

## Review Article

# Review of Culture in Construction Projects: Status Quo and Challenges

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Culture in construction has recently received a lot of attention from practitioners and academia. The purpose of this study is to capture the map of culture in construction projects to provide the picture of culture in construction. This article conducted a two-stage review of culture in construction, including Scientometric analysis and content analysis. First, we carried out Scientometric analysis of 173 relevant articles (from 12 journals) to visualize the literature of culture in construction from 1989 to 2022. The results indicated that the high-published contributors of countries were Peoples R China, Australia, the USA, England, and Singapore. We also identified the critical institutions, high cited articles, keyword co-occurrence, cluster analysis, as well as the research interests and methods in this field. Moreover, we discussed the primary topics of culture in construction based on content analysis. More attention had been paid to the definition and measurement of culture in construction. The measurement of culture remains a promising and controversial area in the future due to the debate over quantitative or qualitative methods. Most of the current research studies use quantitative methods such as questionnaire surveys to explore culture in construction. In addition, scholars have called for exploring the formation of culture in construction which will help managers develop an appropriate culture within the project organisation, particularly in mega projects. This study offers the current state of culture in construction, as well as future trends that promote interdisciplinary collaboration in this area.

## 1. Introduction

Culture has been proved to be the key factor facilitating the development of the construction industry [1]. Over the last decades, culture in construction projects has gained significant momentum in practice and theory. Plenty of mega projects and international projects also provide opportunities to cultural practice. Culture as a common area in all construction projects permeates every construction project. For instance, you can see the manifestations of project culture, national culture, safety culture, and quality culture in one project [2]. This paper conducts a comprehensive review of culture issues in construction such as national culture, organizational culture, project culture, and safety culture.

Culture in construction plays a significant role in theoretical research and practice. Many researchers have pointed out that culture in construction is related to project

performance such as schedule, safety management, and project quality. For instance, David compared the culture in the USA and India and found that the USA had a lower percentage of project schedule delays compared to India [3]. In project practice, stakeholders cooperate without understanding cultural differences, which can easily lead to culture conflicts [4]. Culture in construction is important for the cooperation of project participants.

In construction projects, the current research on culture mainly focuses on organizational culture, national culture, cross-culture, project management culture, and project culture [5]. So far, there have been hundreds of articles on culture in construction projects. However, these studies have not reached a consensus on the research paradigm [6]. For instance, Zuo proposed the project culture framework including integration, cooperation, goal-oriented, flexible, and people oriented in Australia construction while Ankrah investigated the project culture framework in the UK and

these dimensions are workforce orientation, performance orientation, team orientation, client orientation, and project orientation [5, 7]. The definition of culture is complex. Culture is primarily treated as behavior, underlying assumptions, the general attitude to projects, and values. Moreover, those studies in this field are influenced by their research purpose, particularly research backgrounds. For instance, many authors from different discipline areas such as psychology, management theory, sociology, and project management explore the nature of cultural. It is necessary to conduct a systematic research map to help future researchers to better understand the culture in construction projects.

Since Simon blamed on culture in construction projects for the adversarial and antagonistic aspects, there has been a series of studies in this field [8]. Barthorpe analyzed the articles with the theme of culture from three perspectives including history and sociology, organisation and corporation, and construction industry [9]. One of the earlier reviews in culture is by HENRIE in a study of project management from the cultural perspective [10]. This focused on project management books and two journals including International Journal Project Management and Project Management Journal from 1993 to 2003. Ankras reviewed the culture of construction management and suggested that culture comprised the practices peculiar to a group and the underlying values shaping them [11]. Zuo outlined the culture in construction and emphasized investigating culture issues at the project level through a literature review and proposed project culture conceptual framework [5]. Meanwhile, Samaraweera analyzed the nature of project culture via a literature synthesis and discussed what culture in construction is and how project culture came into being [12]. Both of their reviews are based on the theoretical descriptions.

Although these reviews are very valuable for scholars to understand the topic of culture in construction projects like the definition and conceptual framework of culture in construction, the above reviews have limitations that (1) previous studies only focus on a specific topic within culture issues such as what culture in construction is. A comprehensive review is a lack which is important to capture the picture of culture and (2) the above reviews mainly use qualitative research methods to analyze the existing literature. Qualitative research is based on a small, carefully selected sample of individuals without statistical significance. It explores problem in the sole situation. While the purpose of quantitative researchers is to discover general laws of cultural phenomena and to make general explanations of culture in various environments. As Chen advocated, Scientometric working as a quantitative method in the review was useful in presenting a comprehensive research in one field and scientifically provided the future research direction [13]. This paper conducted a two-stage review of culture in construction by combining Scientometric and content analysis.

Given the purpose of this study is to use Scientometric and content analysis to dig deeper into the different characteristics of the research field. We adopted a comprehensive review to identify the status quo and challenge of culture in

the construction industry from 1989 to 2022 with the assistance of Scientometric and content analysis method. 3 questions will be addressed in this paper:

What was the coverage of culture in construction published in leading journals of construction management and megaproject management between 1989 and 2022?

Who did contribute to culture in construction from perspectives of country, institution, or regions during this period?

What were the main research methods, research interests, and the trend of culture in construction?

## 2. Data Collection and Research Methods

*2.1. Data Collection.* To figure out the state of research of culture in construction projects, we select well-known construction management journals and megaproject management academic level journals through journal ranking results [14, 15]. The databases of Web of Science and Scopus are the largest searching engines for peer-review literature [15]. Given the objectives of this paper, a total of 12 journals were found from the database of Web of Science and Scopus including Building Research and Information, Construction Innovation, Construction Management and Economics, Engineering, Construction and Architectural Management, International Journal of Project Management, Journal of Construction Engineering and Management, International Journal of Managing Projects in Business, International Journal of Project Organisation and Management, Journal of Civil Engineering and Management, Journal of Management in Engineering, Leadership and Management in Engineering, and Project Management Journal.

In the selected journals, articles related to culture were retrieved by theme. Due to the diversity of the culture term in research, the string search was adopted by "TS = ("culture\*" OR "value\*" OR "belief\*")" [10, 16]. The term "culture\*" stands for the diverse forms of culture, such as "culture" and "cultures" as well as "value\*" and "belief\*." Journal articles and English-language were set during retrieval and a total of 246 articles were retrieved between 1989 and 2022. To filter irrelevant articles, we further assess abstracts and full texts to ensure articles are relevant to our research question, such as Zhang published an article titled "How to foster contractors' cooperative behavior in the Chinese construction industry: Direct and interaction effects of power and contract" in International Journal of Project Management, which mentioned culture in abstract, but the theme of this article is about cooperative behavior [17]. Then, we excluded the article. Finally, a total of 173 articles were selected for further analysis from 1989 to 2022.

*2.2. Research Methods.* Based on Anupana's article "a bibliometric and content analysis of sustainable development" [18], a two-stage method combining Scientometric analysis and content analysis was conducted to systematically and objectively review culture in construction. Scientometric analysis is a quantitative technology for analyzing a specific field [19]. On the basis of the knowledge domain,

scientometric analysis offers the scientific development process and structure relationship [20]. Given that co-occurrence analysis and cluster analysis are advantages of using Citespace. This paper uses CiteSpace software to conduct Scientometric analysis to analyze the culture in construction. Then, a content analysis was conducted to analyze the research methods and research interests of culture in construction. Content analysis is a method to deal with fragmented knowledge and it provides an inductive analysis for unfamiliar phenomena [21]. Given the research questions of this paper, we adopted scientometric and content analysis to map the culture in construction as shown in Figure 1.

Scientometric analysis: we adopted Citespace for scientometric analysis. The scientometric analysis covered: (1) countries and institutes; (2) keyword co-occurrence and timezone view of keyword co-occurrence; and (3) cluster analysis

Content analysis: the procedure of content analysis included: (1) developing research questions and collecting material for content analysis; (2) formation of material categories based on full-text reading and material form characteristics; (3) defining categories, selecting related articles and analysis categories; and (4) final processing and inspection of the material according to the categories.

### 3. Results and Discussion

*3.1. Published Journals and the Top 10 Cited Articles.* There are 173 papers addressing culture topics or associated issues in the 12 selected journals from 1989 to 2022. Three journals published the most culture articles in the period including International Journal of Project Management (IJPM, 41), Journal of Construction Engineering and Management (JCEM, 31), and Engineering, Construction Architectural Management (ECAM, 32). The three journals are the critical source of culture in construction. In the three journals, the published articles about culture in construction account for 60.12% of the whole chosen papers and the number of IJPM published is the most, which accounts for 23.70% of the total number of papers published in the 12 journals. PMJ and JME account for 9.2% and 10.4%, respectively, which occupy the second. The remaining 29.28% of the selected articles were published in the other seven journals. Figure 2 presents the final selected numbers of each journal.

Table 1 shows the most highly cited articles of culture in construction from 1989 to 2022 of the 12 selected journals. These high cited articles reveal the interesting patterns of culture in construction.

*3.2. Scientometric Analysis.* This section presents a visual analysis of a culture in construction by Scientometric. In the network below, purple indicates links that occurred between 1989 and 1994, and yellow one means links that occurred from 2019 to 2022. Others manifest the time from past to present [32], which are shown in Figure 3 in detail.

*3.2.1. Contributions of Countries and Institutions to Culture in Construction.* The contributions of countries and institutions were analyzed to obtain a collective view of the status quo of culture in a particular location. The chosen 173 papers covered 30 countries and 63 links, which mean frequent collaborations and weak link intensities. And the co-occurrence score of most countries is 2 indicating unstable collaboration, which just meets the basic requirement of analysis [33].

As shown in Figure 4, the larger the size of node, the greater contributions the country has made or the more articles it has published. The top five countries are Peoples R China (47 articles, 27.16%), Australia (45 articles, 26.01%), the USA (27 articles, 15.61%), England (17 articles, 9.83%), and Singapore (11 articles, 6.36%). These are the main contributors to culture in construction, accounting for 84.97%. Although Peoples R China has contributed the most in this field, most of the contributing countries are developed. There are plenty of project practices that provide opportunities to explore culture in construction. For instance, the Belt and Road policy has spawned a series of cross-cultural cooperation projects. Most of the chosen studies were from developed and a few come from developing countries. Because there were plenty of mega projects or international projects in the developed countries which provided practical opportunities for cultural cultivation. Given the scales of the construction market all the world, it is logical and acceptable. Plenty of project practices promoted the theory development of culture in developed countries [4]. This finding was in line with Ankrah's research (2007) that culture in construction was a global phenomenon [7]. In addition, although the USA is not the country with the most publications, its citation burst is 4.09 as shown in Figure 5, while the others do not have. It shows that the USA has made significant contributions in this field. Using node centrality as a metric, Australia has played a key role in this field, and the centrality value for Australia is 0.38.

As for research institutions in this area, the most contributors are The National University of Singapore (7 articles, ranking first among all the identified research institutions), Tianjin University (6 articles), The University of New South Wales (5 articles), Western Sydney University (5 articles), Hong Kong Polytech University (5 articles), and Tsinghua University (5 articles). Among the most productive institutions, they come from Singapore (The National University of Singapore), China (Tianjin University, Hong Kong Polytech University, Tsinghua University), and Australia (The University of New South Wales, Western Sydney University). These are the top 6 institutions that have played essential roles in culture in construction. Comparing to the total number of articles in culture-related research, the number of articles in the 6 top institutions is minimal which reflects the decentralization of culture in current construction projects and fails to systematically study culture.

*3.2.2. Keyword Co-Occurrence.* The frequency analysis of keywords marked by the author of the paper provides us the research theme that is focused on in one field [13]. An analysis

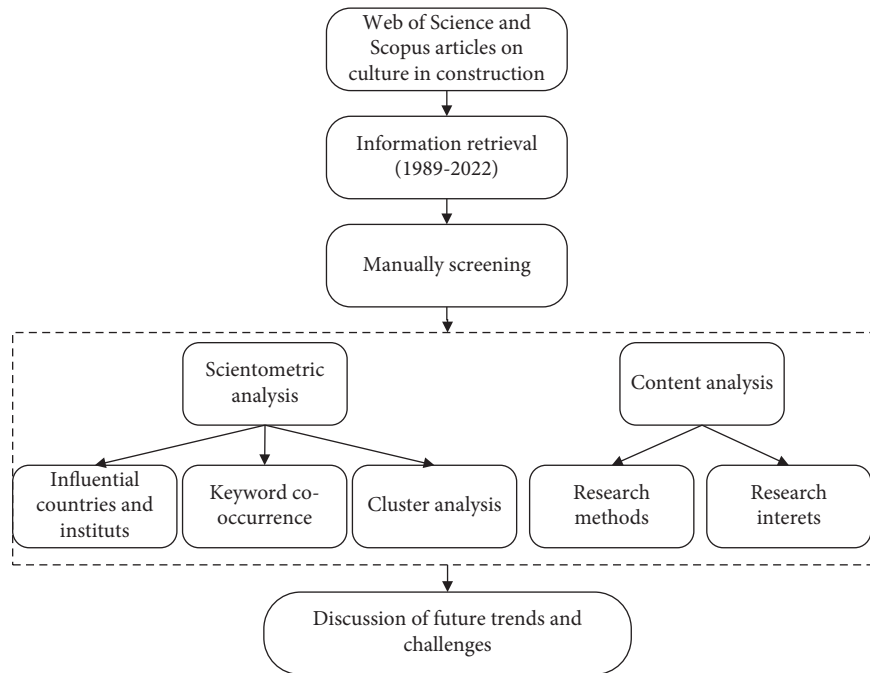


FIGURE 1: Research framework.

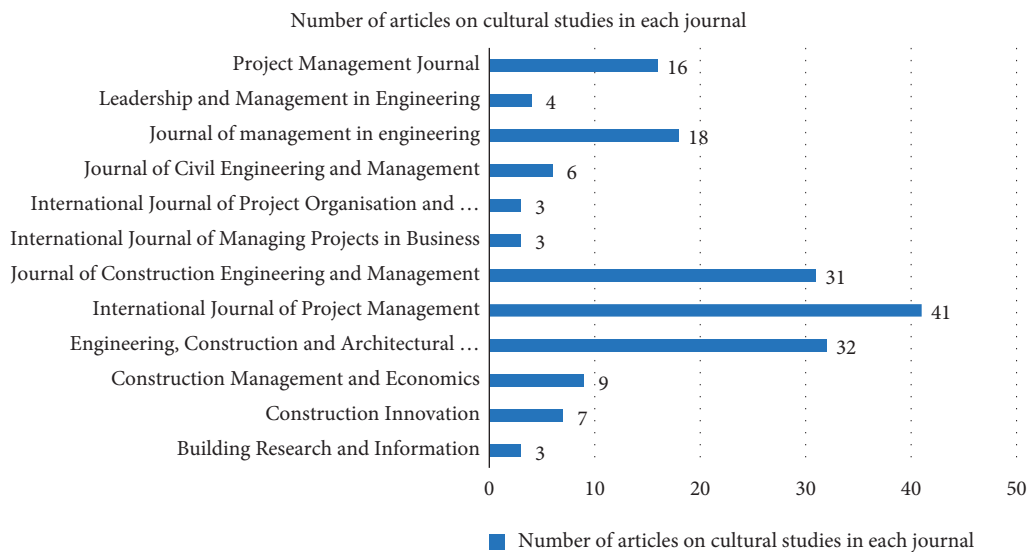


FIGURE 2: Number of articles published in top international periodicals on culture from 1989 to 2022.

of all keywords was conducted by frequency. The keyword co-occurrence network includes 173 nodes and 327 links, as shown in Figure 6. The size of keywords is proportional to the frequency of occurrence. Figure 6 presents the keywords which appear more than 10 times in the 173 papers in this study. As shown in Figure 6, the keywords that appear frequently are construction industry (133 times), project management (110 times), culture (54 times), organisational culture (47 times), survey (38 times), construction (38 times), societies and institution (37), construction project (28), accident prevention (23 times), manager (22), human resource management (21), China (21), contractor (20 times), questionnaire survey (19), safety (18), safety culture (18), industrial

management (17 times), management (17 times), occupational risk (16 times), Hong Kong (16 times), professional aspect (15 times), civil engineering (15 times), construction management (14 times), design/methodology/approach (14 times), social aspect (13 times), organisational framework (13 times), risk management (13 times), communication (12 times), research (12 times), strategic planning (12 times), employment (12 times), safety performance (11 times), national culture (11 times), Eurasia (11 times), decision making (11 times), construction site (10 times), sustainable development (10 times), innovation times (10 times), and knowledge management (10 times). It is obvious that there are many keywords having the same meaning such as

TABLE 1: The top 10 cited articles of culture in construction in 1989–2022.

Article	Author and year	Journal	Citations
Knowledge transfer in project-based organizations: an organizational culture perspective [22]	Ajmal et al. 2008	Project Management Journal	171
Project success: a cultural framework [23]	Kendra et al. 2009	Project Management Journal	105
The culture of the industry and the culture of research [24]	Seymour et al. 1995	Construction Management and Economics	98
Scorecard approach to benchmarking organizational safety culture in construction [25]	Mohamed et al. 2003	Journal of Construction Engineering and Management	97
Managing cross-cultural communication in multicultural construction project teams: The case of Kenya and the UK [26]	Ochieng et al. 2010	International Journal of Project Management	88
Developing a model of construction safety culture [27]	Choudhry et al. 2007	Journal of Management in Engineering	86
The role of organizational culture in motivating innovative behavior in construction firms [28]	Hartmann et al. 2006	Construction Innovation	85
The role of project management maturity and organizational culture in perceived performance [29]	Yazici et al. 2009	Project Management Journal	83
Emergence and role of cultural boundary spanners in global engineering project networks [30]	Di Marco et al. 2010	Journal of Management in Engineering	80
Planning for claims: An ethnography of industry culture [31]	Rooke et al. 2004	Construction Management and Economics	79

Note. Data form google scholar, 2022.



FIGURE 3: Color interpretation.

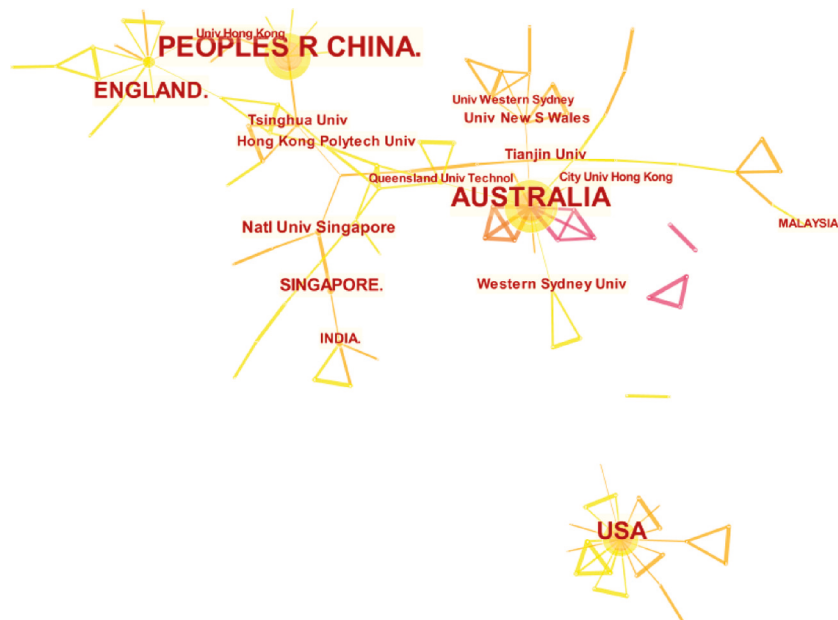


FIGURE 4: Network of countries and institutions: 1989–2022.

“construction industry,” “construction,” and “construction project.” These words make little contribution to this study and are classified as stop-words [34].

Since the journals are limited to construction project management, the keyword “construction industry” has the highest occurrence frequency of 133 times, and the keyword “project management” has 110 times as the second one in frequency ranking. In addition, culture is regarded as project

management objectives such as cost, quality, and time in Gareis and Huumann’s study [35]. Keywords “culture (54 times)” and “organisational culture (47 times).”

On the basis of keywords occurring analysis, culture in construction projects can be grouped into 4 types including analysis of different levels of culture, analysis of cultural research methods, the cross-culture of region analysis, and analysis of antecedents and consequences of culture. For

Top 1 Countries with the Strongest Citation Bursts



FIGURE 5: Top 1 countries with the strongest citation bursts.

example, in the section on different levels of culture, keywords comprise nation, organization, and manager (personal). As for the research method, survey as a keyword appears more than 38 times. Further, the keywords of cross-culture of region analysis include China, Hong Kong, and Eurasia. The keywords in the analysis of antecedents and consequences of culture include societies and institution, organisational framework, communication, and knowledge management.

In order to further analyze the evolution path and knowledge map in this field, this paper conducts a dynamic analysis of keywords by timezone, which presents the change from 1989 to 2022 in Figure 6. In Figure 7, keywords are chosen by a frequency that occurs more than 2 times and then the chosen keywords are present by the first occurring years. As shown in Figure 6, scholars studied culture from diversity perspectives between 1999 and 2009. There were a total number of 32 research topics referring to culture between 1999 and 2004, while the research topics reaching to the maximum of 80 in 2004–2009. Nevertheless, the study of culture is still a flash in the pan. And there are few researchers who insist on studying culture all the time like Zuo, Ankrah. Figure 6 shows the overall research evolution of culture in construction from 1989 to 2022.

**3.2.3. Cluster Analysis.** Cluster analysis is usually conducted to identify the critical and significant themes and interrelationships [33]. In this section, cluster analysis is adopted to classify the group or cluster of literature on culture in construction. The Log-Likelihood Ratio (LLR) is the statistical criterion in this paper, which contributes to high similarity within clusters and low similarity between clusters. Figure 8 shows the 9 highlighted clusters in this field by keywords. In cluster analysis, mean silhouette represents similarity, and modularity describes the importance of cluster results. When both scores are greater than 0.5, the overall cluster results are meaningful and the cluster members are similar in some ways. As shown in Figure 8, Modularity  $Q=0.8053$ , and Mean silhouette  $=0.9316$ , indicating that the results of cluster analysis are very important and there are similarity of cluster members in each cluster. The largest clusters are clusters #0 and #1. #0 is named Monte Carlo method, which illustrates the widely used method in this field. #1 is named safety climate which means that most studies on culture in construction cover the word “safety.” Because culture is seen as one of the critical factors affecting safety. For instance, culture influences safety management. The overlaps of the clusters in Figure 8 indicate that the keywords are associated with these clusters simultaneously. Such as the overlapped between #2 (safety behavior) and #1 (safety climate) includes a keyword like safety management.

### 3.3. Content Analysis

#### 3.3.1. Categories of Research Methods in the Selected Articles.

The chosen studies of culture in construction mainly covered 2 research paradigms, namely, the function paradigm and the nonfunction paradigm. The function paradigm tends to adopt quantitative methods like survey questionnaire to explore culture while the nonfunction paradigm prefers to study culture through qualitative methods [6, 36]. This is about whether culture is considered a variable or a root metaphor. The variable is regarded as something an organization has while the root metaphor is considered as something an organization is. The function paradigm describes culture by dimensions with considering culture as a variable of organizations. The non-function paradigm treat culture as organization itself. To examine culture in construction, they emphasize on construct project contexts and focus on the informality. Most of the chosen articles adopted quantitative methods in the studies of culture in construction industry. Mixed method also received the higher ranking than qualitative methods. The following showed the primary methods in this area:

- (1) Questionnaire survey (e.g., Yvonne Brunetto et al. 2014) [37]
- (2) Interview (e.g., Linda S. Henderson et al. 2018) [38]
- (3) Case study (e.g., Rafiq M. Choudhry et al. 2007) [39]
- (4) The partial least squares-structural equation modeling (PLS-SEM) (e.g., Fred Lijauco et al. 2020) [40]
- (5) Ground theory (e.g., Adriane Domingues Quelhas et al. 2019; Simon Collyer, 2017) [41, 42]

In general, qualitative methods are often used when studying what culture is and how to measure it. Quantitative methods and mixed methods are usually used when studying the relationship between culture and other variables such as project performance. Among the mixed methods, a variety of qualitative methods of triangulation are often used like interviews, questionnaires, and content analysis, to explore the essence of the case.

#### 3.3.2. Research Interests of Culture in Construction Industry.

There are increasingly publications on culture in construction research from identifying culture to the influence of culture on performance. Culture in construction covers 3 topics by a systematic review including culture itself in construction, the relationship between culture and project outcomes, and the formation of culture in construction.

(1) *Culture Itself in Construction.* The definition of culture and the measurement of culture received the highest attention. The definition of culture has been controversial so far. Generally, culture is defined as the whole of beliefs, customs, habits, attitudes toward project, project values, project-related artifacts, ritual, patterns of behaviors, assumptions, and others [43–46]. Culture in construction is complex and has many manifestations of itself. When it comes to cultural measurement, it is mainly divided into two

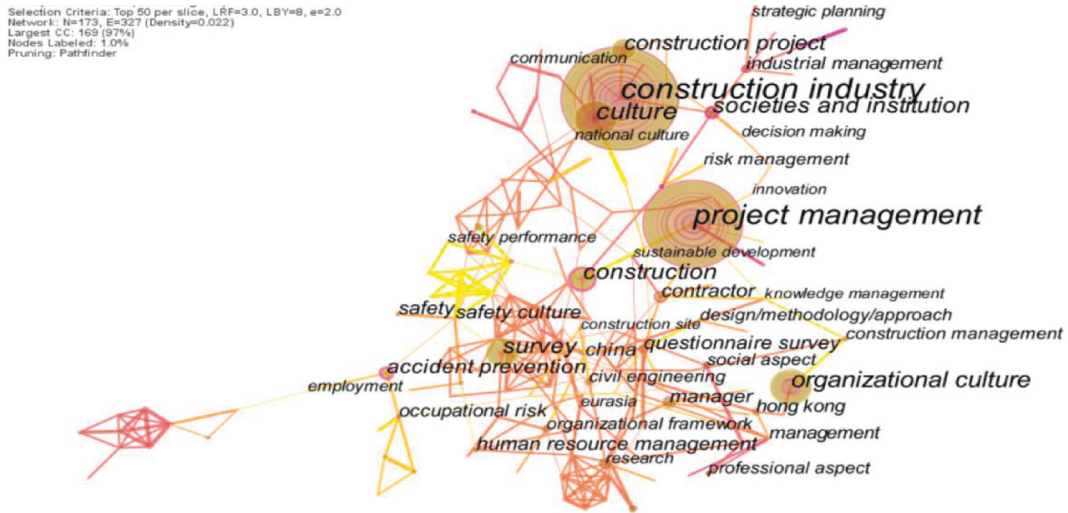


FIGURE 6: Top keyword occurring more than ten times: 1989–2022.



FIGURE 7: A timezone view of keywords occurring more than twice: 1989–2022.

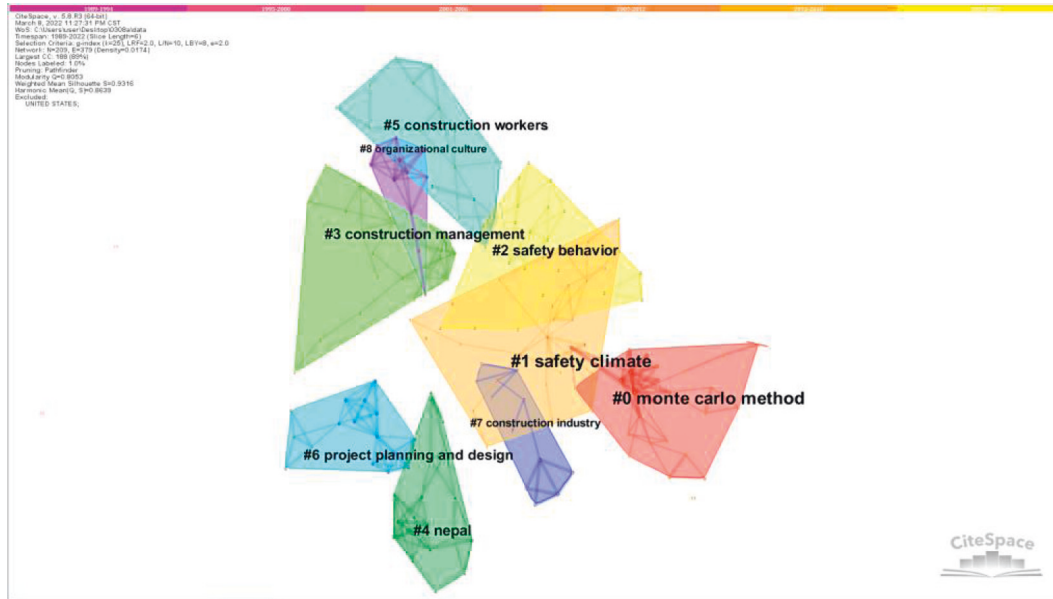


FIGURE 8: Cluster analysis of culture in construction: 1989–2022.

categories in the cultural research of construction projects consisting of the function paradigm and the non-function paradigm [47, 48]. On one hand, culture is treated as a variable of organization in the function paradigm. This view emphasizes culture can be measured by several dimensions such as integration, goal oriented, and so on [49]. On the other hand, the non-function paradigm offers a differing view of culture in which culture as a root metaphor is organization itself on the basis of anthropology and sociology theories. Organization manifests culture by forms or artifacts and can express the culture conscious of human in organization [50]. In the existing studies, this paradigm argues that several dimensions of culture are too simple to explain the culture nature and emphasis on understanding culture via informal artifacts in the organization [51]. Table 2 shows the common culture models in construction.

(2) *The Relationship between Culture and Project Outcomes.* Most researchers explore the relationship between culture and project outcomes by empirical studies. And there are many empirical studies on culture in construction based on a quantitative nature. These studies are usually conducted to examine the relationship between culture and management, project performance outcomes, project success, project team behavior, Project Knowledge Sharing innovation, and so on [58–62]. Existing studies have investigated the impact of culture on project performance from different levels such as national culture, organizational culture, project culture, team culture, and safety culture [49]. Significantly, culture model of the manufacturing industry is usually used for the relationship research in the construction industry between culture and project outcomes.

(3) *The Formation of Culture in Construction.* A few researchers tried to uncover the development of culture in construction. Kumaraswamy proposed a framework for cultural formation and the origin of culture including

organizational culture, operational culture, individual culture, and professional culture [63]. Other scholars have studied several factors that influence the formation of culture including project manager and project characteristics. For instance, Marrewijk explored how the project manager effecting the development of project culture in Environ Megaproject [57]. During the project life cycle, project culture was divided into two culture episodes due to the different management styles of project managers. Further, project features were related to the development of culture in construction including project size, the technology complexity, the main project participants, project location, and variations [64]. Moreover, project history and prior working relationships were proved to be the critical factors affecting culture [65]. Although a few researchers have paid attention to the driving factors of culture in construction, the types of factors and the degree of impacts need to be further verified in the future. For example, there is a debate about whether the procurement approach adopted affects the culture in a project-based construction.

#### 4. Challenges and Implications for Future Research

Based on the Scientometric and content analysis, the challenges and implications of culture in construction were delineated in this section.

*4.1. Challenges.* Despite the increasing emphasis on culture in construction, there are still three main challenges in this field: (i) the simplification of culture; (ii) multilevel research; and (iii) the dynamics of culture.

First, culture in construction manifests itself in many aspects such as the pattern of behaviors, rituals, slogans, values, and underlying assumptions. Although culture itself in construction attracts attention from researchers based on



TABLE 2: The measurement of culture in construction.

Paradigm		Perspectives	Representative results
The function	Culture as variable	Organizational culture	Clan culture, market culture, adhocracy culture, hierarchy culture [3] Adaptability, mission, consistency, involvement [52] The constructive culture, the defensive culture [53]
		National culture	Individualism/collectivism, power distance, long-term/short-term orientation, uncertainty avoidance, masculinity/femininity [54]
		Project culture	Integration, cooperation, goal-oriented, flexible and people oriented [55] Workforce orientation, performance orientation, team orientations, client orientation and project orientation [7]
		Safety culture	The person (safety climate), the behavior (safe or unsafe), <i>d</i> the environment/situation (safety management systems) [56]
		The non-function	Culture as a root metaphor

the content analysis, the definition of culture in construction is diverse. Researchers try to define culture in construction via its manifestations. Most studies on culture in construction are too simplistic and fragmented to explore it, which rely heavily on dimensions models of culture.

Second, the extent research on relationships between culture and outcomes in construction is at a single level. Based on Scientometric analysis, it is clear that culture affects project outcomes such as innovation, safety management, and attitudes of participants. However, there are no literature examining culture effects across levels. For example, project organizational culture and citizenship behaviors were positively related at the individual level [66]. But what the relationship is at the organizational levels has not been seen.

Finally, contrary to the traditional static view of culture, culture is not frozen but interacts with the specific environment. There are relatively few scholars who focus on the dynamics of culture based on the content analysis. In line with Van's research, culture in construction develops during the project life cycle. Current research shows that culture in construction is influenced by factors such as project managers, project complexity, and participants [57, 64]. At present, many researchers such as Ankrah [64] have explored the factors that influence culture of project organizations, but how and to what extent they works are still unknown. The processes by which these factors affect culture in construction remain undisclosed.

**4.2. Implications.** The definition of culture in construct needs to be broadened in the future. On one hand, the existing definitions of culture in construction mainly come from the definition of culture in the permanent organization in the manufacturing industry, ignoring the characteristics of the construction industry. On the other hand, culture in construction is usually defined as values or artifacts. It is time to broaden the definition via other theories and even interdisciplinary. For example, based on cognitive theory in psychology, schemas and norms are proposed to define culture in construction.

The measurements of culture in construction needs to be boost. First, research on culture prediction has made great progress in the past 20 years. Much research from the chosen literature centered on the culture-outcome relationship in construction such as delay in construction, project team behaviors, inter-project knowledge sharing, and so on. However, there has been very little improvement in the measuring and diagnosing of culture in construction. Culture in construction has changed with the times and others. The frameworks of culture in construction need to be advanced. Sadly, few scholars have attempted to explore novel dimensions of culture in construction. In the existing literature, the models of culture in construction have stalled, and it is questionable whether they should continue to be used in the future. Second, it is urgent to combine multiple methods to explore and measure culture in construction. In the previous research, quantitative methods like survey mostly used to detect culture in construction while a few scholars prefer qualitative methods like interviews to explore it. As we know, culture in construction is complex. We need to focus more attention on approaches combing quantitative and qualitative methods and the primary data.

## 5. Conclusions

Given the confrontational disputes and poor outcomes in construction industry, it is not surprising that more scholars focused on investigating culture in construction. Culture in construction draws extensive attention from managers and researchers. Culture experienced a fast development no matter in temporary project organizations or permanent organizations. As a driver of project success, culture will develop rapidly as well in construction. The present study conducted a two-stage review of culture in construction. A total of 173 articles relating culture in construction were analyzed by Scientometric and content analysis, which were published in the 12 leading journals in construction area from 1989 to 2022.

In the first stage, we conducted Scientometric analysis. The results revealed that the top 3 journals which publish the most articles about culture in construction are IJPM (41),

JCEM (31), and ECAM (32) during 1989–2022. Five countries contributed the most in this area, including Peoples R China, Australia, the USA, England, and Singapore. Through the analysis of keywords, it revealed that the research theme is the organizational culture. And there were 9 highlighted clusters in this field.

Subsequently, content analysis was adopted in the second stage. The research interests and methods of culture in construction were analyzed. The results indicated that there are mainly about 3 subareas including culture itself in construction, the relationship between culture and project outcomes, and the formation of culture in construction. The subarea of culture itself in construction is the hotpot all the time and makes a contribution to develop an appropriate culture with the organization. Scholars have proved through empirical research that culture has a direct and indirect influence on project outcomes. Many managers and scholars call for more attention to explore the formation of culture in construction which is more practical and emergent. Based on the comprehensive review of culture in construction, the future trends and challenges are identified. This study provides a roadmap of culture in construction for further research in this area.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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