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CRITICAL SUCCESS FACTORS FOR SUSTAINABLE BUILDING CONSTRUCTIONS-A REVIEW

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Abstract- Green building is also known as a sustainable or high performance building. Various efforts have made by researchers to discover the critical success factors (C-S-Fs) for green building projects (G-B-P) in past few years. However, the most important C-S-Fs need to summarize from the literature review for the successful completion of G-B-P from planning to execution. The overall aim of this research is to explore the suitability of C-S-Fs for G-B-P. The current study is review of previous studies from 2010 to 2020 on important C-S-Fs for G-B-P. In addition, the C-S-Fs are identify for G-B-P by reviewing 57 research articles of different countries. The review results show the popularity of survey and case study in G-B-P related to construction management sector. The essential contributing factors are collected that are corresponded to research approaches in sustainable construction. The outcomes show that the significant attention is gain by the researchers to consider the C-S-Fs for G-B-P. The C-S-Fs of G-B-P are concisely considered by reviewing 27 articles from the total of 57 articles. After that, outcome in form of almost 12 C-S-Fs are reported in current paper. Among all critical success factors, five factors plays an important role in G-B-P for the improvement in sustainable construction. These factors include clear goals and objectives, owner's involvement and commitment, performance of project manager's, effectiveness of project control and planning and cooperation and communication between project members. These commonly identified five C-S-Fs for G-B-P are discuss in detail. Further studies are required for C-S-Fs of G-B-P, which are also suggested in this work.

Keywords- Critical success Factors, green building projects; review; sustainable construction.

1 INTRODUCTION

Green building is the practice of making structures and using processes that are environmentally responsible and resource effective throughout a buildings life-cycle from arrangement to design, construction, operation, maintenance, renovation and deconstruction. Green building is also known as a sustainable or high performance building. Construction industry is one of the largest user of energy, material resources, and water. As a result the huge amount of waste and pollution produces. In this regard strategies and actions are needed to make construction activities more environmentally sustainable. There are many ways in which the current nature of building construction activity can be controlled and improved to make it less environmentally damaging, without reducing the useful output of construction building activities. Although new technologies such as Building Research Establishment Environmental Assessment Method (BREEAM), Building for Environmental and Economic Sustainability (BEES), Leadership in Energy and Environmental Design (LEED) *etc*. are the key solutions to sustainable developed. G-B provides good performance to environment, i.e. improved energy, air quality and water efficiency, and minimize the environmental pollution. Live or working in G-B environment can lead to healthy and environmental friendly as compared to traditional buildings. With the rising environmental pollution, it is recommended that G-B is the solution of sustainable buildings. The green building projects (G-B-P) are categorized according to the environmental performance like better water efficiency and energy, better air quality of in-door environment, and minimization of air pollutions [1]. Through, the rising universal concern on the global pollutions for G-

B-P are being recommended [2]. The construction industry badly impacts the environment throughout the life cycle of a construction from the raw materials transport to sites of construction, operation, processing, repairs and destruction of a building facility [3, 4]. Further than these environmental paybacks which are stated earlier, it is easier and better to work or live in G-B-P rather than traditional method of construction [5]. Moreover, study has discovered the economic benefits of G-B-P from a development perception owed to water savings and energy, reduced cost of mechanical equipment's, reduce consumption of natural resource and material [6, 7]. In addition, the G-B-P industry is still in the preliminary phase by fast growth in specific developing countries. Most probably, the project members have limited knowledge in executing the G-B-P competently without failure.

In past years, focus was about social, environment and economic advantages. Several countries take action to apply a series of G-B-P correlated strategies, as well as compulsory principles, tax concessions and financial incentives, to promote the growth of G-B-P [8-10]. However, delivering G-B-P is necessary, which would need novel technologies, dependable reproduction exploration, friendly environmental materials and complex architectural design [11, 12]. Moreover, organization actions have well known through the C-S-Fs [13]. In this regard, the exact list of C-S-Fs for G-B-P requirements can be recognize for recovering the probabilities of success. The firstly C-S-Fs is innovated by Rockart [14] and it is well-defined as key zones of action where advantageous outcomes are completely essential for a leader to achieve the targets. The literature also explored the efforts in G-B-P area, and three collective themes are identified: (a) definition and scope of G-B; (b) various methods to achieve G-B; and (c) quantification of benefits of G-B [15]. One more investigation was reported and classified in to four parts: G-B-P project delivery and improvements, G-B-P documentations, performance of energy and innovative technologies. Also, the quick-tempered development of G-B-P associated are considered in recent years [16]. In this regard, quantitatively investigation is made for G-B-P field in thirty eight core fields [17]. Therefore, in this study, the critical success factors are identified for ease of project completion, while execution of green building projects.

In this current study, the latest articles from last 10 years are selected for analysis with limited number of critical success factors (C-S-F) from 2010 to 2020. Previous studies on review of green building did not reported the different analysis tools for C-S-F. Therefore, in this paper, a brief review is presented with limited number of C-S-F and tools for analysis of these C-S-Fs are suggested for future work, which is the main contribution of this work.

2 METHODOLOGY

2.1 Identification of journal for success factors

The current research is organize in a way to address studies on C-S-Fs for G-B-P. Frequently, many factors might influence the provision of G-B-P, wide range and departmental level factors [18, 19]. Only project-management-and project interrelated aspects are taken in consideration. Three databases, i.e. Science Direct, Engineering Village, and Scopus are taken into consideration. Keywords for searching include sustainable construction, sustainability in construction projects, critical success factor, green building, environmental effect of building construction and factor effecting sustainability etc. The papers from high quality journals were selected on the basis of journal ranking according to the top most journals of construction management. For summarization of C-S-Fs for G-B-P research articles are categorized. The journal articles were selected accordance with classification list as shown in Figure 1. The twelve journals for research articles include International Journal of Project Management (I-J-P-M), Journal of Construction Engineering and Management (J-C-E-M), Construction Management and Economics (C-M-E), Journal of Management in Engineering (J-M-E), Journal of Civil Engineering and Management (J-C-E-M), Building and Environment (B-E), Engineering Construction and Architectural Management (ECAM), Energy and Buildings (E-B), Habitat international (H-I), Building Research and Information (B-R-I), Journal of Cleaner Production (J-C-P) and Journal of Green building (J-G-B). Afterward that thoughtful check was applied to the study group and a total of 57 research articles are kept given their significance to C-S-Fs of G-B-P. Content collection for C-S-Fs for G-B-P criteria for journal articles are as follows:

- Main concentration on reviewing articles was on G-B-P related to C-S-Fs.
- Only International journal articles publications are considered.
- Investigation of articles consideration especially from 2010 to 2020.

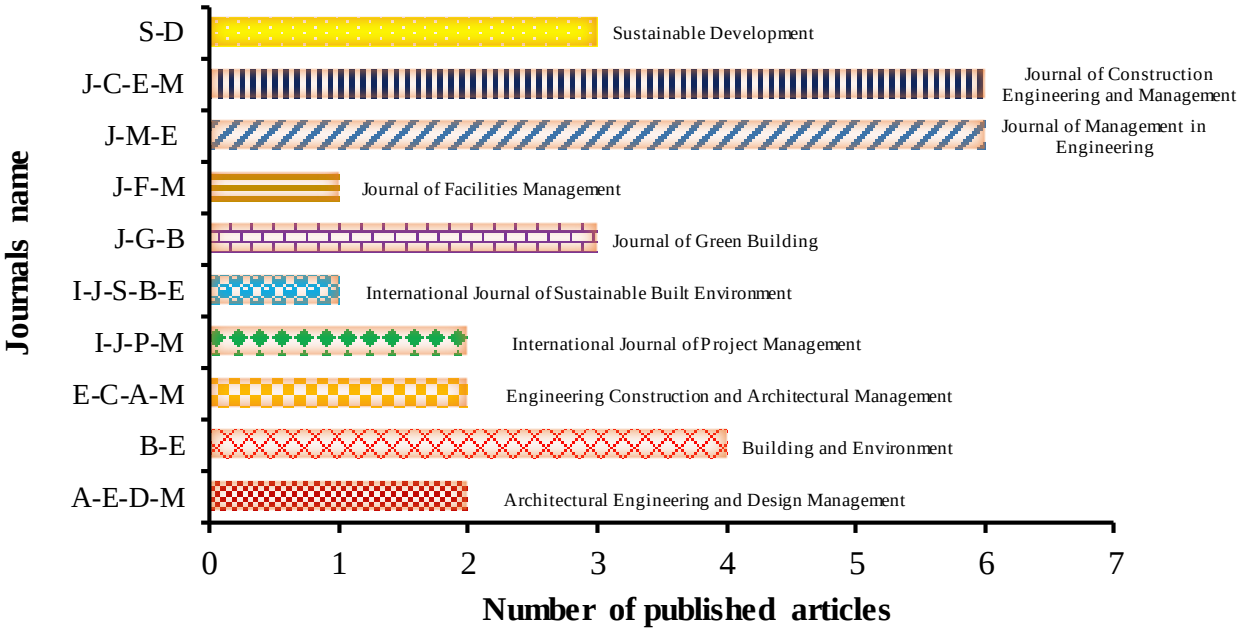

Figure 1. Journals details.

2.2 Papers analysis

The current research is focus on review of publications that are relative to C-S-Fs of G-B projects from the years of 2010 to 2020 judgmentally and thoroughly as shown in Figure 2. The 57 research articles are reviewed for C-S-Fs of G-B projects.

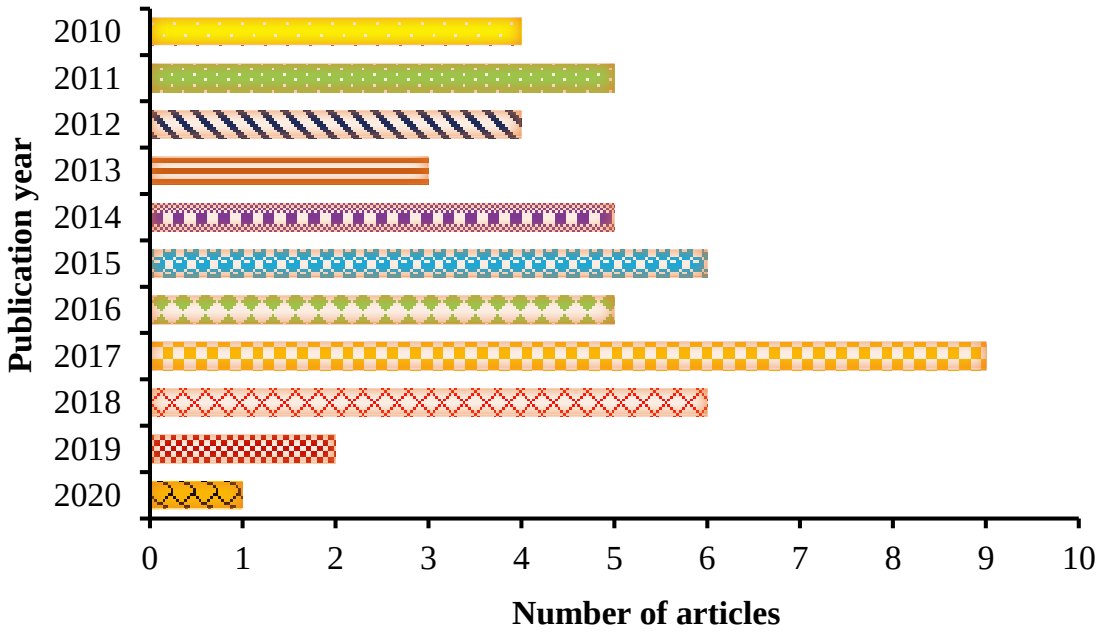

Figure 2. Published articles details.

3 RESULTS AND DISCUSSIONS

3.1 Analysis outcome

Analysis outcome for C-S-Fs for G-B-P are shown in Figure 3. The twelve C-S-Fs are reported in current research namely reliability & quality of specification, guide & bench marking systems, effective project planning & control, trust among stakeholders, communication & cooperation between project participants, skilled facilities management team, top management support, workers' experience, awareness & skill level, clear goals & objectives, longer commissioning & tuning periods, policy & regulatory project manager's performance, owner's involvement & commitment [20, 21].

Figure 3. Tree of 12 identify critical success factors from literature

3.2 Discussions

. The C-S-Fs of G-B-P are brief investigated by reviewing 27 publications from total of 57 articles as shown in Table 1. After the investigation, 27 articles are found to have these top five critical success factors, which are also mention in Figure 4. The importance of each factor of G-B-P for the duration of the life cycle phase of project, which contain planning and design stage, construction stage and se and maintenance stages are studied. Planning, design, and construction stages discover in 27 articles. Use and maintenance stages found to be in 9 articles. Planning, design, and construction stages has dynamic impact on G-B-P [19, 22]. Use & maintenance stage has limited focus in current study. According to conducted analysis, the top five factors are clear goals and objectives, owner's involvement and commitment, performance of project manager's, effectiveness of project control and planning and cooperation and communication between project members [23, 24]. All these factors are categorize by most reviewed article level, i.e. 8, 9, 9, 11 and 14 times in accordance with 27 research articles, respectively.

Figure 4. Flow chart of five critical success factors for green building

The term "clear objectives and goals" is recognized as level 1 and considered as the first C-S-Fs for G-B-P cited by 8 research articles. Only depending on plainly well-defined project goals and objectives, perfect and complete execution project ideas for entirely upcoming work by all other phases of the project are established. It is understandable that well-defined and flawless goals can decrease the chance of or later orders changing or changes in design which can result inadequacies of cost, delay in schedule and even failure of G-B applications [25]. The second term "commitment and involvement of owner's" are categorized as level 2, accordance with 9 research articles. It is more attention-grabbing to note that the owner's role is more perilous than that of other project sponsors, like project managers, designers and builders.

For understanding it is too easier, that the G-B-P primary cost generally rises with the level of enhanced sustainability and maximum primary costs is the core barricades affecting the G-B-P employment [26]. The third term "project manager's performance" C-S-Fs for G-B-P outcome reported by 9 research articles and also fall in level 3. The project manager is responsible for project management group and manages project deeds and tasks. In the design phase, the leader would involve the whole project management group to bring prepared cost estimates, finalized design, and related documents etc. which is very important for G-B-P design phase [27]. In the construction phase, the project leader is responsible for implementation of sustainable scheme technology for project delivery. The term four "effective project planning and control" C-S-Fs for G-B-P outcome by 11 research articles and also fall in to level 4. It is clear that G-B-P has integrated new materials and technologies that are greatly difficult and tough to implement at the operating phase rather than traditional method. Accordingly, G-B-P easily suffer from schedule interruption, overruns of cost, losses in production and might result in greater damage rate [28]. In this regard, highest-quality of sustainability for planning implementation incorporated into the accomplishment plan of project which might decrease the risks and assure the execution of G-B-P [29]. The term five "communication and cooperation between project participants" outcome is reported by 13 research articles and also reported in level 5. It is very clear that the term five would be the option for minimizing the path barriers to the incorporation of responsive materials for globally, innovative green technologies and model software in G-B-P. [30].

4 ANALYSIS TOOLS

The Analytic network process (ANP) is a common form of the investigative hierarchy method. The technique fuzzy ANP is used to find the complication of the project. Building Information Modeling (BIM) is a combination of digital tools for managing the effectiveness of construction projects for sustainability. A Green Building assessment method is a tool for evaluating either the building is green or not, after this detailed assessment building will be ranked accordingly. The different techniques are used for the analysis of C-S-Fs for the sustainability in construction projects like fuzzy DEMATEL and fuzzy analytic network process (fuzzy ANP) [31]. Analytic Network Process (ANP) method and interpretative structural modelling (ISM) are also employed for analysis of C-S-Fs for G-B-P. Furthermore, comprehensive details of G-B-P are available, like affecting barriers to G-B-P adoption [32], implementation of G-B-P for drivers stimulating [33], assessment methods for G-B [34], building information modeling (BIM) [35], and construction of G-B in economics perspective [36].

Table 1. C-S-Fs for G-B-P from previous studies.

Sr. No.	Authors	Category	No. of articles	Critical success factors	References of articles
1	Robichaud & Anantatmula 2010, Low et al. 2014, Shi et al. 2012, Rasekh & McCarthy 2016, Saleh et al. 2015, Ihuah & Kakulu 2014, Hwang et al. 2017, Mavi & Standing 2018.	Planning & Design, Construction, Use & Maintenance	8	Clear goals and objectives.	[25]. [37]. [22]. [38]. [39]. [40]. [41]. [42]. [31]
2	Hassan et al. 2010, Low et al. 2014, Shi et al. 2012, Korkmaz et al. 2011, Aktas & Ozorhon 2015, Murtagh et al. 2016, Ihuah & Kakulu 2014, Venkataraman & Cheng 2018, Banihashemi 2017.	Planning & Design, Construction, Use & Maintenance	9	Owner's involvement and commitment.	[21]. [37]. [22]. [43]. [44]. [26]. [45]. [41]. [46].
3	Hassan et al. 2010, Shen et al. 2017, Shi et al. 2012, Hwang et al. 2013, Ihuah & Kakulu 2014, Xu et al. 2015, Banihashemi 2017, Sang et al. 2018, Yu et al. 2018, Raouf & Ghamdi 2020.	Planning & Design, & Construction	9	Performance of project managers.	[21]. [47]. [22]. [48]. [41]. [49]. [50]. [51]. [52].
4	Hwang et al. 2016, Hassan et al. 2010, Low et al. 2014, Korkmaz et al. 2011, Rasekh & McCarthy 2016, Hwang et al. 2016, Ihuah & Kakulu 2014, Xu et al. 2011, Xu et al. 2015, Yates 2014, Banihashemi 2017.	Planning & Design, Construction, Use & Maintenance	11	Effectiveness of project control and planning.	[37]. [26]. [39]. [53]. [41]. [54]. [49]. [55]. [50].
5	Robichaud & Anantatmula 2010, Li et al. 2011, Hassan et al. 2010, Shi et al. 2012, Hwang et al. 2015, Korkmaz et al. 2011, Aktas & Ozorhon 2015, Sakr et al. 2011, Rasekh & McCarthy 2016, Saleh et al. 2015, Hwang et al. 2016, Ihuah & Kakulu 2014, Venkataraman & Cheng 2018, Xu et al. 2011.	Planning & Design, Construction, Use & Maintenance	13	Communication and cooperation between project members.	[13]. [21]. [22]. [56]. [44]. [26]. [57]. [39]. [40]. [53]. [41]. [46]. [54].

5 CONCLUSION

The current work is critical review of the articles from 2010 to 2020. A total of 27 published articles related to C-S-Fs of G-B-P were specifically considered from 57 articles. After the investigation, 27 articles are found to have top five critical success factors, which plays an important role in G-B-P for the improvement in sustainable construction. The top five aspects are describe as clear goals and objectives, owner's involvement and commitment, performance of project manager's, effectiveness of project control and planning and cooperation and communication between project members. The detailed investigation exhibited that the maximum interrelated articles were published in different journals namely International Journal of Project Management (I-J-P-M), Journal of Construction Engineering and Management (J-C-E-M), Construction Management and Economics (C-M-E), Journal of Management in Engineering (J-M-E), Journal of Civil Engineering and Management (J-C-E-M), Building and Environment (B-E), Engineering Construction and Architectural Management (ECAM), Energy and Buildings (E-B), Habitat international (H-I), Building Research and Information (B-R-I), Journal of cleaner production (J-C-P) and Journal of Green building (J-G-B). The evaluation of factor is done based on the same factors considered by many studies in planning, design, construction and maintained phase. Also, the identified 12 C-S-Fs for G-B-P were reported by reviewing 27 research articles and 5 C-S-Fs are briefly discussed in current research. The most important phases were considered, i.e. construction and design phase, but more studies are taken at the usage and maintenance phase. It is found that the interrelated project sponsors, contractors and owners are the major contributors accountable to the C-S-Fs in G-B-P. The different tools for analysis of these C-S-F are also discussed.

6 FUTURE FINDINGS

The academic focus on C-S-Fs for G-B-P are more since 2010 from previous research. However, the practical implementation of these factors are still lacks. Further investigation should be carried out on following aspects:

1. Comparison between different analysis methods should be consider for validity of top common success factors.
2. More investigation are necessary on C-S-F for all building types.
3. There is need to develop relations between the C-S-Fs and important phase from planning to execution.
4. More studies is required on C-S-Fs of different project like China Pakistan Economic corridor (CPEC).

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