

1 **Identification of critical factors for Construction**
2 **Megaprojects Success (CMS)**

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9 **Abstract.** The worldwide growth of construction megaprojects has triggered an
10 increasing number of academic publications in the past few decades. Therefore,
11 this paper aims to systematically review studies on the critical success factors
12 (CSFs) to identify the CSFs for construction megaprojects from academic
13 journals between 2000 and 2018. The research results indicated an increasing
14 research interest in the investigation of critical factors for CMS since 2000.
15 Meanwhile, based on the number of 27 journal articles, a total of 33 CSFs were
16 identified eventually and the top five were adequate resource availability,
17 partnering/relationships with key stakeholders, adequate communication and
18 coordination among related parties, public support or acceptance, and clear
19 strategic vision. A checklist of CSFs for CMS was developed and could render
20 new insight for researchers and practitioners to conduct further studies and
21 enhance megaproject management in practice. Moreover, the results would also
22 enrich the theory of megaproject management.

23 **Keywords:** Critical Success Factors, Construction megaprojects, Megaproject
24 management, Project success.

25 **1 Introduction**

26 Generally, megaprojects are defined as large-scale and complex ventures that cost more
27 than \$1 billion and take many years to build [1]. megaprojects are intrinsic
28 complexities, risky and uncertainties. It is worth noting that they are not magnified
29 versions of normal projects but are comprised of interdependent subsystems usually
30 aiming to provide public service and welfare [2]. Typical examples of megaprojects
31 include airports, seaports, dams, high-speed railways, offshore oil and gas extraction,
32 defense projects, the Olympic, ICT systems, and the development of new aircraft [2].
33 Over the past few decades, an increasing number of megaprojects are being built
34 worldwide. As pointed out by Merrill Lynch, US\$2.25 trillion annually between 2009
35 and 2012 have been spent on infrastructures in emerging markets [3]. According to the
36 estimation by McKinsey, the world needs no less than US\$57 trillion to the investment

37 of infrastructure construction by 2030 in order to keep the expected growth of global
38 GDP [4].

39 Given the increasing interest in megaprojects [5], different areas of megaprojects
40 have been researched by researchers worldwide, including megaproject performance
41 [6]; complexity management [7]; relationship management [8] and so on forth. For the
42 past years, an area of megaproject studies that has received much attention from
43 researchers is on megaproject success. For example, Shenhar and Holzmann [9] pointed
44 out that megaproject success, especially on the CSFs, as a research area should be
45 highlighted for future explorations. The above researches exhibit how researchers are
46 interested in exploring the successful ways of delivering megaprojects.

47 However, despite the increasing interest in success factors for megaprojects, the
48 effort given to the need for review and analysis of what has already been done in
49 literature is still lacking. Therefore, it is of great value to carry out a study on
50 identification of CSFs for megaprojects so as to make an insightful understanding of
51 effective and successful ways of delivering megaprojects.

52 **2 Research methodology**

53 In this research, there are major two phases to reveal critical factors for CMS, and this
54 research process was adopted by other existing review work of Zhang et al.[10]. In the
55 first phase, the authors conducted the literature exploration to identify target papers. In
56 the second phase, a descriptive analysis to research the characteristics of the target
57 papers, including the year of publication and distributions of journals. Then, a content
58 analysis was followed by identifying the sub-themes of CSFs.

59 Firstly, Authors conducted a comprehensive literature review on CMS via two
60 academic databases, namely Web of Science and Scopus in October 2018. The first
61 round of electronic search identified a total of 331 journal articles. Afterward, two main
62 criteria were considered in the second round of paper selection. One is that articles
63 should focus on construction megaprojects, and papers not related to the construction
64 projects, such as IT project management, were excluded. The other one is that articles
65 should concentrate on the CSFs. Based on the abovementioned two selection criteria,
66 after briefly reviewing titles and abstracts, a total of 62 relevant journal articles were
67 left. Next step involved a brief review of the contents to identify irrelevant papers, and
68 the identified journal articles were narrowed to 27 eventually.

69 After identifying the relevant papers, the descriptive analysis was adopted to reveal
70 the characteristics of the identified papers. It is a common method and usually
71 employed in previous review work [10]. Using methods such as frequency count and
72 percentage, the results via descriptive analysis can provide an overview of the annual
73 number of publications and distribution of selected journals.

74 The content analysis was employed to inductively identify and classify CSFs for
75 construction megaprojects. This method is a structured and systematic approach to
76 compress many words or textural materials into fewer content classifications based on
77 a series of rules of coding [11]. This method has been adopted many times to facilitate
78 the researches in the area of construction and engineering management, such as Zhou

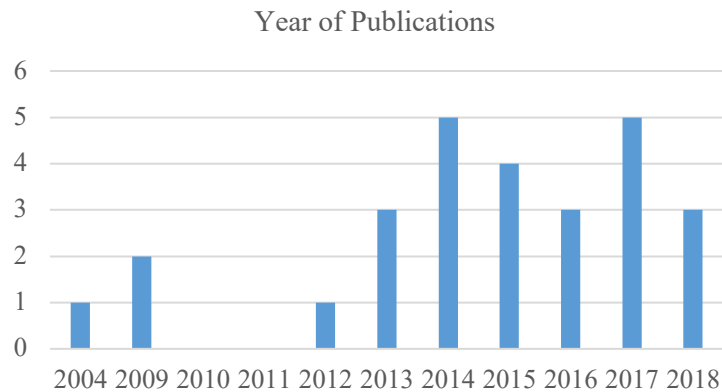
79 and Mi [12]. Preparation, organization, and reporting are regarded as three main
80 processes in content analysis, but there are no standardized rules for conducting the
81 content analysis [13]. In this study, the authors selected a four-step process, including
82 de-contextualization, re-contextualization, categorization and compilation, and
83 assessment of consistency. As stated by Elo and Kyngas [13], these processes not only
84 combine typical content analysis procedures but can provide the most recent strategy
85 for scholars to conduct a qualitative study.

86 **3 Results and discussions**

87 **3.1 Analysis of annual publications and the distribution of selected journals**

88 Figure 1 shows the annual number of relevant publications during the selected period.
89 It is worth noting that the figure only illustrates years with publications in this study.
90 As illustrated in the figure, during the selected period of 2000 to 2018, the number of
91 publications shows an increasing trend from 2004 to 2018. In fact, the rapid increase
92 began in 2012, which then stepped to a peak of five publications in 2017. The
93 abovementioned result indicates the gradual rising of interest in exploring the ways of
94 delivering construction megaprojects successfully.

95 It is also not surprising with the abovementioned data as after the 2008 global
96 economic crisis, many countries implemented a series of economic stimulus policies,
97 especially on the investment and construction of mega infrastructures. Hence, more
98 attention were paid to research on how these construction megaprojects could be
99 effectively and successfully delivered. According to the research results between 2000
100 to 2010, only three journal articles were published on CSFs for CMS, which reveals
101 that during these years, research on construction megaprojects could at the infancy
102 stage. However, after 2010, 24 journal articles were published on CSFs of construction
103 megaprojects, this also an indication of the continuously growing of the development
104 of construction megaprojects between these years. It is worth mentioning that the
105 increasing trend of researching on critical factors for CMS would continue since the
106 number of construction megaprojects worldwide is growing, which would spur more
107 studies on CMS for implementing future projects.



108

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Fig. 1. The annual number of relevant publications from 2000 to 2018

110 What's more, the number of selected articles published in the 22 journals between
 111 2000 to 2018. According to the results, the top six journals, namely International
 112 Journal of Project Management, Journal of Management in Engineering, Journal of
 113 Construction Engineering and Management, Project Management Journal,
 114 Construction Innovation, and Engineering, Construction and Architectural
 115 Management, published the most relevant articles within the selected period
 116 (5,3,2,2,2,1 articles respectively). Obviously, among 27 journals, the International
 117 Journal of Project Management published 5 target articles, accounting for nearly 18.5%
 118 of all 27 papers and contributed the most to relevant research from 2000 to 2018.
 119 Followed by the Journal of Management in Engineering with 3 publications ranked the
 120 second place.

121 **3.2 Analysis of findings from previous studies on CSFs for CMS**

122 Table 1 shows the findings from previous studies on CSFs for CMS. It is observed from
 123 the table that a total of 33 factors account for successful construction megaprojects,
 124 however, the topmost five factors were adequate resource availability,
 125 partnering/relationships with key stakeholders, adequate communication and
 126 coordination among related parties, public support or acceptance, and clear strategic
 127 vision, with the number of 9,8,7,7,6 accumulation times respectively.

128 The adequate resource availability was identified as the significant factors for CMS,
 129 with 9 times mentioned, accounting for one-third of all selected articles. The resource
 130 in the megaprojects generally refers to adequate workers, construction materials,
 131 machines, and funding as well. Adequate resource, especially the adequate funds
 132 available in projects, is vital to the progress of construction megaprojects. Project funds
 133 can be used to purchasing construction materials, machines and hiring workers, which
 134 are the basis for the smooth construction of megaprojects. In practice, interruptions in
 135 the supply of project funding could happen for some reasons, such as untimely issued

136 bank loans, and private or governmental funding not in place, which finally affecting
137 the smooth progress of construction or even resulting in a failure.

138 Partnering or maintain good relationships with key stakeholders was in second place
139 with a total number of 8 accumulation times. Generally, formal contracts stipulate clear
140 rights and responsibilities of participants in construction projects to ensure the progress
141 of construction activities. Nevertheless, existing studies partnering and good
142 relationships which may beyond contracts, still could play important roles in improving
143 project governance and project efficiency, and contribute to project success finally [14].
144 What's more, for the consideration of long-term cooperation, partnering or good
145 relationships is encouraged to be implemented. In the Hong Kong-Zhuhai-Macau
146 Bridge, a kind of partnering that called a partnership based on the strict implementation
147 of contractual agreements was encouraged to implement. Different from the traditional
148 relationships among project participants in megaprojects, under this kind of partnership,
149 organizations involved in the megaproject were expected to be viewed as a union and
150 made their best efforts to complete this super bridge [15]

151 Adequate communication and coordination among related parties was identified 7
152 publications. Lacking cross-functional communication is identified as one of the main
153 obstacles to maintaining the effectiveness of the organization. On the contrary, timely
154 and effective communication between project teams can greatly improve project
155 success. Considering the construction megaprojects involve numerous participants in
156 the progress of megaproject construction, it is not surprising that communication and
157 coordination are of great importance to the successful outcomes. Moreover, as pointed
158 out by Hu et al. [5], regular and informal meetings, newsletters, training programs, joint
159 working activities, and emergency drills with government agencies and contractors
160 were highlighted to improve communication and coordination among key stakeholders
161 in megaprojects.

162 Public support or acceptance was also one of the most important factors for CMS,
163 with the number of 7 the same as that of adequate communication and coordination
164 among related parties, ranked as the third place. The acceptance and understanding by
165 the public are rather important in ensuring the progress of megaprojects since the public
166 is a necessity to establish a harmonious and stable environment for the construction of
167 megaprojects, especially when some construction work that may have a seriously
168 negative impact on people's living surroundings. And meanwhile, the public support at
169 initial stages could reduce delays, such as land acquisition and immigration work for
170 project development [16]. For instance, the megaproject "Three Gorges Dam" in China
171 involved a large amount of immigration work, and the support of immigrants became
172 one of the critical factors determining the success of this project.

173 A clear strategic vision was mentioned 6 times in the literature review. A vision can
174 be defined as a simple and exciting expression of project results. The strategic part
175 refers to that the project sets a very desirable and important long-term goal which is
176 expected to have a lasting impact beyond its immediate outcome [9]. A strategic vision
177 of construction megaprojects is always presented in a visual and emotional way and
178 can be acted as a strong link to exceptional leadership. Good leaders know how to use
179 the strategic vision to effectively motivate the people involved in the construction
180 projects, and meanwhile, they are able to combine the vision with the right strategy to
181 implement.

182 **4 Conclusions**

183 This paper reviewed 27 relevant journal articles published from 2000 to 2018 to
184 investigate the status quo of studies on CSFs for CMS. The main results revealed an
185 increasing interest in the research on CSFs for CMS during the selected period. A total
186 of 22 journals were identified as the publication sources for the target articles and top
187 six were International Journal of Project Management, Journal of Management in
188 Engineering, Journal of Construction Engineering and Management, Project
189 Management Journal, Construction Innovation, and Engineering, Construction and
190 Architectural Management. Meanwhile, a total of 33 CSFs were explored and the top
191 five were discussed, namely adequate resource availability, partnering/relationships
192 with key stakeholders, adequate communication and coordination among related
193 parties, public support or acceptance, and clear strategic vision.

194 This study contributed to the body of knowledge in two ways. On the one hand, the
195 findings revealed in this research have provided a solid foundation for future studies on
196 relevant topics. For instance, a list of identified journals could be useful for researchers
197 to acquire and publish studies on CSFs for CMS. On the other hand, the paper identified
198 a list of 33 CSFs for CMS which was expected to be regarded as the checklist of CSFs
199 for practitioners to check project activities in practice in order to improve the success
200 of construction megaprojects. These research findings would help industry
201 professionals and academic scholars to manage megaprojects in a more effective way
202 and improve the possibility of CMS. Meanwhile, the results could also enrich the
203 existing theory of megaproject management.