

A SCIENTOMETRIC ANALYSIS OF CONSTRUCTION VALUE MANAGEMENT RESEARCH: A 25-YEAR REVIEW

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ABSTRACT

This study presents a Scientometric analysis of construction Value Management (VM) research to map the intellectual structure, knowledge evolution, and emerging trends within the field. Despite the growing body of VM literature, a comprehensive understanding of its development, influential contributors, and research directions remains limited. To address this gap, CiteSpace was employed to analyse 400 publications indexed in the Web of Science Core Collection between 2001 and 2026. The analysis incorporated document, author, and country co-citation techniques to identify influential publications, collaboration patterns, knowledge clusters, and thematic evolution within the construction VM domain. The findings reveal a substantial increase in research activity over the past decade, indicating the growing importance of value-based approaches in construction management. The knowledge domain is characterised by strong research clusters centred on project performance improvement, value optimisation, and implementation-related studies, while developed countries continue to dominate research output and influence. The results further indicate an emerging shift towards sustainability-oriented VM, digital technologies, and data-driven decision-making approaches. By providing a comprehensive knowledge map of construction VM research, this study contributes to a deeper understanding of the field's intellectual foundations and development trajectory. The findings offer valuable insights for researchers and practitioners and establish a foundation for future investigations into value-based approaches in the construction industry.

Keywords: Knowledge Mapping; Literature Review; Scientometric; Value Management

1. INTRODUCTION

Developed countries such as the United States and the United Kingdom have extensively implemented Value Management (VM) in construction projects (Perera et al., 2006). While VM is a well-established practice in these countries (Kelly et al., 2014), its adoption remains uneven globally. In many developing economies, including Malaysia, China, and several African nations, VM implementation is still limited due to factors such as low awareness, regulatory constraints, and contextual challenges (Jaapar et al., 2012;

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Oke & Ogunsemi, 2011; Zhao & Moh, 2016). These disparities continue to influence the diffusion and maturity of VM practices across the construction sector (Alshehri, 2020).

Growing recognition of VM as a strategic approach for improving project value, stakeholder satisfaction, and resource efficiency has led to a substantial increase in research output over the past two decades. Consequently, the field has expanded to encompass diverse topics, including project performance, sustainability, stakeholder management, and digital technologies. However, existing reviews have primarily adopted narrative or systematic approaches, providing limited insights into the intellectual structure, evolution, and research networks of the field. To date, no comprehensive Scientometric study has mapped the development of construction VM research over the past 25 years. This gap limits understanding of how the field has evolved, where research influence is concentrated, and which topics are emerging as future research priorities. Therefore, this study employs CiteSpace-based Scientometric analysis to examine construction VM research published between 2001 and 2026. Specifically, the study aims to: (1) analyse publication trends; (2) identify the intellectual foundations of the field through document, author, and country co-citation analyses; and (3) reveal major research clusters, collaboration patterns, and emerging research directions. The findings provide a comprehensive knowledge map of construction VM research and offer insights for future scholarly and industry development.

2. METHODOLOGY

This study adopted a Scientometric research design to systematically map the intellectual structure, evolution, and emerging trends of construction VM research. Scientometric analysis is a quantitative literature analysis technique that enables the exploration of knowledge domains through citation relationships, collaboration networks, and thematic evolution patterns. Compared with conventional literature reviews, Scientometric methods provide a more objective and comprehensive understanding of the development of a research field by analysing large volumes of bibliographic data.

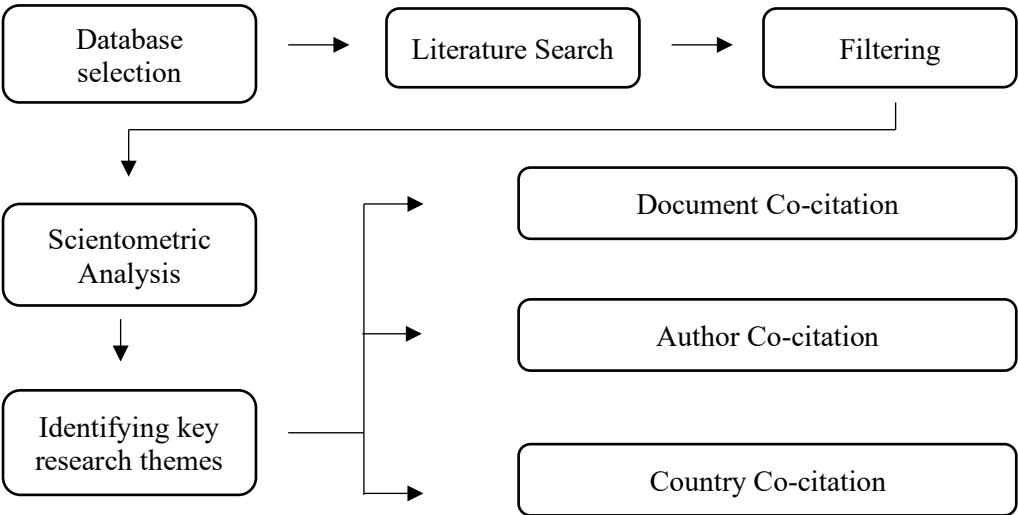


Figure 1: Schematic diagram of research methodology

CiteSpace (Version 6.3.R1) was employed as the primary analytical tool due to its strong capability in visualizing knowledge structures and detecting emerging research trends

(Chen, 2006). Previous studies have demonstrated that CiteSpace is particularly effective in identifying intellectual foundations, research hotspots, influential publications, and thematic evolution within scientific domains (Fang et al., 2018; Wei et al., 2015). Accordingly, the software was used to perform document co-citation, author co-citation, and country co-citation analyses to map the development of construction VM research. The overall research process adopted in this study is illustrated in Figure 1.

Prior to data collection, a comparison of major academic databases, including Web of Science (WoS), Scopus, and Engineering Village, was conducted. The Web of Science Core Collection was selected as the primary data source because of its comprehensive coverage of high-quality peer-reviewed journals, standardized citation information, and widespread use in Scientometric studies.

The literature search was conducted in March 2026 using the following search query:

TS = ("value management" OR "value engineering") AND

TS = ("construction" OR "construction project*" OR "construction industry" OR "building project*" OR "built environment")

NOT

TS = ("earned value");

where the topic field (TS) searches within the title, abstract, and keywords of publications. The search was restricted to publications published between 1 January 2001 and 1 March 2026. The exclusion of "earned value" was intentionally applied to minimise the retrieval of studies focusing exclusively on Earned Value Management (EVM), which represents a distinct project control methodology from Value Management and Value Engineering.

A multi-stage screening process was undertaken to ensure the relevance and quality of the dataset. The initial search returned 947 publications, which were subsequently filtered to include only English-language journal articles, reducing the dataset to 585 records. Further screening was conducted using relevant Web of Science categories, namely Construction and Building Technology, Civil Engineering, Industrial Engineering, Management, Business, and Multidisciplinary Engineering. A manual review of titles, abstracts, and keywords was then performed to exclude studies unrelated to construction value management, such as those focusing on manufacturing, product design, or healthcare applications. Following the screening process, a final dataset of 400 publications was obtained for Scientometric analysis.

The dataset was imported into CiteSpace, and document co-citation analysis (DCA) was employed to identify the intellectual foundations and knowledge structure of construction VM research. It should be noted that although studies containing the term "earned value" were excluded from the primary dataset, Earned Value Management (EVM) publications may still appear in the co-citation network because DCA analyses references cited by the selected publications rather than only the publications included in the dataset. Their presence therefore reflects their influence on the intellectual development of the field rather than their inclusion in the primary dataset.

Citation networks were generated using annual time slices, with the top 50 cited references selected from each year. The analysis incorporated document co-citation, author co-citation, country co-citation, and citation burst analyses to identify influential publications, key contributors, geographical research patterns, and emerging research

trends. Network quality was assessed using Modularity Q and Silhouette scores, which measure cluster separation and homogeneity, respectively (Chen, 2013). The resulting visualisations and Scientometric indicators were subsequently interpreted to identify major research themes, intellectual foundations, collaboration patterns, and emerging trends within the construction VM domain.

3. RESEARCH FINDINGS

This research analyses the construction VM research studies starting from 2001 to 2026. It was discovered that in the early 2000s and before, the yearly productivity of pertinent articles remained low. This could be explained by the fact that at the time few people were aware of the broad applicability of VM, despite ongoing efforts to increase awareness of it (Perera et al., 2006). The annual publication trend indicates a clear growth in research on construction value management between 2001 and 2026. In the early years (2002–2013), publication output remained relatively low, generally below 15 publications per year, reflecting the limited research attention given to the topic during that period. However, a steady increase in research publications is evident after 2015, with publications rising significantly from 23 studies in 2019 to a peak of 41 studies in 2021, which represents the highest contribution (10.25%) within the dataset. Although slight fluctuations are observed in subsequent years, the consistently high outputs in 2024 and 2025 (38 publications each) demonstrate sustained scholarly interest in the field. The lower number recorded for 2026 (8 publications) can be attributed to the ongoing nature of the year at the time of data collection. Overall, the trend highlights a rapid expansion of research interest in construction VM, particularly in the last decade, indicating the growing importance of value-based approaches in construction management research.

3.1 DOCUMENT CO-CITATION ANALYSIS

The core data set of VM under construction from 2001 to 2026, which is the development era of the knowledge domain, was used in the study to conduct a document co-citation analysis. The timeline was broken up by CiteSpace into a series of time slices, each of which represented a year, according to the analysis. Each time slice's top 50 citations were considered for the analysis. The co-citation network with 463 nodes and 1489 links, which is the detailed result of CiteSpace's document co-citation analysis, is shown in Figure 2. The network is logically separated into densely connected clusters, as indicated by the findings' modularity Q, which is equal to 0.7937. The fair homogeneity of the clusters is indicated by the mean silhouette value, which is 0.9304. Figure 2 provides a graphical representation of the clusters identified through the CiteSpace analysis. Several clusters were identified by the software which indicated that construction VM is a popular topic amongst the research community. The high number of links indicate that VM research community relies on and uses peer research articles to strengthen the new research studies. From a broader perspective, similar patterns have been observed in global VM research. Studies such as Ekanayake et al. (2019) and He et al. (2017) demonstrate that construction management domains tend to evolve into clearly defined thematic clusters over time, often centred around key areas such as value optimisation, project performance, decision-making frameworks, and sustainability integration. The presence of densely connected clusters in this study similarly suggests that VM research has moved beyond fragmented early explorations toward more consolidated and specialised research streams.

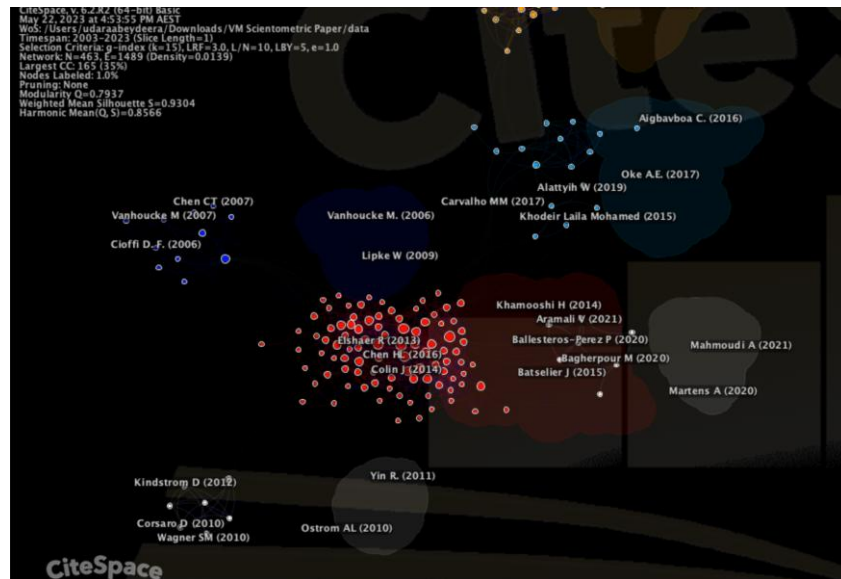


Figure 2: Document co-citation analysis of construction VM research from 2001 to 2026

Table 1 provides the details of the top 9 highly co-cited documents of this research domain. These 9 research studies belong to a single cluster, cluster #0 of the figure 2. The other notable fact is that all these studies were conducted after 2012. Two studies, EDM: Earned Duration Management, a new approach to schedule performance management and measurement by Khamooshi and Golafshani (2014) and Evaluation of deterministic state-of-the-art forecasting approaches for project duration based on earned value management by Batselier and Vanhoucke (2015) reported a co-citation count of 18 while the others studies also followed closely ranging a co-citation count of 14-17. All these studies mainly focused on one significant theme: enhancing the project performance by using VM. This has been the common motive of construction stakeholders when VM is integrated to construction projects.

VM is distinct from other management metrics in that its goal is to increase value by controlling function and cost (Value/ Function/Cost). Typically, a project's value is increased while expenditures are decreased, and the needed project functions are met or improved (Cheah & Ting, 2005). The improvement of project function is the intended result, which will raise the value of the final building product overall. VM can be used for virtually any project or product (Adnan et al., 2018). VM is therefore more than just a straightforward way to minimise costs. Because VM involves a systemic technique and applies a systematic VM task plan to increase project value, it varies from related methodologies like cost cutting, constructability, and reengineering.

Table 1: Top 9 publications with the highest citation count

Research Article	Author (Year)	Citation count
EDM: Earned Duration Management, a new approach to schedule performance management and measurement	Khamooshi and Golafshani (2014)	18
Evaluation of deterministic state-of-the-art forecasting approaches for project duration based on earned value management	Batselier and Vanhoucke (2015)	18

Research Article	Author (Year)	Citation count
Impact of sensitivity information on the prediction of project's duration using earned schedule method	Elshaer (2013)	17
Setting tolerance limits for statistical project control using earned value management	Colin and Vanhoucke (2014)	16
Improving project forecast accuracy by integrating earned value management with exponential smoothing and reference class forecasting	Batselier and Vanhoucke (2015)	16
Earned value project management: Improving the predictive power of planned value	Chen et al. (2015)	16
A comparison of the performance of various project control methods using earned value management systems	Colin and Vanhoucke (2014)	15
Classification of articles and journals on project control and earned value management	Willems and Vanhoucke (2015)	14
A multivariate approach for top-down project control using earned value management	Colin et al. (2015)	14

A citation burst indicates a highly active research field. A citation burst is the detection of a burst event that can last for more than one year. A citation burst indicates that a specific publication is associated with an increase in citations. In other words, the publication has evidently garnered a great deal of interest from the scientific community. Moreover, if a cluster contains numerous nodes with significant citation surges, the cluster as a whole represents an active area of research or a developing trend.

3.2 AUTHOR CO-CITATION ANALYSIS

By measuring the number of times any author's work is co-cited with the work of another author in the references of citing documents, author co-citation analysis, or ACA, is used to identify, track, and visualise the intellectual structure of an academic subject (Bayer et al., 1990). The basic objective of the ACA is to pinpoint the conceptual organisation of a scientific knowledge area in terms of the clusters created by collected co-citation trails in the literature. Figure 3 provides a visualization of the author co-citation analysis results of construction VM research. The results revealed 460 nodes with 1521 links and a mean silhouette of 0.9115. The modularity Q of the results received was 0.7776 which is an indication of the fair homogeneity of the clusters. There were twelve main clusters in the co-author analysis results. The largest cluster (#0) has 90 members and a silhouette value of 0.994. It is labelled as top-down project control by LLR, value management by LSI, and signal quality (1.35) by MI. The major citing article of the cluster is: Batselier and Vanhoucke (2015) Empirical evaluation of earned value management forecasting accuracy for time and cost. The most cited members in this cluster are: 100 Lipke, 80 Vanhoucke and 74 Anbari.

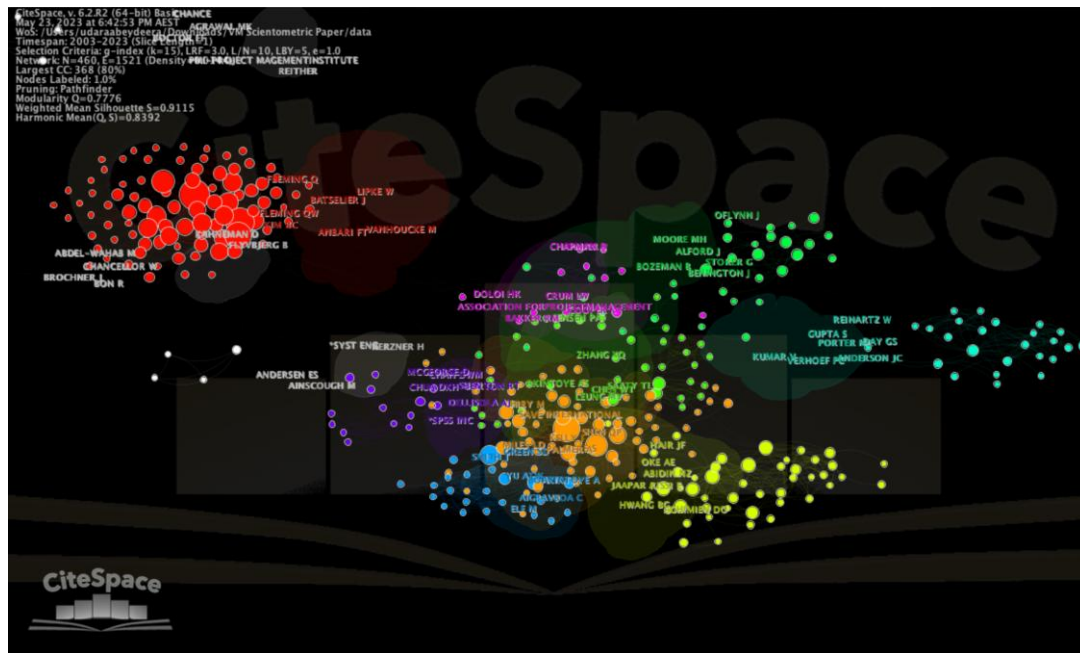


Figure 3: Author co-citations of construction VM research 2001-2026

The second largest cluster (#1) has 70 members and a silhouette value of 0.785. It is labelled as value management studies by both LLR and LSI, and as knowledge management system (1.01) by MI. The major citing article of the cluster is: Aghimien et al. (2018) Barriers to the adoption of value management in developing countries. The most cited members in this cluster are: 76 KELLY J, 48 MALE S, and 25 SHEN QP. The third largest cluster (#2) has 46 members and a silhouette value of 0.907. It is labelled as structural equation modelling approach by LLR, value management by LSI, and stationary barrier (0.24) by MI. The major citing article of the cluster is: Kineber et al. (2021) Impact of value management on building projects success: structural equation modelling approach. The most cited members in this cluster are: 18 Oke A.E., 18 Hair J.F., and 18 Jaapar A.

The citation burst analysis, as indicated in Figure 4, reveals how scholarly attention within the field has shifted over time, highlighting authors whose work significantly shaped the development of value management research in construction. Citation burst strength reflects the intensity of scholarly interest in a particular author's work, while burst duration indicates how long that influence remained prominent within the literature. Early citation bursts were driven by foundational contributors such as Dell'Isola (1997), whose work played a critical role in establishing the theoretical and methodological foundations of value management in the construction industry. As the field matured, citation bursts between 2015 and 2020 became associated with authors such as Colin, Batselier, and Khamooshi, reflecting a growing research emphasis on project performance monitoring and the application of earned value management techniques. More recent bursts from 2021 onwards, particularly those linked to Aghimien, Oke, Jaapar, and Kissi, suggest a shift toward practical implementation issues and the integration of value management with broader concerns such as sustainability and contemporary construction management practices. Overall, the pattern of citation bursts illustrates the evolving intellectual trajectory of the field, moving from foundational theoretical development toward

performance-oriented methodologies and, more recently, toward implementation-driven and sustainability-focused research directions.

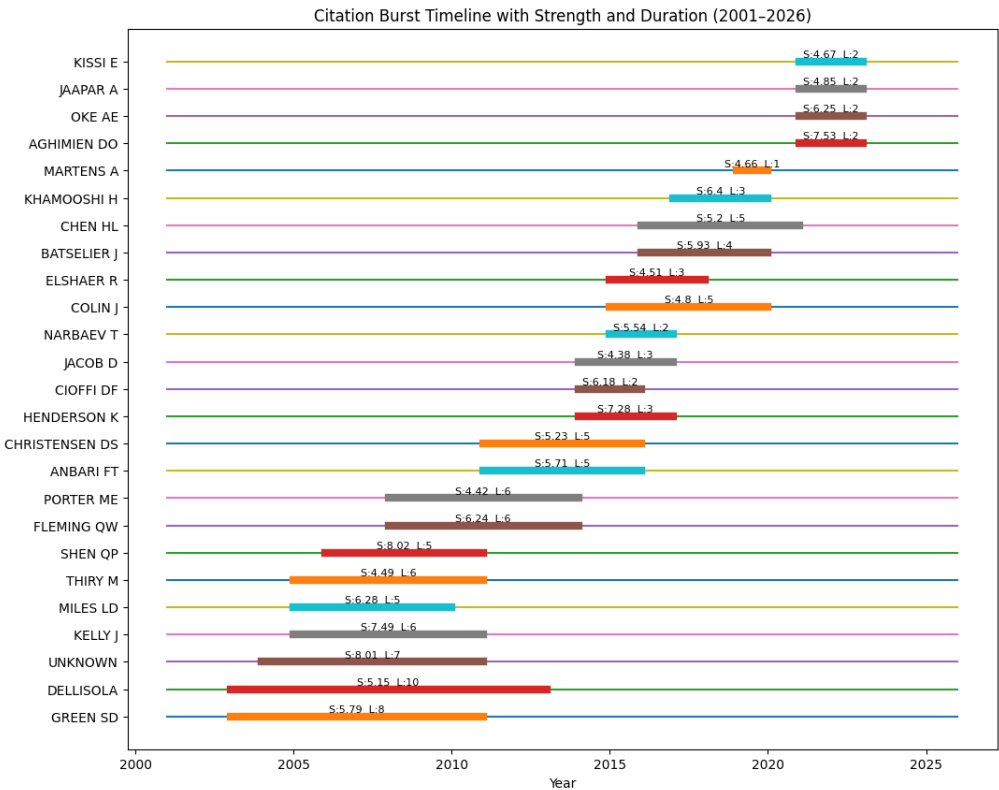


Figure 4: Top 25 author citation bursts of construction VM research 2001-2026

3.3 COUNTRY CO-CITATION ANALYSIS

The country co-citation network provides an insight on how the construction VM research studies span around the world. Figure 5 provides a visual of the most prominent countries in this research domain. The results indicate 70 nodes with 126 links with a mean silhouette of 0.8793. The results also indicated a low modularity Q of 0.4535 suggesting that community structure in construction VM research is not strong. The top ranked item by citation counts is USA (2003), with citation counts of 84. The second one is ENGLAND (2005), with citation counts of 70. The third is PEOPLES R CHINA (2003), with citation counts of 67. The 4th is AUSTRALIA (2005), with citation counts of 38. The 5th is MALAYSIA (2008), with citation counts of 26. The 6th is BELGIUM (2011), with citation counts of 26. The 7th is IRAN (2007), with citation counts of 26. The 8th is SOUTH KOREA (2006), with citation counts of 26. The 9th is SPAIN (2005), with citation counts of 21. The 10th is SOUTH AFRICA (2006), with citation counts of 19. These results are also in line with the common argument that construction VM research is majorly limited to the developed countries.

Several authors note the application of VM outside of the United States, including Australia, Indonesia, and Korea (Jay & Bowen, 2015); Europe, Australia, Hong Kong, and Japan; and France, Germany, Japan, and Australia (Kelly et al., 2014). These researchers discovered that the primary reason for adopting value management was cost reduction. China provides an example of an adoption path; the concept was sparked in

1978 by academic research (Liu & Shen, 2005). The subsequent collaboration with Japanese firms led to significant cost savings (Liu et al., 2004). In most countries, a value study is conducted over a brief "time box" period of hours or days. However, in China, a study may be conducted over a substantially extended period and may involve the identification and quantification of value opportunities in great detail (Shen & Liu, 2004).

VM research domain has become popular among the academia in the recent years thus resulting an increase in the research output. The country co-citation analysis further affirms this result and indicates that the research domain is gradually gaining its popularity in the developing countries. The cluster is included with countries such as Malaysia, Indonesia, Saudi Arabia and Taiwan which is a clear indication that over the past years, developing countries have also stepped up in the construction VM research sector. The use of VM in various construction projects was said to be in its infancy in numerous countries. More research on the existing use and lack of VM in various building projects, notably infrastructural and industrial projects, should be conducted. Furthermore, more research is suggested to discover and assess aspects that have a substantial impact on VM in different building projects, such as risk factors encountered during VM (Lin et al., 2022). Considering limited VM research on individual construction projects has been undertaken in most parts of Africa, new studies are suggested to assist the wider application of VM throughout the continent. Furthermore, further studies that employ appropriate and multiple research methodologies to provide credible results are strongly encouraged (Lin et al., 2022). It is intended that research findings would be published in a wider range of journals, helping to publicise and promote the method in other construction projects.

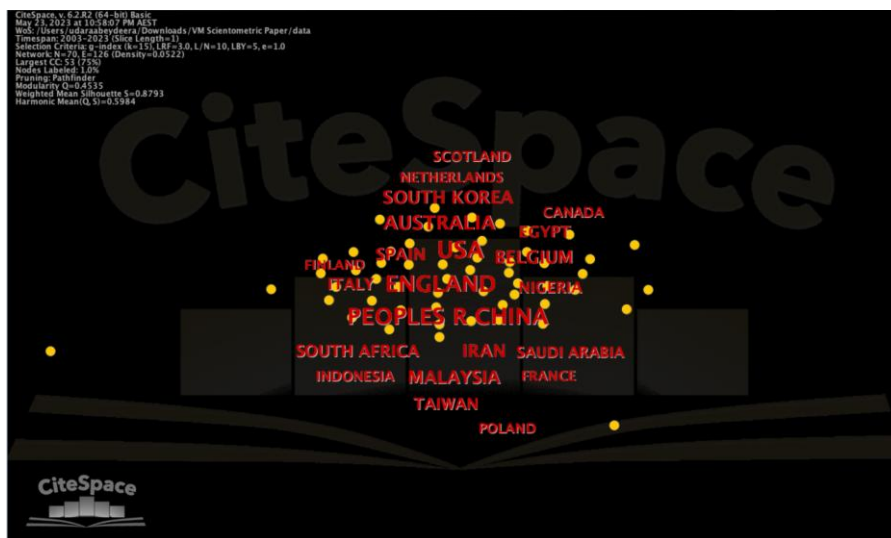


Figure 5: Country co-citations of construction VM research 2001-2026

4. DISCUSSION

4.1 EVOLUTION OF CONSTRUCTION VALUE MANAGEMENT RESEARCH

The publication trend analysis demonstrates that construction value management research has evolved from a relatively niche research area in the early 2000s into an increasingly established field of scholarly inquiry. The limited publication output observed between 2001 and 2013 suggests that VM was primarily viewed as a specialist project

management technique rather than a broader strategic management approach. However, the substantial growth in publications after 2015 indicates increasing recognition of VM's role in improving project performance, enhancing stakeholder value, and supporting organisational decision-making. This trend coincides with the growing complexity of construction projects, increasing client expectations, and the industry's shift towards value-driven project delivery approaches. The sustained publication growth observed during the last decade also suggests that researchers are increasingly exploring VM beyond its traditional cost optimisation focus. Contemporary studies have expanded the scope of VM to include project success, stakeholder satisfaction, sustainability considerations, risk management, and strategic decision-making. This evolution reflects the broader transformation of the construction industry from a cost-centric paradigm toward a value-centric paradigm.

4.2 INTELLECTUAL STRUCTURE OF THE CONSTRUCTION VM KNOWLEDGE DOMAIN

The document co-citation analysis revealed a highly interconnected knowledge network characterised by several well-defined clusters. The high modularity and silhouette values suggest that construction VM research has matured into a structured and specialised knowledge domain rather than remaining a fragmented collection of isolated studies. One of the most significant findings is the dominance of publications related to project performance measurement and forecasting within the most highly cited cluster. Although the primary dataset excluded studies explicitly focused on Earned Value Management (EVM), EVM-related publications emerged prominently within the co-citation network because they are frequently cited by VM researchers. This indicates that project performance measurement has become an important intellectual foundation supporting contemporary VM research.

The prominence of these studies suggests that researchers increasingly view value creation and project performance as interconnected concepts. While traditional VM research focused primarily on function-cost relationships, recent studies demonstrate a broader concern with measuring, monitoring, and predicting project outcomes. This shift reflects the industry's growing demand for evidence-based decision-making and performance-oriented management practices. Furthermore, the dense connectivity observed within the co-citation network indicates a high degree of knowledge accumulation and intellectual convergence. Researchers are increasingly building upon established theoretical foundations rather than conducting isolated investigations, suggesting that the field has entered a stage of academic maturity.

4.3 EVOLUTION OF RESEARCH THEMES AND SCHOLARLY INFLUENCE

The author co-citation analysis provides valuable insights into the intellectual evolution of construction VM research. The largest author cluster was associated with project control and performance measurement, highlighting the growing importance of evaluating value delivery throughout the project lifecycle. The prominence of authors such as Vanhoucke, Lipke, and Anbari demonstrates the influence of project performance management literature on the broader VM knowledge domain. The second cluster, dominated by authors such as Kelly, Male, and Graham reflects the foundational body of work that established VM principles, methodologies, and implementation frameworks. These authors have played a critical role in defining the conceptual boundaries of VM

and promoting its application within construction projects. The emergence of more recent clusters focusing on implementation barriers, organisational adoption, and structural equation modelling indicates a gradual shift from theoretical development toward empirical validation and practical implementation. Researchers are increasingly investigating factors influencing VM adoption, organisational readiness, and the measurable benefits of VM implementation in different project contexts. The citation burst analysis further illustrates the intellectual progression of the field. Early citation bursts were associated with foundational VM theorists, whereas more recent bursts highlight researchers investigating implementation challenges, project success factors, and sustainability-related applications. This pattern suggests that VM research has progressed from establishing conceptual foundations toward addressing contemporary industry challenges.

4.4 GLOBAL RESEARCH DISTRIBUTION AND KNOWLEDGE DIFFUSION

The country co-citation analysis demonstrates that construction VM research remains concentrated within a relatively small group of countries, particularly the United States, the United Kingdom, China, and Australia. These countries have historically been early adopters of VM and continue to serve as major centres of knowledge production. The dominance of developed economies may be attributed to stronger institutional support, established professional frameworks, greater research funding, and wider industry adoption of VM practices. The findings therefore reinforce previous observations that VM has achieved greater maturity in developed construction markets. However, the emergence of countries such as Malaysia, Saudi Arabia, South Africa, Iran, and Taiwan within the co-citation network suggests that the geographical distribution of VM research is gradually expanding. This pattern indicates increasing recognition of VM's potential benefits in developing economies, particularly in addressing cost efficiency, project performance, and resource optimisation challenges. The growing participation of developing countries also reflects the globalisation of construction knowledge and the increasing transfer of management practices across national boundaries. Nevertheless, substantial disparities remain, indicating opportunities for future research examining VM implementation within underrepresented regions, particularly Africa, South Asia, and Latin America.

4.5 EMERGING RESEARCH DIRECTIONS

The findings suggest that construction VM research is entering a new phase characterised by greater integration with contemporary construction management challenges. While traditional studies focused primarily on value optimisation and cost reduction, recent research trends indicate increasing interest in sustainability, digitalisation, and project performance enhancement.

Several emerging directions can be identified from the evolution of citation patterns and recent scholarly contributions:

- Integration of VM with sustainable construction and life-cycle value assessment.
- Carbon value management and environmental performance evaluation.
- Application of Building Information Modelling (BIM) to support VM workshops and decision-making.
- Artificial intelligence and machine learning techniques for value optimisation and decision support.

- Digital twins and data-driven approaches for real-time value assessment.
- Integration of VM with risk management and resilience frameworks.

These emerging areas demonstrate that the future development of VM is likely to extend beyond traditional cost-function optimisation toward supporting broader sustainability, digital transformation, and strategic project management objectives.

5. CONCLUSIONS

This study presents a Scientometric analysis of construction VM research based on 400 publications published between 2001 and 2026. The findings reveal a significant increase in research interest over the past decade, highlighting the growing importance of value-based approaches in construction management. The analysis identified project performance improvement, value optimisation, and implementation-related studies as the dominant research themes, while developed countries such as the United States, the United Kingdom, China, and Australia continue to play a leading role in shaping the field.

This study contributes to the literature by mapping the intellectual structure, influential contributors, and evolution of construction VM research over a 25-year period. The findings provide researchers and practitioners with valuable insights into current research priorities and emerging directions. In particular, sustainability, carbon value assessment, BIM, artificial intelligence, machine learning, and digital technologies appear to be promising areas for future investigation.

The study is limited by its reliance on English-language publications indexed in the Web of Science database and citation-based Scientometric techniques. Future research could incorporate additional databases and complementary review methods to provide broader thematic insights. Overall, this study offers a comprehensive overview of the development and emerging directions of construction VM research and provides a foundation for future value-based construction research.

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