Received 30 June 2023
Revised 19 September 2023
27 November 2023
6 February 2024
28 February 2024
Accepted 3 March 2024

Dominant risk factors (DRFs) in construction-specific supply chains: a systematic review

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Abstract

Purpose – Due to the uniqueness of individual construction projects, identifying the dominant risk factors is needed for risk mitigation in ongoing and future projects. This study aims to identify the dominant construction supply chain risk (CSCR) factors, based on studies conducted between 2002 and 2022.

Design/methodology/approach – The study adopts the preferred reporting items for systematic reviews and meta-analysis (PRISMA) procedure to identify, screen and select relevant articles in order to provide a bibliography and annotation of the prevalent risks in the supply chains. A descriptive analysis of the findings then follows.

Findings – The study's findings have highlighted the three most prevalent risks in the construction supply chain (poor communication across project teams, changes in foreign currency rate, unfavorable climate conditions) as reported in literature, that project teams need to pay closer attention to and take proactive steps to mitigate.

Research limitations/implications – Due to limitations imposed by the chosen research methodology, tools, time frame and article availability, the study was unable to examine all CSCR-related papers.

Practical implications – The results will serve as a useful roadmap for risk/supply chain managers in the construction industry to take strategically proactive steps towards allocating resources for CSCR mitigation efforts.

Social implications – Context-specific research on the impact of social and cultural risks on the construction supply chain would be beneficial, due to emerging social network risk factors and the complex socio-cultural settings.

Originality/value – There is presently no study that has reviewed extant studies to identify and compile the dominant risk factors (DRFs) associated with the supply chain of construction projects for ranking in the supply chain risk management process.

Keywords Risk, Systematic literature review, Supply chain risk, construction supply chain

Paper type Review paper

This research is part of a Ph.D. programme in Civil Engineering (Construction Engineering and Management) at Stellenbosch University. The authors wish to express gratitude to Stellenbosch University and Koforidua Technical University for the partial financial support of this Ph.D. programme.

Frontiers in Engineering and Built Environment
Vol. 4 No. 2, 2024
pp. 130-145
Emerald Publishing Limited
e-ISSN: 2634-2502
p-ISSN: 2634-2499
DOI 10.1108/FEBE-06-2023-0030

1. Introduction

Modern supply chains (SCs) have evolved to become intricate, volatile, and interdependent, driven by globalization and the demand for innovation (Behzadi *et al.*, 2020; Baryannis *et al.*, 2019). This complexity introduces heightened risks, including terrorism, economic downturns, wars, and pandemics, as is the case with the COVID-19. However, effectively managing these supply chain risks can provide organizations with a competitive advantage (Baryannis *et al.*, 2019).

Construction supply chains, especially in megaprojects, are notably complex due to diverse materials and stakeholders (Bolzan de Rezende *et al.*, 2021), involving temporary interactions and disruptions from dynamic internal and external environments (Erol *et al.*, 2020). The extremely disconnected characteristic of the construction industry makes it more difficult for organizations to detect potential threats in the SC network. The recent covid-19 epidemic exacerbated construction supply chain interruptions by critical staff and material shortages, and jobsite re-organization (Raoufi and Fayek, 2020). The supply chain concept in the construction industry has also evolved, in response to these forces. Such intricacies result in significant risks, potentially causing delays, increased costs, and project failures (Siraj and Fayek, 2019).

While several studies have explored supply chain risks in construction projects, most have focused on risk categorization (for example, Rudolf and Spinler, 2018; Zainal and Ingirige, 2018; Luo *et al.*, 2019), source identification (see Gosling *et al.*, 2016; Hwang *et al.*, 2017) or risk management. Thus, there remains a gap in the literature regarding the identification and compilation of dominant risk factors (DRFs) associated with construction project supply chains for ranking in the risk management process.

Identifying the most prevalent risk factors is crucial for implementing appropriate mitigation measures, as all construction projects share some common risk factors along their supply chains (Wuni *et al.*, 2019). Previous studies (see Malik *et al.*, 2022; Rudolf and Spinler, 2018) have demonstrated a necessity to identify those supply chain risks that are most likely to occur on construction projects. Contextually, the DRFs in this study refer to the construction project supply chain risks that have been mostly reported in research over the past 20 years.

This study aims to provide a bibliography and annotation of the DRFs in construction supply chains, providing a valuable roadmap for practitioners in the construction sector to take proactive steps toward mitigating those supply chain risks. The subsequent sections provide a description of the systematic literature review methodology, a descriptive analysis of the findings, and concludes with implications, future directions, and limitations.

2. Research methodology

The study adheres to the PRISMA guidelines (Moher *et al.*, 2009) for systematic reviews and meta-analysis. It focuses on construction-specific SCs, with the following objectives: (1) to identify the annual trends in construction supply chains risk publications; (2) to identify the journals that mostly publish the construction supply chain risk articles; (3) to identify the geographical distribution of the studies; and (4) to provide a bibliography, rank and categorize the DRFs. The pursuit of these objectives will produce information on the dominant construction supply chain risks (CSCRs) for researchers and practitioners to appreciate CSC research trends and developments and expand their knowledge in the field. As the prevalent risks in the CSC gain wider attention from practitioners and researchers, supply chain managers benefit by prioritizing strategies for mitigating those risk factors.

The SLR has been widely used in construction management research for advancing knowledge on specific topics (Darko *et al.*, 2017; Wuni *et al.*, 2019). It is valued for its rigor, replicability, and unbiased examination of existing studies, facilitating theory building using evidence from diverse literature (Tranfield *et al.*, 2003). Consistent with recent studies (see Wan *et al.*, 2020; Ekanayake *et al.*, 2021), this study adopted a methodical approach (summarized in Figure 1), to locate, retrieve, and assess the pertinent literature on CSC risks.

Two primary search engines, Scopus and Google Scholar, were used to obtain pertinent academic journals. Preceding the primary literature search, a set of keywords was employed across multiple databases including Scopus, Web of Science, ASCE Library, Taylor and Francis, Google Scholar, and Emerald Insight. The objective was to determine search engines with the utmost credibility, extensive coverage, and relevance. It was observed that several articles retrieved were accessible across various databases and libraries, yet Scopus and Google Scholar exhibited the most extensive array of articles.

Scopus was selected due to its superior functionality, user-friendly search result restriction options, and advanced features. Previous risk management reviews

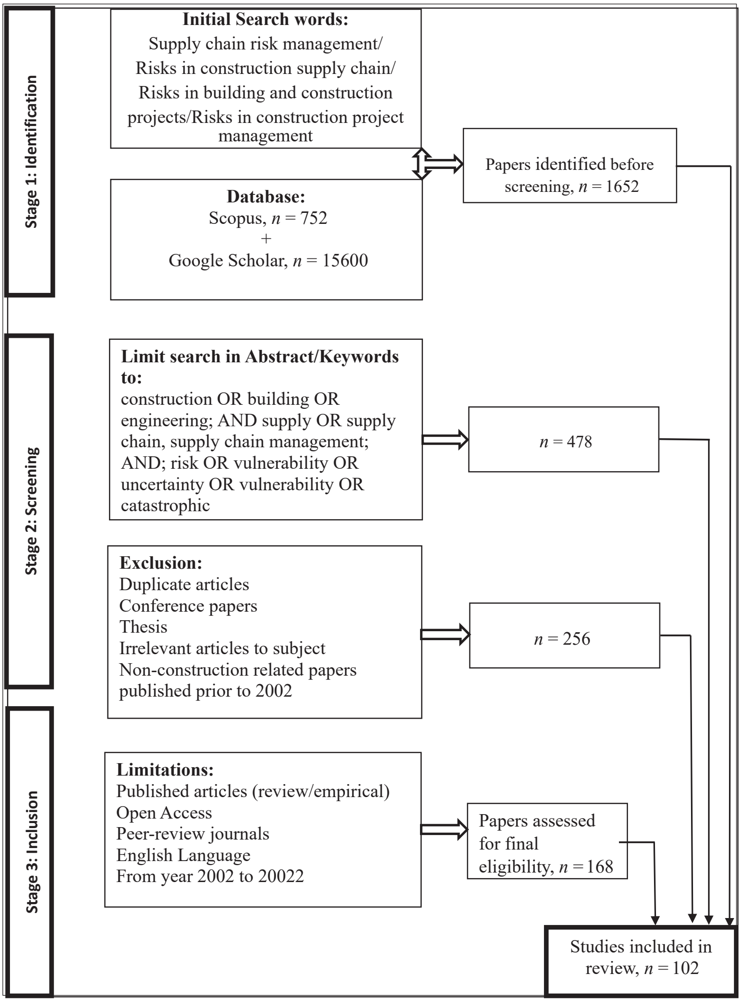

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Figure 1.
Systematic review process

(e.g. Rudolf and Spinler, 2018; Wuni *et al.*, 2019; Ekanayake *et al.*, 2021), relied on Scopus to discover relevant articles. The selection of the two databases was consistent with existing literature (e.g. Govindan and Hasanagic, 2018 relied on the Web of Science and Scopus). Generally, the selected articles are composed of both empirical studies (such as surveys and case studies) and non-empirical studies (such as literature reviews and conceptual papers). Following the selection of Scopus and Google Scholar, the most frequently used synonyms for "risk" and "supply chain" in the existing literature were determined. The initial keywords were derived from published review articles on risk management in construction (Siraj and Fayek, 2019). Subsequently, several combinations of keywords were adopted to search for articles that focus on SCRM and CSC risk. The keywords used were a combination of (construction, building, engineering) AND (supply chain, supply management, materials management) AND (risks, uncertainty, uncertainties, vulnerability, catastrophic), which should be sufficiently broad enough to avoid limiting results and to select as many articles as possible relevant to the research objectives. The search was performed in the title, abstract, and keyword interface of the databases and was completed in August 2022.

2.1 Inclusion and exclusion criteria

Wohlin (2014) is of the opinion that to make it easier for the work to be verified and replicated, an SLR needs to explicitly specify the inclusion and exclusion criteria. Therefore, the study provided the criteria for inclusion or exclusion to extract and filter articles from the Scopus and Google Scholar records. The qualifications for inclusion of an article are: (1) it is either an empirical or review article relating to risk management of CSC; (2) peer-reviewed articles were the sole document type; (3) published in the English language; (4) it specifically list/identifies risk factors in the CSC and (5) published from January 2002 to August 2022.

Based on criticism that conference papers lack strict peer review, they were excluded. Although this raises the possibility of publication bias, it is believed that the focus on peer-reviewed academic articles will ensure the quality, reliability, and relevance of the study (Bastas and Liyanage, 2018). The authors evaluated the titles, abstracts, and keywords of 1,652 records for preliminary consideration according to the outlined metrics. This quick filtering procedure yielded 478 potential articles which were further reduced to 256 by a second screening. Following an assessment of the full-text, 102 papers were included. Articles which only broadly enumerated risk categories instead of the specific risk factors were excluded from the final review. Figure 1 shows a flowchart of the procedure of article filtering.

3. Review findings and discussions

This section presents the results obtained through the sampling strategy as outlined in the "Research Methodology" section.

3.1 Annual trend of publications on CSCRs

Figure 2 denotes the number of yearly publications on the subject matter researched in this study, which spanned from 2002 to August 2022. On the vertical axis, the results in Figure 2 are ordered according to the number of papers, and not according to the year of publication. The objective of the timespan analysis is to assess the yearly progress of CSCR research. Generally, the number of yearly publications shows a somewhat erratic trend throughout the study period without any indication of published articles on the subject matter in any of the selected journals in the year 2021. The absence of any articles in 2021 can probably be attributed to the anxiety brought on by the COVID-19 pandemic and the focus of the world on looking for solutions to the global pandemic. However, the number of yearly publications saw

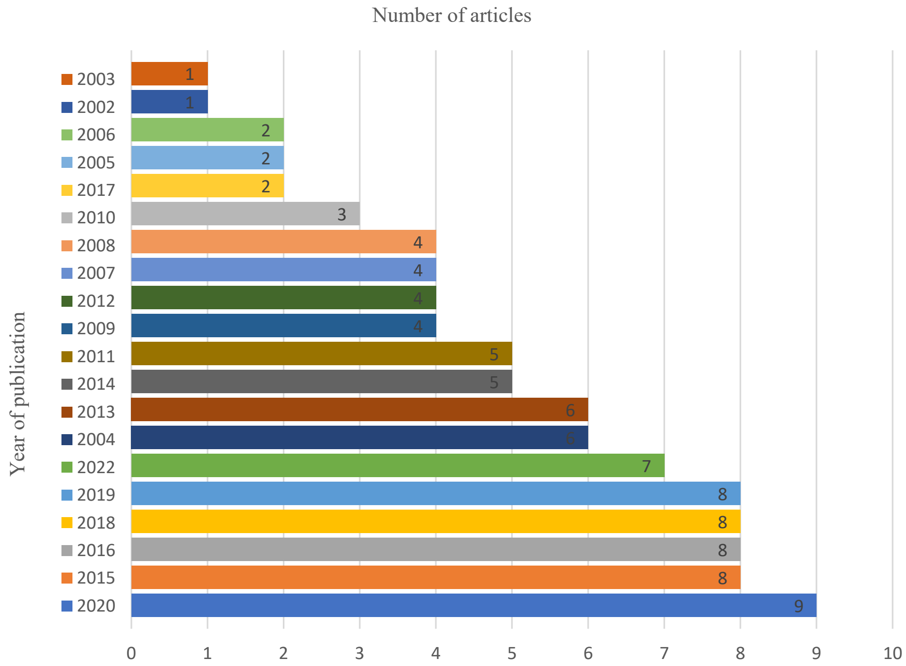


Figure 2. Yearly distribution of publications

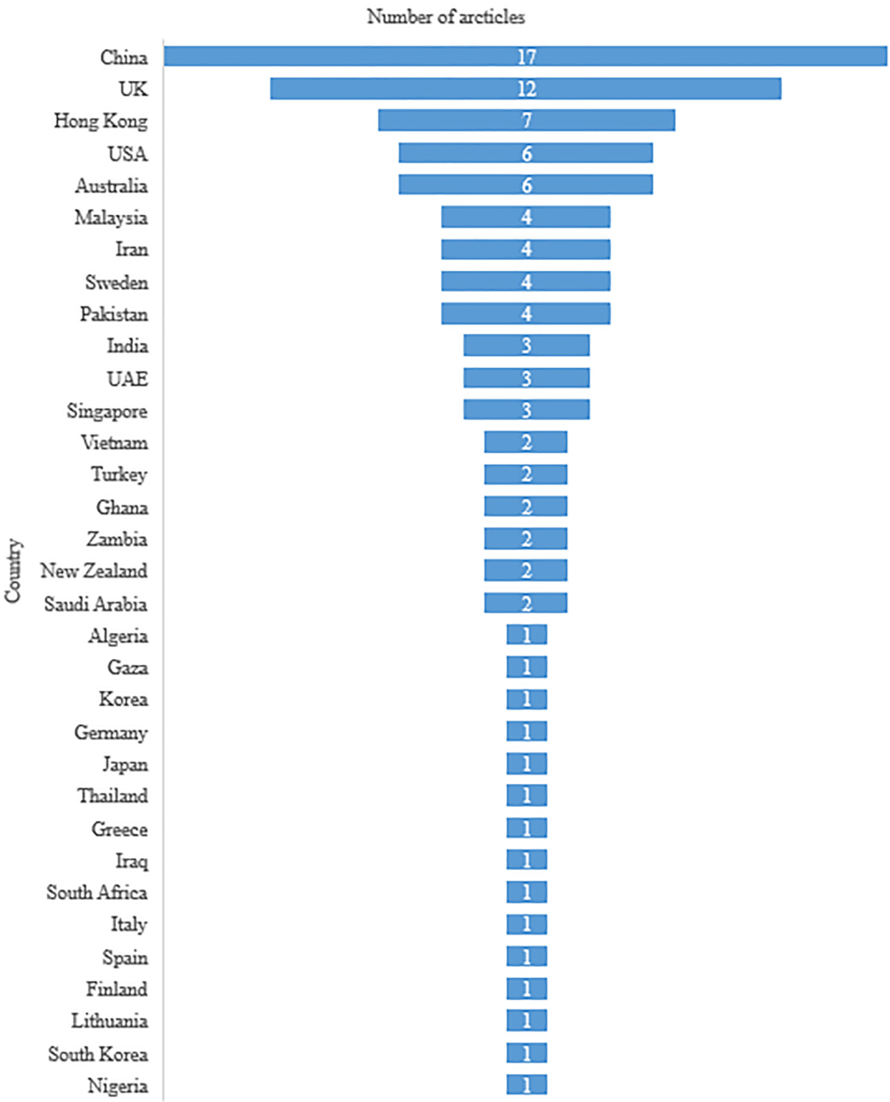
Source(s): Figure by authors

a steady increase from 2002 to 2022, the figures ranging from 1 each in 2002 and 2003 to 9 in 2020. It important to note that 7 published articles had been reported in just a part of 2022. This gives an indication that the numbers could exceed the number of articles recorded in 2020. This further affirms the observation that studies on the subject have seen a steady increase over the years. The years 2005, 2006 and 2017 each recorded 2 publications, while the years 2010 recorded 3 articles each in the period. Also, in,2007,2008, 2009, and 2012, each year had four articles, but in 2011 and 2014, there were five papers observed. In 2004 and 2013, a relatively higher number of 6 articles were published on the risk of construction supply chains, with an increase to 8 articles in 2015, 2016, 2018 and 2019. In fact, this shows a continual increase in interest in CSCR research.

The highest number of publications (9) was reported in 2020, but the 7 articles reported up to August 2022 gives an indication that the final numbers could exceed that of 2020. Therefore, it is noteworthy to state that the interest is increasing in CSCR-related research studies, especially in the latter part of the past 2 decades. These high numbers point to the importance that researchers are attaching to the role and importance of properly identifying the key risk factors in the supply chain to develop appropriate management strategies. As depicted in Figure 2, more than 67% of the outputs reviewed were published in the last decade (2012–2022). This shows that the significance of SCRs in the construction industry has recently become apparent to researchers. This trajectory implies a growing attempt to identify and comprehend the key risks associated with CSC, thus emphasizing the significance and necessity of this research. The outcomes concur with the research results by Bevilacqua *et al.* (2018) and Ekanayake *et al.* (2020), who said that research on the concept of SCR has soared in the past few decades, and thus reaffirms the importance of risk identification in the supply chain.

3.2 Geographical dispersion of research articles on CSCRs

Figure 3 shows the geographic (country) spread of the selected extant articles for the study over the last 20 years (January 2002–August 2022). The identified studies spread across five different continents, i.e. Africa, Asia, Australia/Oceania, Europe, and North America. Most of the studies were conducted in Asia (e.g. China, Gaza, Hong Kong, India, Iran, Japan, Korea, Malaysia, Singapore, Thailand, Pakistan, Saudi Arabia, South Korea, Turkey, UAE, and Vietnam), with China leading in the number of CSCR in the selected articles published in the past 2 decades. The majority (57) of the papers (representing 58%), were published in Asia, followed by Europe (22), Australia (8), the Americas (6), and Africa (7). Out of the 33 countries



Source(s): Figure by authors

Figure 3. Geographical distribution of articles

that made research contributions on the subject matter over the stated period, China had the highest number (17) of publications, followed by the UK (12) publications, Hong Kong (7), the USA and Australia, each accounting for (6) publications. During the same period, Malaysia, Iran, Sweden and Pakistan, each had four articles published about CSCRs, while India, the United Arab Emirates, Singapore each had three articles.

These findings show that researchers are increasingly interested in addressing supply chain risks in the construction industry. This may indicate that many developing countries have already intensified some initiatives to develop SCM aimed at strengthening supply chain resilience since these countries value CSCRs and their associated effects on construction project success. The smaller number of CSCR-related articles in Africa and North America and the absence of articles from South America highlight the need for more attention to be dedicated to research on the two continents. The social network dynamics surrounding construction projects in Africa could expose the supply chain to more risks, and studies, particularly regarding social network-related risks, would prove beneficial. Social network risks, in this case, refer to the risks resulting from the interaction or connectedness between construction projects and stakeholders in society.

From Figure 3, the country distribution shows that articles from both developed economies (e.g. UK, USA, etc.) and developing countries (e.g. Malaysia, Ghana, etc.), were identified in this study. Accordingly, the outcomes represent the general trend in both developed and emerging nations. However, it is evident that developing countries are leading in CSCR research. This confirms the observation by Malik *et al.* (2022) that although SC disruptions have severely affected different countries in the world, the effects are more pronounced in developing countries.

3.3 Analysis of the distribution of featured journals

This section lists the sources of articles included in the review, by highlighting the journals in which each article was published. The purpose of journal-wise distribution is to assess the existing journals that publish CSCR-related articles. The identified articles on CSCR research were distributed across fifty-five (55) journals. As shown in Figure 4, seven journals – International Journal of Project Management (IJPM), International Journal of Construction Management (IJCM), Engineering Construction and Architectural Management (ECAM), Journal of Construction Engineering and Management (JCEM), Construction Management and Economics (CME), International Journal of Managing Projects in Business (IJMPB), and Journal of Management in Engineering (JME), out of the 55 journals are the most active in the research related to CSCR, accounting for more than 43% of related publications. It is noticeable that the International Journal of Project Management, which has 14 articles, has been the leading publisher of CSCR research in the last 20 years.

The other emerging publishers on the subject are Journal of Financial Management and Property (JFMPC), International Journal of Supply Chain Management (IJSCM), Buildings (Blgs), Automation in Construction, Journal of Management in Engineering and Journal of Cleaner Production, each with 2 publications in the domain. Without a doubt, these journals are considered "heavyweights" in the publication of academic journals in construction engineering and management (Osei-Kyei and Chan, 2015; Hosseini *et al.*, 2018; Wuni *et al.*, 2019). The wide array of journal reporting suggests the growth of the CSCR research field. It is important to indicate that the remaining 28 journals collectively contributed 36% of the articles featured in this study.

3.4 Dominant supply chain risk factors in construction

There is a consensus that risk identification is the important first step to risk assessment and one of the critical steps for the success of supply chain risk management efforts

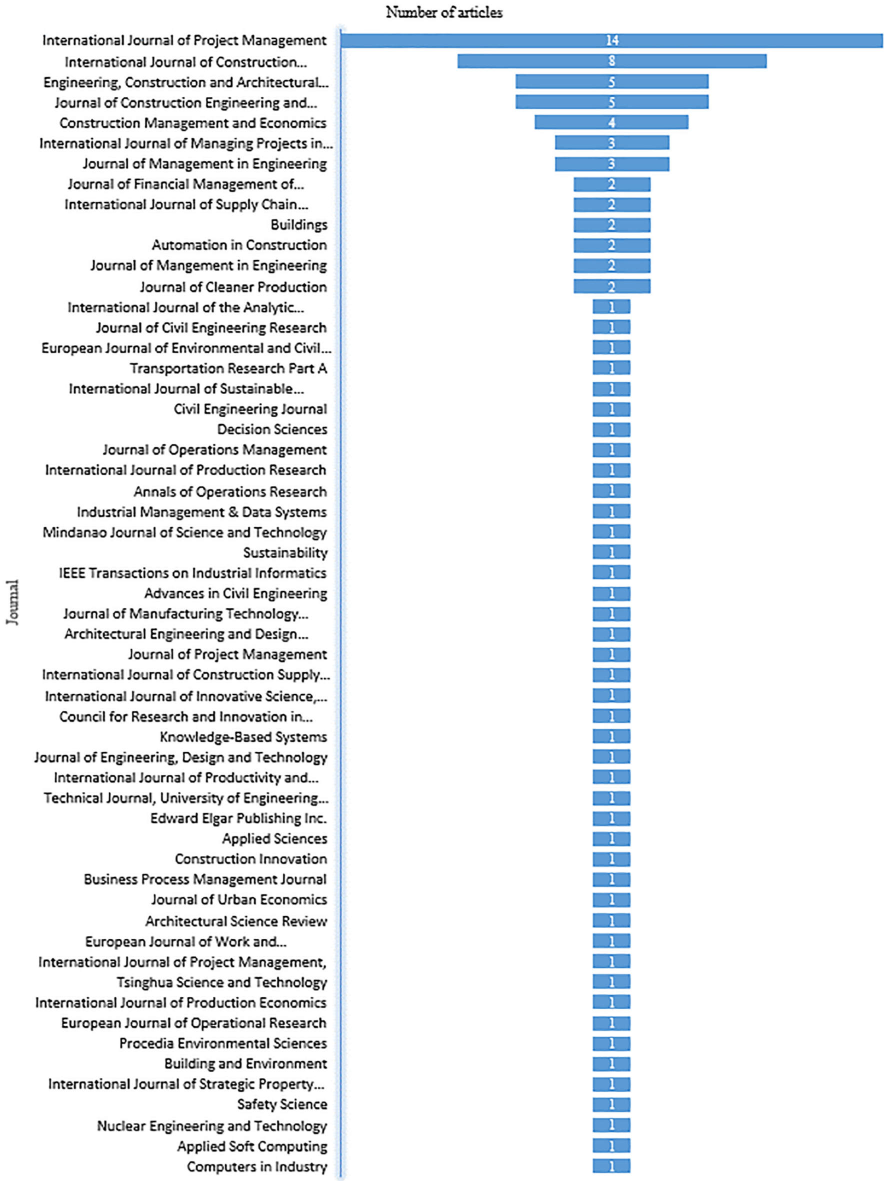


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Figure 4.
Distribution of publications per journal

(Foli *et al.*, 2022; Canbakis *et al.*, 2018; Faizal and Palaniappan, 2014). This review indicates that research to identify the supply chain risk factors that affect construction projects has seen a significant increase over the past 2 decades. Improvements in risk management efforts may not be possible without identifying factors that influence these risks. Since both the internal and external environments have an impact on construction projects, as shown in Table 1, a wide range of different factors may have an impact on the supply chains. Accordingly, an assessment of previous studies shows that the relative occurrence rates and significance of a few factors are more pronounced than others. The most prevalent risk factors in the CSC are listed in Table 1 and are ranked exclusively according to the number of included articles that mentioned the factor (i.e. the total number of references for each risk factor). These 44 DRFs were identified in at least two (2) research articles and are considered the most significant risk factors out of a preliminary 63 risk factors. As per the criteria for inclusion, a factor must have been cited twice as a risk factor in the selected journal articles. Various methods of risk classification/categorization were established based on a review of the relevant literature. As further shown in Table 1, each risk has been allocated to one of five (5) groups (social-political, technical, environmental, economic, and management) which are discussed below. The sources of the individual risk factors are shown in Table 2.

It can be concluded that the ten (10) most dominant factors in construction supply chains, in decreasing order of prevalence, are: poor communication, changes in foreign currency rates/change in inflation rate, unfavorable climate conditions, shortage or lack of access to modern tools and equipment, uncertainty of project scope/poor scope definition, alterations to project requirements/scope, scarcities of materials, material price fluctuations/escalation, competing interests and concerns among project stakeholders, lack of qualified/skilled personnel/workforce/lack of expertise, poor or inadequate supply chain planning, scheduling and monitoring. The finding of this study largely concurs with recent research, which suggests that poor communication is a major risk factor responsible for cost and time overruns in the SC (e.g. Gamil and Abd Rahman, 2023; Ekanayake *et al.*, 2020; Yaser *et al.*, 2019).

3.5 Categorization of identified risks

Diverse strategies for categorizing risks in construction projects have been proposed in extant literature. The categorization promotes the efficiency and robustness of the risk identification process and fosters a better comprehension of the characteristics and origins of risks. Risks are typically categorized according to their source, nature, stage of occurrence in the project, and effect on project objectives (Elbarkouky *et al.*, 2016; Tavakolan and Etemadinia, 2017). The classification of risks using either their origin or characteristics is the method commonly adopted in construction projects (Ebrahimnejad *et al.*, 2010; Siraj and Fayek, 2019). Individual risks may fall under a variety of groups such as financial, contractual, technical, management, construction, social/political, external, and environmental. For this study, the five groups to which the individual risks have been allocated are shown in Figure 5. To assess the risks identified, they are often categorized according to their levels of frequency of occurrence (Er Kara *et al.*, 2020). According to Hudnurkar *et al.* (2017), the categorization of risks helps in allocating responsibilities within the organization or the supply chain, depending on a particular risk type.

3.6 Dominant risk categories in CSC

One of the most important components of an efficient supply chain risk management process is risk categorization and ranking (Parsa and Torfi, 2017). The risks in the project supply chain can be inferred to represent mixtures of risks in categorized chains rather than discrete, individual risks. In line with the aim of the study, and with the aid of the RawGraph software, a ranking was developed using two distinct criteria to portray the most dominant risk category in the CSC. The first ranking (as shown in the left portion of Figure 5) was done based on the number of individual risk factors making up the category. The results of this

Risk factors	References	Category	Frequency	Rank
1. Poor communication/lack of shared information across project teams	[4, 6, 7, 11, 12,13, 21, 30, 35, 37, 39, 40, 48, 51, 52, 53, 54, 58, 66, 67; 74, 75, 76, 77, 78, 79; 81; 83; 87; 88; 94; 96; 98; 101]	D	34	1
2. Changes in foreign currency rates/Change in inflation rate	[1, 4, 6, 10, 12, 24, 28, 30,40, 41; 80; 84; 85; 89]	B	14	2
3. Unfavorable climate conditions	[1, 4, 6, 7, 9, 15,30,41; 82; 83; 93; 94; 95; 96]	C	14	2
4. Shortage or lack of access to modern tools and equipment	[1, 4, 5–6, 7, 10, 11, 17, 29; 51; 81; 83]	E	12	4
5. Uncertainty of project scope/ poor scope definition	[1, 4, 5–6, 8, 9–10, 30,43,44]	E	10	5
6. Alterations to project requirements/scope	[5, 9–10, 11, 35, 62, 63; 82; 99]	E	9	6
7. Scarcities of materials	[18, 19, 20, 28, 29, 32, 51; 58; 83]	C	9	6
8. Material price fluctuations/ escalation	[1, 5, 28, 29, 31,34; 51; 63; 72]	B	9	6
9. Competing interests and concerns among project stakeholders	[25, 26, 40, 61; 94; 96; 101; 102]	D	8	9
10. Lack of qualified/skilled personnel/workforce/lack of expertise	[5, 2, 3, 30, 36, 40, 41]	E	7	10
11. Poor or Inadequate supply chain planning, scheduling and monitoring	[17, 39, 53, 55; 94; 96; 102]	D	7	10
12. Time overruns	[1, 5–6, 8, 9, 11]	D	6	12
13. Unanticipated project changes	[1, 3, 31, 35, 44; 65]	D	6	12
14. Engineering and design modifications	[5, 1, 31, 35; 65; 98]	E	6	12
15. Poor project costs estimation	[1, 4, 7,40; 63; 71]	B	6	12
16. Materials/component delivery delays	[5,27,38; 80; 82; 86]	C	6	12
17. Bribery and corruption practices	[22,40; 63; 65; 73; 91]	A	6	12
18. Late involvement of all relevant parties	[66, 68; 74; 75; 77; 79]	D	6	12
19. Societal/community concerns and project objections	[1, 2, 3, 40, 42]	A	5	19
20. Lack of social cooperation with project execution	[2, 3, 48, 49, 50]	A	5	19
21. Project cost overruns	[1, 8, 9, 15, 30]	B	5	19
22. Restrictions due to outbreak of natural pandemics or disasters	[33, 56, 57, 59, 60]	C	5	19
23. Insufficient consideration of project complexity	[1, 31, 58; 70; 71]	E	5	19
24. Cultural differences and grievances in the project	[2–3, 23, 40]	A	4	24
25. Lack of access to modern technologies	[4, 5, 31, 66]	E	4	24
26. Regulatory/legislative changes	[1, 21, 30; 81]	A	4	24
27. Shortage of client's funding	[29; 89; 90; 97]	B	4	24

(*continued*)

Table 1. Ranking and categorization of individual risks

Risk factors	References	Category	Frequency	Rank
28. Lack of transparency	[4, 5, 53]	A	3	28
29. Supply chain interruption	[1, 5, 31]	C	3	28
30. Inexperience with emerging technology	[5, 7, 31]	E	3	28
31. Political resistance to project execution	[1, 2, 3]	A	3	28
32. Lack of collaboration and trust among supply chain stakeholders	[45, 46, 47]	D	3	28
33. Delay due to labor disputes	[1, 21; 100]	D	3	28
34. Changes in tax regimes	[1, 49; 81]	B	3	28
35. Delay in authorization from the appropriate authorities	[1, 6; 66]	A	3	28
36. Inefficient/Delays in the design and approval processes	[5, 66; 98]	E	3	28
37. Subcontractor incompetence	[4, 5]	E	2	37
38. Minimum wage rate adjustment	[1, 5]	A	2	37
39. Uncertain political climate	[1,17]	A	2	37
40. Project termination due to political changes	[1, 16]	A	2	37
41. Payment delays	[41; 83]	B	2	37
42. Changes in interest rate	[3; 72]	B	2	37
43. Inappropriate supplier selection methods	[66; 79]	D	2	37
44. Land acquisition difficulties	[63, 69]	A	2	37

Note(s): *A = Sociopolitical; B = Economic/Financial; C = Environmental; D = Management; E = Technical
Source(s): Table by authors

Table 1.

ranking show that the most prevalent (top-ranked) risk categories in CSC are sociopolitical and technical (each with 11 individual risks), followed by the management-related category (9 individual risks), and economic category (8 individual risks). According to the results, the least prevalent risk categories in the supply chain are economic and environmental risks, comprising five (5) individual risks.

Furthermore, a grouping was done based on the sum of citations referring to all the individual risk factors constituting each category. Citation counts have served as basis for several bibliometric metrics in previous studies (eg. Wuni, 2022; Oliveira Lucena *et al.*, 2019). On this basis, the management related risk category was found to be the most prevalent (79 total citations) in CSC, followed by the technical category (63 references), economic category (41 references), sociopolitical category (39 references), and environmental risk category (37 references). From these results, the management, technical and sociopolitical risk categories are the most prevalent in the CSC and require much more attention from project teams to mitigate.

4. Conclusions

This study aims to identify the dominant risk factors in the construction project supply chain by using an SLR of articles published from 2002 to 2022. The study has contributed to the identification, ranking, and categorization of risks in the construction supply chain. Many of the risk factors identified in the study are not mutually exclusive; they seem to relate to one another. While almost all the studies reported on risk in the supply chain in general, this

Ref. code	Author (year)	Ref. code	Author (year)	Ref. code	Author (year)
[1]	Boateng *et al.* (2015)	[36]	Mao *et al.*, 2015	[71]	Nielsen and Randall (2013)
[2]	Chen, 2010	[37]	Pozin *et al.* (2016)	[72]	Frimpong *et al.*(2003)
[3]	Khumpaisal (2010)	[38]	Asri *et al.* (2016)	[73]	Cirilovic *et al.* (2013)
[4]	Duy *et al.*, 2004	[39]	Luo *et al.* (2019)	[74]	Errasti *et al.* (2007)
[5]	Abroon (2016)	[40]	Li *et al.* (2022)	[75]	Xue *et al.* (2007)
[6]	Renuka *et al.* (2014)	[41]	Tang *et al.* (2020)	[76]	Tindsley and Stephenson (2008)
[7]	Hamzaoui *et al.* (2014)	[42]	Soderholm (2008)	[77]	Ala-Risku and Karkkainen (2006)
[8]	Al-Nahyan *et al.*(2018)	[43]	Ghosh and Jintanapakanont (2004)	[78]	Yeo and Ning (2006)
[9]	Enshassi *et al.* (2009)	[44]	Kaliba *et al.* (2009)	[79]	Xue *et al.* (2004)
[10]	Eybpoosh *et al.* (2011)	[45]	Rompoti *et al.* (2020)	[80]	Chopra and Sodhi (2004)
[11]	Goh *et al.* (2013)	[46]	Loosemore (2014)	[81]	Liu and Wang (2011)
[12]	Sun and Meng (2009)	[47]	Sarhan *et al.* (2017)	[82]	Gosling *et al.* (2013)
[13]	Thunberg and Fredriksson (2018)	[48]	Bidabadi *et al.* (2015)	[83]	Abas *et al.* (2020)Liu
[14]	Funderburg *et al.* (2010)	[49]	Das *et al.* (2015)	[84]	Oztas and Okmen (2004)
[15]	Pejman (2012)	[50]	Chalker and Loosemore (2016)	[85]	Banaitiene *et al.* (2011)
[16]	Frick (2008)	[51]	Hijazi *et al.* (2019)	[86v	Muneeswaran *et al.* (2018)
[17]	Norouzi and Namin (2019)	[52]	Wang and Shi (2019)	[87]	Adafin *et al.* (2019)
[18]	Craighead *et al.* (2007)	[53]	Feng *et al.* (2018)	[88]	Tembo Silungwe and Khatleli (2018)
[19]	Bode and Wagner (2015)	[54]	Shi *et al.* (2016)	[89]	El-Sayegh *et al.* (2018)
[20]	Scheibe and Blackhurst (2017)	[55]	Deep *et al.* (2022)	[90]	Doloi (2009)
[21]	Jun *et al.* (2011)	[56]	Al-Mhdawi *et al.* (2022)	[91]	Hashem *et al.* (2013)
[22]	Hwang *et al.* (2013)	[57]	Rhodes *et al.* (2022)	[92]	Choudhry and Iqbal (2012)
[23]	Liu *et al.* (2015)	[58]	Heaton *et al.* (2022)	[93]	Yang *et al.* (2021)
[24]	Esmaeilikia *et al.* (2014a)	[59]	Aigbavboa *et al.* (2022	[94]	Li *et al.* (2016)
[25]	Olander (2007)	[60]	Duong *et al.* (2022)	[95]	Li *et al.* (2013)
[26]	Olander and Landin (2005)	[61]	Seppänen and Peltokorpi (2016)	[96]	Wuni *et al.* (2019)
[27]	Panova and Hilletofth	[62]	Mbachu (2011)	[97]	Mojtahedi *et al.* (2010)
[28]	Darko *et al.* (2016)	[63]	Wang *et al.* (2020)	[98]	Hossen *et al.* (2015)
[29]	Khattak *et al.* (2015)	[64]	Hwee and Tiong (2002)	[99]	Taylan *et al.* (2014)
[30]	Ekanayake (2020)	[65]	El-Sayegh (2008)	[100]	Aibinu and Odeyinka (2006)
[31]	Basole *et al.* (2016)	[66]	Aloini *et al.* (2012)	[101]	Wuni *et al.* (2020)
[32]	Wang *et al.* (2020)	[67]	Zainal Abidin and Ingirige (2018)	[102]	Darko *et al.* (2020)
[33]	Ayat *et al.* (2022)	[68]	Zou *et al.*(2005)		
[34]	Truong and Hara (2018)	[69]	Hilber and Robert-Nicoud (2013)		
[35]	Zou and Couani (2012)	[70]	Arain *et al.* (2004)		

Source(s): Table by authors

Table 2. A legend of risk sources

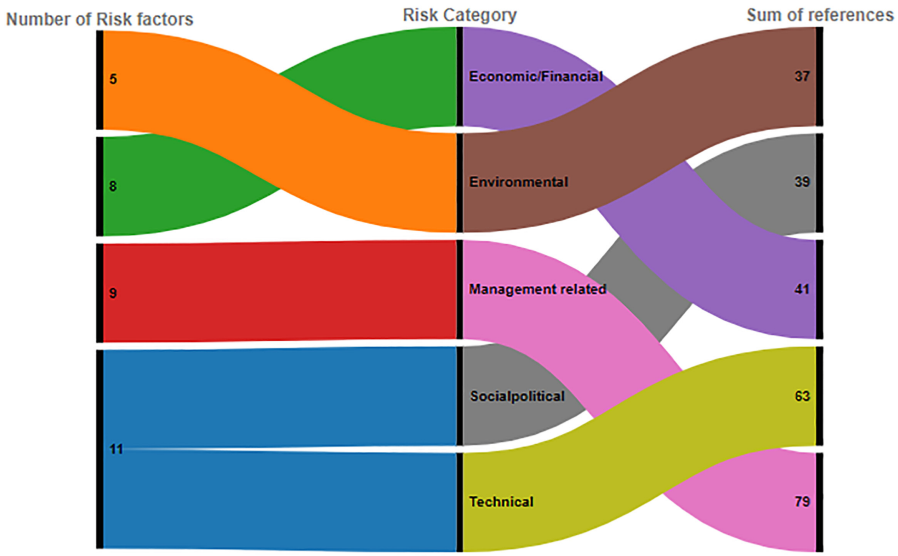

Figure 5. Ranking of risk categories

Source(s): Figure by authors

study synthesized empirical study findings to establish a construct unique to CSC. In all, sixty-five (102) peer-reviewed studies were found relevant. Literature synthesis found sixty-three (63) risk factors, of which forty-four (44) were considered dominant because they were recorded in at least two publications. Identification, categorization, and mitigation are essential for the success of any SC, which is only possible when risks are identified. Effective risk management is only achievable if risks are properly identified and categorized to reduce the complexity of developing mitigation strategies for individual risks. Out of the 44 individual RFs in the CSC, the three (3) most dominant factors included poor communication across project teams, changes in foreign currency rate, and unfavorable climate conditions. Although there is a consensus on the criticality of some of the factors based on the pattern of their occurrence in papers over the 20 years, there are noticeable emerging factors such as societal resistance and cultural differences in the project that require attention.

Furthermore, CSCR has been the subject of several studies in Asia and Europe, only a few studies have been conducted in Africa and South America. It is undeniable that these continents lag in infrastructure, especially in their least developed regions.

5. Implications for practice and policy

The results of this study will serve as a useful roadmap for practitioners in the construction industry to take proactive steps to mitigate construction supply chain risks.

Although investment in infrastructure is an essential component of economic development, developing nations lag far behind established economies in terms of the availability, quantity, and quality of capital infrastructure. Thus, many developing nations are increasing infrastructure spending, mainly through public funding. The findings of this study hold significant relevance for policymakers in these nations to proactively take precautions against risks that could potentially jeopardize the success of these capital-intensive infrastructure projects.

6. Limitations

Notwithstanding the research's validity, the following limitations are to be noted: The limitations imposed by the chosen research methodology, tools, time frame, and article availability, may have led to the exclusion of some CSCR-related papers. The adoption of the number of occurrences in studies as the criterion for assessing the dominance or criticality of the risk factors may thus not be fully comprehensive. Consequently, quantitative analysis in future research may prove useful. Nevertheless, the risk factor of poor communication in this study was found to be sufficiently dominant, and thus it would be unlikely that more related papers will change this outcome. Given the expanding popularity of CSCR research, the sample size of the articles-while adequate for this review - may need to be updated to reflect any new risk variables.

Future research may examine management interventions for the DRFs since no measures are proposed here. Context-specific qualitative research in Africa on the impact of social and cultural risks on the construction supply chain would be beneficial, due to the complex socio-cultural settings.

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