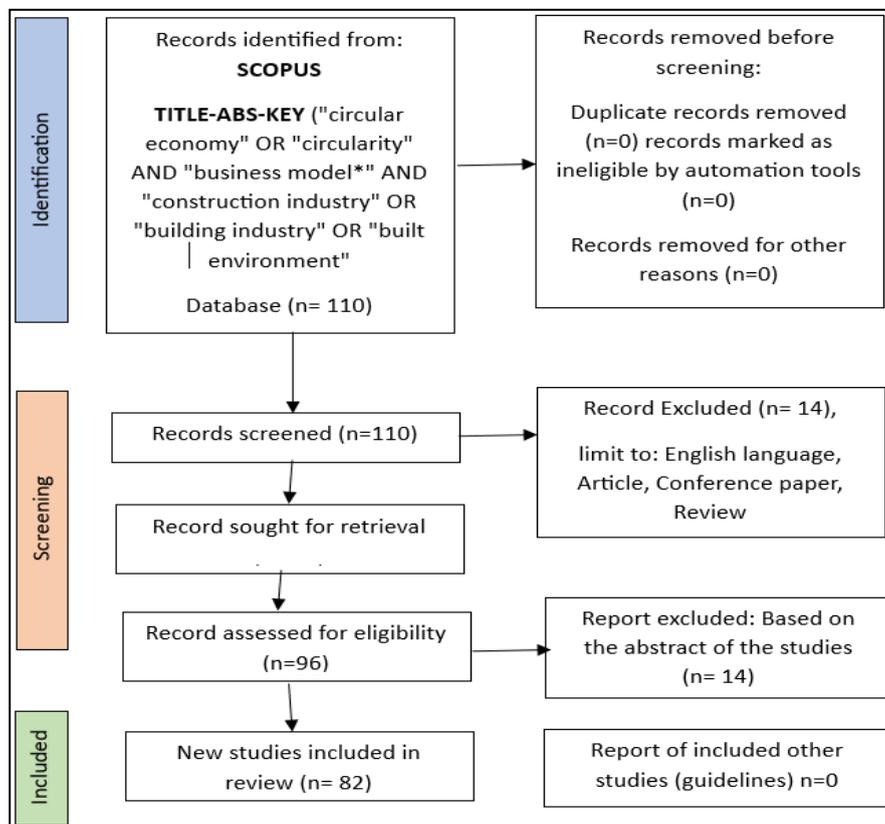

Figure 1: Systematic Literature review proses based on PRISMA 2020 method
Source: Author's own work

Result and Discussion
Publications Per Source of Document
The top five sources in Table 1 were determined by counting the number of articles they had published in CEBM in the construction industry. Among the reviewed sources, the *Journal of Cleaner Production* stands out as a leading forum for CEBM research. There is a clear emphasis on waste reduction and resource efficiency in this journal. The high number of citations indicates that the research published in the *Journal of Cleaner Production* has made a significant contribution to academic discussions and has gained attention and recognition among the academic community.

Table 1
Top Journals or Conferences that Published most cited Articles in CEBM in Construction Industry

	Source	Number of articles	Citation
Journal Of Cleaner Production		13	807
IOP Conference Series Earth and Environmental Science		10	60
Sustainable Production and Consumption		6	316
Sustainability Switzerland		6	148
Circular Economy and Sustainability		3	11

Source: SCOPUS and Author's own work

Influential Publications
Table 2 presenting 10 articles with the highest ranking sorted by number of citations in the CEBM in construction publication by June 2024. The articles published by Leising et al., (2018) have received the higher number of citations (299). These articles explore the potential of new supply chain collaboration methods for accelerating the transition towards a circular economy (CE) in the Dutch building sector. Additionally, Leising et al. (2018) have developed a tool based on empirical evidence to improve collaboration for CE in the building sector. The second most cited article Hossain et al., (2020) review the current trends, challenges, and potential frameworks for implementing the Circular Economy (CE) in the construction industry with 252 citations. The prospective framework which includes the analysis, implications and challenges was proposed. Munaro et al., (2020) emphasize the need for new business models to enhance the residual values of materials from the review.

Table 2

Top 10 most influential articles addressing CEBM in the construction industry

Tittle	Author	Total citation	Source	Focus	Method
Circular Economy in the building sector: Three cases and a collaboration tool	(Leising et al., 2018)	299	Journal of Cleaner Production	Application of Circular Economy (CE) principles in the Dutch building	Case study
Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction	(Hossain et al., 2020)	252	Renewable and Sustainable Energy Reviews	current trends, challenges, and potential frameworks for implementing CE in the construction industry	Review
A systematic literature review on the circular economy initiatives in the European Union	(Mhatre et al., 2021)	208	Sustainable Production and Consumption	Mechanism of CE implementation in the EU	Review
Towards circular and more sustainable buildings: A systematic literature review on the circular economy in the built environment	(Munaro et al., 2020)	206	Journal of Cleaner Production	Business model	Review
Barriers and drivers in a circular economy: The case of the built environment	(Hart et al., 2019)	198	Procedia CIRP	Barrier to CE	Review
Circular economy in the building and construction sector: A scientific evolution analysis	(Norouzi et al., 2021)	195	Journal of Building Engineering	Emerging trend in CE	Review
Circular economy in the construction industry: An overview of United States stakeholders' awareness, major challenges, and enablers	(Guerra & Leite, 2021)	128	Resources, Conservation and Recycling	awareness and adoption levels of CE strategies among U.S. architectural, engineering, and construction (AEC) industry stakeholders	Mix method
Circular digital built environment: An emerging framework	(Çetin et al., 2021)	115	Sustainability (Switzerland),	Digital technology enabling CE	Review
Drivers and barriers towards circular economy in the building sector: Stakeholder interviews and analysis of five European countries policies and practices	(Giorgi et al., 2022)	99	Journal of Cleaner Production,	Implementation policies in EU	Qualitative Study
Fundamentals of building deconstruction as a circular economy strategy for the reuse of construction materials	(Bertino et al., 2021)	67	Applied Sciences (Switzerland)	Analyse and promote building deconstruction as a key strategy within the Circular Economy (CE) framework	Case study

** The total number of citations reported based on data in Scopus on June 24,2024
Source: Author's own work

Influential Authors Based on Author and Co-Authors Network
Table 3 list out the top 10 researchers which have most documents and most citations in CEBM in Construction. The most contributed researchers in this field were Bokken,Nancy with 3 number of documents and 431 citations while Antwi-Afari also contributed with 3

documents but 336 citation. The third researcher that has more than 300 citations isNg,S.Thomas with 2 number of documents

Table 3
Top 10 researchers published document on CEBM in Construction

Author	No of Documents	Citations	Total link strength
Bokken,Nancy	3	431	24
Antwi-Afari, Prince	3	336	2
Ng,S.Thomas	2	310	2
Mhatre,Purva	2	260	0
Munaro,Mayara Regina	2	227	2
Braganca, Luis	2	227	2
Leite, Fernanda	2	195	2
Guerra,Beatriz C.	2	195	2
Osmani,Mohamed	2	99	0
Wuni,Ibrahim yahaya	2	58	0

Source: VOSviewer and Author's own work

Visualisation overlays the authorship network in Figure 3 represents node as authors, and links represent co-authorship relationships. Bocken,Nancy is centrally located in the network, showing a strong influence and numerous co-authorships with other researchers while Durdyev, Serdar is part of another group with different collaborative areas. Authors with total link strength 2 demonstrate that they collaborate with others and may be able to improve their research by using each other's knowledge and resources.
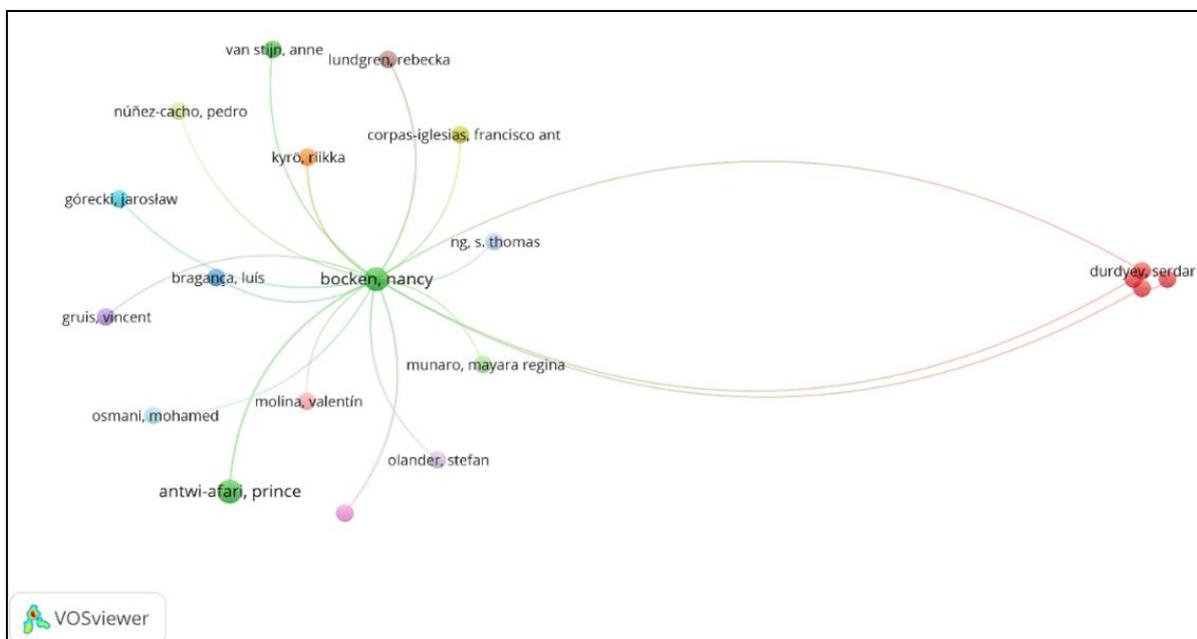

Figure 3: Visualisation overlay authorship network
Source: VOSviewer

Research Trends and Key Themes
Exploring the connections between terms in a large collection of keywords can be done by using VOSviewer as data visualization tool. it helps the identification process of theme for each cluster by grouping phrases according to their co-occurrence. A minimum number of

occurrences of a keyword were specified to five to generate a co-occurrence map from bibliographic data. This ensures proper keyword grouping, revealing research themes. Minimum five co-occurrence keywords were set in VOSviewer. Four clusters emerged from 34 keywords that met this criterion. Figure 4 depicts a network visualisation of these 34 co-occurring keywords, with Circular Economy and the construction industry at the centre.

Cluster 1 identified as red region in Figure 4 contains 13 co-occurring keywords, including architectural design, building, business model, business models, construction sectors, energy efficiency, environmental impact, intelligent buildings, life cycle, literature reviews, structural design and sustainable development. The study in this cluster can be simplified as study that focus on themes related to business models and sustainable development within the construction industry. The focus is on understanding and developing business models that incorporate sustainability principles (Whalen, 2019). This cluster highlights the significance of assessing the entire lifespan of construction materials and practices (Ishan et al., 2023). It also involves valuable research in exploring existing literature to develop an overview for sustainable business models in the construction industry (Benachio et al., 2020; Brenner & Drdla, 2023; Jayakodi et al., 2024; Osobajo et al., 2022).
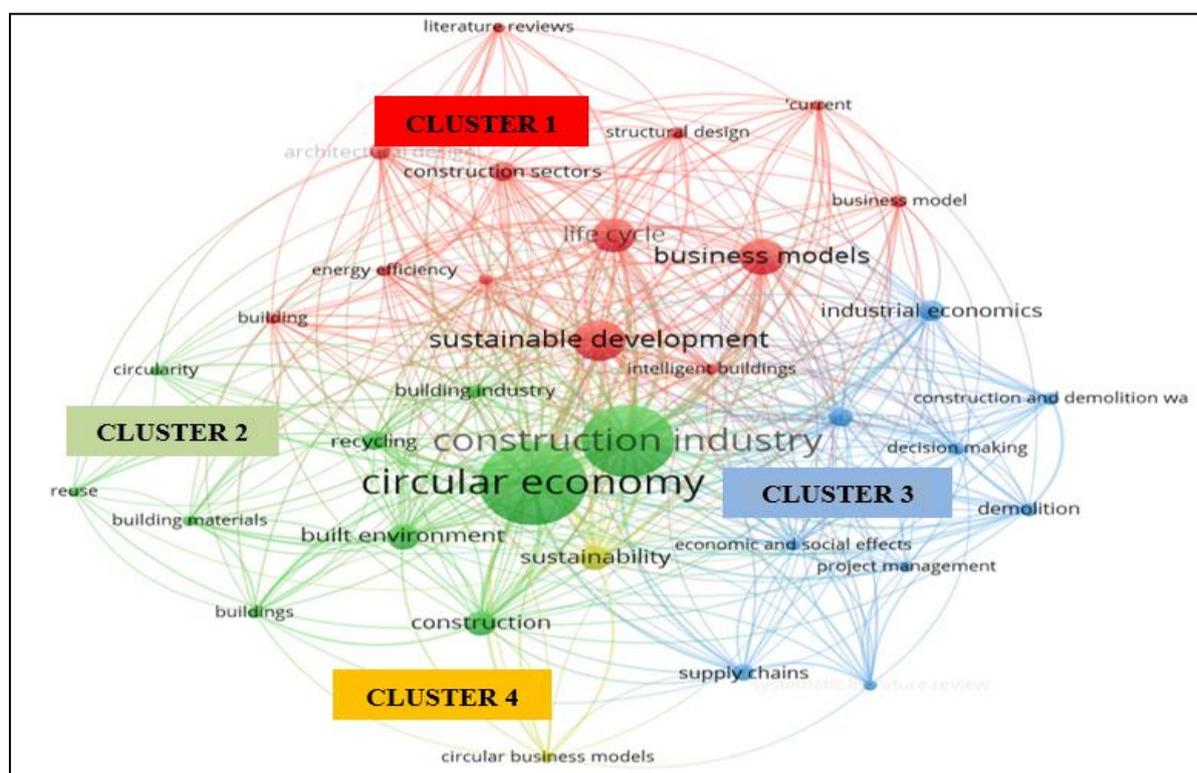

Figure 4: Four clusters emerged from 34 top keywords of co-occurrences
Source: VOSviewer and Author's own work

The green region in Figure 4 represents Cluster 2, which focuses on the implementation of circular economy ideas in the building industry.10 co-occurring keyword were identified which is building industry, building materials, buildings, built environment, circular economy, circularity, construction, construction industry, recycling and reuse. The green cluster emphasises the construction industry's shift towards sustainable and circular

practices to improve environmental impact and resource efficiency (Mohd et al., 2018; Sinoh et al., 2023).

Cluster 3 is identified as the blue region in Figure 4, and it focuses on industrial economics and management aspects related to construction and demolition. Nine keywords were identified: construction and demolition, decision making, demolition, economic and social effects, industrial economics, project management, supply chains, systematic literature review and waste management. The goal is to integrate sustainable economic principles into the construction industry, ensuring that industrial practices align with environmental sustainability (Ginga et al., 2020).Salleh et al., (2022) developing guidance for the adoption of a circular economy in construction and demolition waste management in Malaysia. By adopting these practices, construction organisations can enhance circularity and minimise construction demolition waste.

Cluster 4, marked as the yellow zone in Figure 4, focuses on circular business models and their application in the construction industry. The cluster focuses on the keywords circular business models and sustainability. The link shows the connection between supply chain and business model in promoting circular economy practices. This visualisation helps to identify key areas of focus and collaboration within the field. Ferasso et al., (2020) highlights the importance of innovative or circular business strategies in the construction industry. Circular business models focus on how companies are adopting circular principles to create economic value while reducing environmental impact.

Evolution of Research Themes in CEBMs for Construction Based on Publication Year
The VOSviewer visualization in Figure 5 represents the co-occurrence of keywords over time, with the colour of each node representing the average publication year of the documents in which the keyword appears. This temporal mapping offers valuable insights into the evolution of research trends on circular economy business models (CEBMs) in the construction sector. The visualization in Figure 5 indicates that initial research conducted between 2020 and 2021 was mostly concentrated on fundamental concepts such as the circular economy, sustainability, and their implementation within the construction sector. Sustainability development represents an earlier keyword that link to the circular economy, reflecting ongoing concerns with integrating sustainability into construction practices. The Circular Economy keyword appears prominently in the earlier period, indicating a foundational focus on circular economy principles in sustainable construction research. Over the years 2021–2022, there has been an apparent shift towards practical implementations, such as recycling, reusing, and improving energy efficiency. A recent study conducted between 2021 and 2022 directed towards developing sustainable business models, industrial economics, and waste management. Emerging interest in circular business model in 2022, suggesting a focus on integrating circular economy principles into business strategies. This indicates that the area is becoming more mature and is placing a strong emphasis on incorporating sustainability into economic and managerial processes. Overall, variation in keywords over time shows how research in sustainable building has grown and changed, from basic ideas to real-world applications and strategic integration.
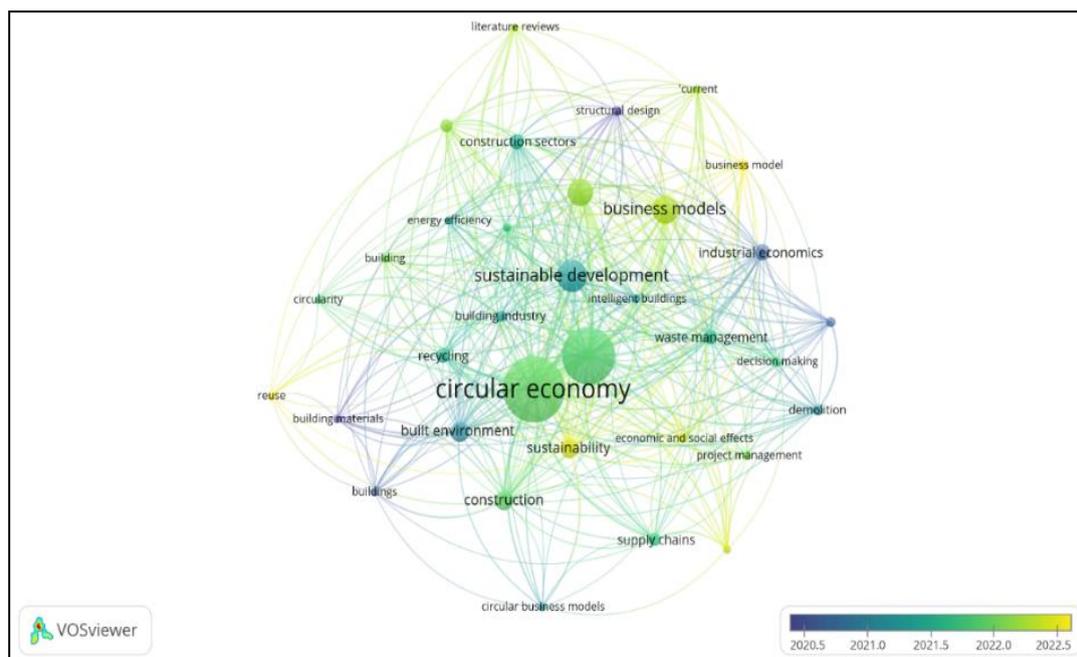
Figure 5: Overlay visualisation map for co-occurring keyword through year
Source: VOSviewer

These trends underscore a growing area for research on circular economy business models but still lack studies on the development of the framework that is directly tailored to construction circularity assessment. Such a framework could facilitate a closed-loop production process, enabling the recovery and reuse of materials or their composting for environmental benefit.Therefore, Business models that integrate circular economy ideas enable the efficient implementation of sustainability in the construction industry. It creates a framework for establishing circular practices, ensuring that economic operations are in line with environmental sustainability goals (Oluleye et al., 2022).

Interrelations among Clusters
Integrating circular economy principles with business models involves a comprehensive approach that redesign how businesses operate to ensure that resources are used more sustainably and efficiently. Changes in revenue models, supply chain management, stakeholder participation, and product design are necessary to be done to make sure company that implement these strategies can save expenses, increase sustainability, and generate new value opportunities.

The visualization in Figure 6 highlights the interconnectedness of different themes in the VOSviewer, particularly focusing on circular economy and business models. The interrelations among clusters, specifically between circular economy and business models in the construction industry context, can be understood by examining how these concepts support and enhance each other.
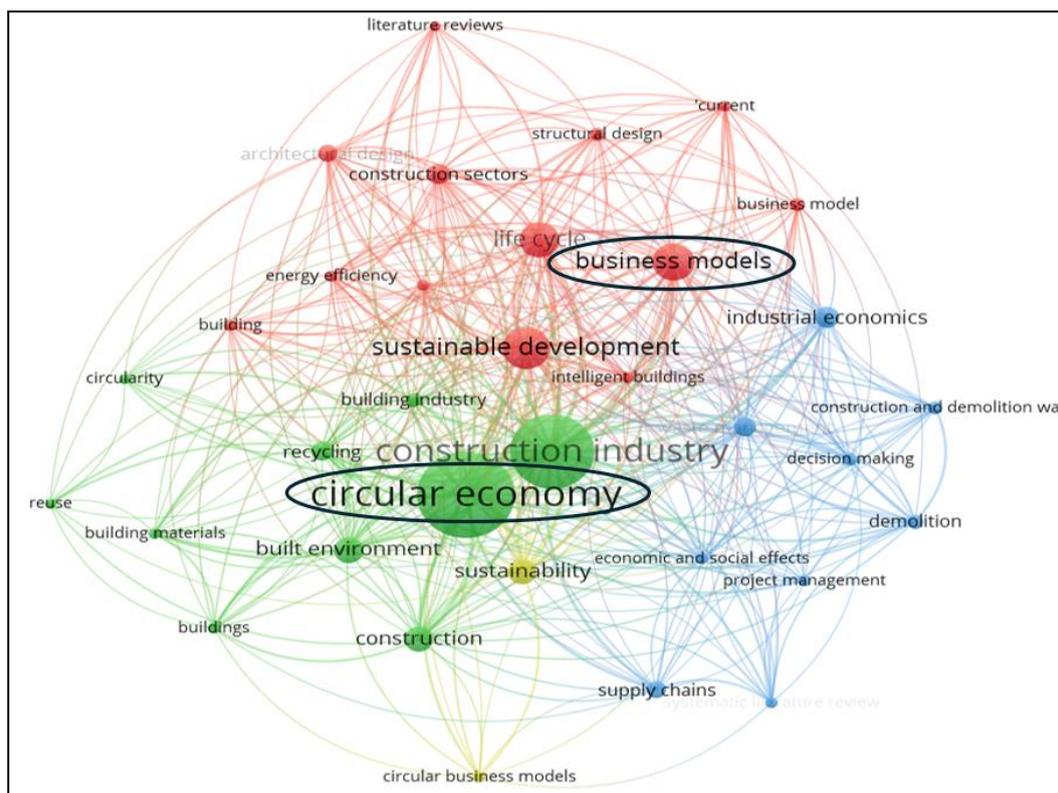
Figure 6: Interrelations among clusters
Source: VOSviewer

Business Models (Red) interlinkages with **Circular Economy (Green)** by incorporating concepts like recycling and reuse into business strategies. These concepts highlight how businesses are reshaping their models to incorporate circular practices. Jaya Surya & Kranti Kumar, (2021) highlight the importance of circular business models that promote a closed-loop system, prioritizing recycling and reuse to decrease reliance on raw materials and minimize environmental impacts.

Conclusion

This study presents a bibliometric analysis to identify the research focus of business models in circular economy in the construction sector, using publications indexed in the Scopus database from 2020 until June 2024. The findings highlight key research trends, major themes, influential publications, and evolution of research themes in CEBMs for Construction based on publication year.

By mapping co-authorship, citation networks, and keyword co-occurrences using VOSviewer, this study provides four (4) major thematic clusters focus on business models and sustainable development, circular economy concepts in the building sector, industrial economics and management aspects related to construction and demolition, and circular business models and their practical applications within the construction industry. The most contributed researchers in this field were Bokken,Nancy with 3 number of documents and 431 citations while Journal of Cleaner Production has contribute to the highest number of article and citations. This shows significant contribution to academic discussions and has gained attention and recognition among the academic community.However, there still lack of exploration of regulatory, financial, and policy-related barriers. Future study should focus on

policy analysis to identify governance strategies that accelerate circular transitions, and interdisciplinary approaches that link business, engineering, and environmental sciences. Collaboration between academia, industry practitioner and policymakers can enhance the practical implementation of CEBMs. As construction companies and policymakers continue to pursue environmentally sustainable strategies, the insights from this bibliometric analysis emphasize the transformative potential of CEBMs and the importance of further research to address the challenges and capitalize on the opportunities within this field.

References
Benachio, G. L. F., Freitas, M. do C. D., & Tavares, S. F. (2020). Circular economy in the construction industry: A systematic literature review. In Journal of Cleaner Production (Vol. 260). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2020.121046

Brenner, B., & Drdla, D. (2023). Business Model Innovation toward Sustainability and Circularity—A Systematic Review of Innovation Types. In Sustainability (Switzerland) (Vol. 15, Issue 15). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/su151511625

Chen, Q., Feng, H., & Garcia de Soto, B. (2022). Revamping construction supply chain processes with circular economy strategies: A systematic literature review. In Journal of Cleaner Production (Vol. 335). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2021.130240

Esa, M. R., Halog, A., & Rigamonti, L. (2017). Developing strategies for managing construction and demolition wastes in Malaysia based on the concept of circular economy. In Journal of Material Cycles and Waste Management (Vol. 19, Issue 3, pp. 1144–1154). Springer Tokyo. https://doi.org/10.1007/s10163-016-0516-x

Ferasso, M., Beliaeva, T., Kraus, S., Clauss, T., & Ribeiro-Soriano, D. (2020). Circular economy business models: The state of research and avenues ahead. Business Strategy and the Environment, 29(8), 3006–3024. https://doi.org/10.1002/bse.2554

Gasparri, E., Arasteh, S., Kuru, A., Stracchi, P., & Brambilla, A. (2023). Circular economy in construction: A systematic review of knowledge gaps towards a novel research framework. In Frontiers in Built Environment (Vol. 9). Frontiers Media SA. https://doi.org/10.3389/fbuil.2023.1239757

Ginga, C. P., Ongpeng, J. M. C., & Daly, M. K. M. (2020). Circular economy on construction and demolition waste: A literature review on material recovery and production. In Materials (Vol. 13, Issue 13, pp. 1–18). MDPI AG. https://doi.org/10.3390/ma13132970

Hossain, M. U., Ng, S. T., Antwi-Afari, P., & Amor, B. (2020). Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. In Renewable and Sustainable Energy Reviews (Vol. 130). Elsevier Ltd. https://doi.org/10.1016/j.rser.2020.109948

Illankoon, C., & Vithanage, S. C. (2023). Closing the loop in the construction industry: A systematic literature review on the development of circular economy. Journal of Building Engineering, 76, 107362. https://doi.org/10.1016/J.JOBE.2023.107362

Ishan, M., Gamage, I., & Lingasabesan, V. (2023). Highly Effective Circular Economic Practices For The Life Cycle Of A Construction Project. World Construction Symposium, 1, 532–544. https://doi.org/10.31705/WCS.2023.44

Jaya Surya, R., & Dr. Kranti Kumar, M. (2021). Implementation of Circular Business Models in Construction and Demolition Waste Management of India. International Journal of Engineering and Management Research, 11(2), 87–93. https://doi.org/10.31033/ijemr.11.2.12

Jayakodi, S., Senaratne, S., & Perera, S. (2024). Circular Economy Business Model in the Construction Industry: A Systematic Review. In Buildings (Vol. 14, Issue 2). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/buildings14020379

Leising, E., Quist, J., & Bocken, N. (2018). Circular Economy in the building sector: Three cases and a collaboration tool. Journal of Cleaner Production, 176, 976–989. https://doi.org/10.1016/j.jclepro.2017.12.010

Lewandowski, M. (2016). Designing the business models for circular economy-towards the conceptual framework. In Sustainability (Switzerland) (Vol. 8, Issue 1). MDPI. https://doi.org/10.3390/su8010043

Anuar, S., Zakaria, Z., Othman, A., & Abdullah, Y. (2018). Adoption Of Circular Economy For A Sustainable Solid Waste Management System In Malaysia. In Malaysian Management Journal (Vol. 22).

Munaro, M. R., Tavares, S. F., & Bragança, L. (2020). Towards circular and more sustainable buildings: A systematic literature review on the circular economy in the built environment. In Journal of Cleaner Production (Vol. 260). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2020.121134

Oluleye, B. I., Chan, D. W. M., Saka, A. B., & Olawumi, T. O. (2022). Circular economy research on building construction and demolition waste: A review of current trends and future research directions. In Journal of Cleaner Production (Vol. 357). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2022.131927

Osei-Tutu, S., Ayarkwa, J., Osei-Asibey, D., Nani, G., & Afful, A. E. (2023). Barriers impeding circular economy (CE) uptake in the construction industry. In Smart and Sustainable Built Environment (Vol. 12, Issue 4, pp. 892–918). Emerald Publishing. https://doi.org/10.1108/SASBE-03-2022-0049

Osobajo, O. A., Oke, A., Omotayo, T., & Obi, L. I. (2022). A systematic review of circular economy research in the construction industry. In Smart and Sustainable Built Environment (Vol. 11, Issue 1, pp. 39–64). Emerald Publishing. https://doi.org/10.1108/SASBE-04-2020-0034

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L.,

Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. International Journal of Surgery, 88, 105906. https://doi.org/10.1016/J.IJSU.2021.105906

Research and Markets. (2024). Construction and demolition waste management market report. Retrieved from https://www.researchandmarkets.com/reports/5766698/construction-demolition-waste-management-global

Salleh, H., Ke Ying, C., Hanid, M., Abdul Samad, Z., Azlinda Mohamed Sabli, N., & Mazlina Syed Khuzzan, S. (2022). Development Of Guidance For The Adoption Of Circular Economy In Construction And Demolition Waste Management. In Journal of the Malaysian Institute of Planners VOLUME (Vol. 20).

Sinoh, S. S., Othman, F., & Onn, C. C. (2023). Circular economy potential of sustainable aggregates for the Malaysian construction industry. Sustainable Cities and Society, 89. https://doi.org/10.1016/j.scs.2022.104332

Tanveer, M., Khan, S. A. R., Umar, M., Yu, Z., Sajid, M. J., & Haq, I. U. (2022). Waste management and green technology: future trends in circular economy leading towards environmental sustainability. In Environmental Science and Pollution Research (Vol. 29, Issue 53, pp. 80161–80178). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s11356-022-23238-8

United Nations Environment Programme. (2022). 2022 Global Status Report for Buildings and Construction:Towards A Zero-Emissions, Efficient, And Resilient Buildings and Construction Sector. UNEP. Retrieved from https://www.unep.org/resources/report/global-status-report-buildings-and-construction

Whalen, K. A. (2019). Three circular business models that extend product value and their contribution to resource efficiency. Journal of Cleaner Production, 226, 1128–1137. https://doi.org/10.1016/j.jclepro.2019.03.128

World Economic Forum. (2021). How cities can reduce emissions through sustainable construction. World Economic Forum. Retrieved from https://www.weforum.org/stories/2021/01/planet-warming-emissions buildings-construction-climate-goals-risk