

Challenges of Sustainable Construction Projects Delivery

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Abstract

As the construction industry plays a significant role in the growth of a country socially and economically, it is also considered a crucial contributor to environmental degradation. This has led to the development of several sustainable construction initiatives around the world. However, this uptake of sustainable construction comes with its fair share of challenges. This research sets out to identify the most significant challenges of sustainable construction projects delivery. Literature review was conducted to extract a list of the most cited challenges, thirty-three were shortlisted and used to create a questionnaire survey that was then distributed among construction professionals within the United Arab Emirates (UAE) to gather their perceptions on the significance of each of these challenges. Eighty-two questionnaires were returned and used for analysis. The Relative Importance Index was calculated in order to rank the challenges. The five most significant challenges were: owner's unwillingness to pay, client's funding issues, cost overruns due to tight schedule plans, lack of early involvement of construction professionals and lack of contractual incentives for the contractor. This research suggests increasing the levels of integration, investing in innovation and advanced technological systems as well as relinquishing traditional management practices to better achieve sustainability criteria among the main recommendations to overcome these challenges.

Keywords

Sustainability, Challenges, Construction Management, Sustainable Construction Practices.

1. Introduction

Sustainable construction has been gaining a lot of attention over the past years. It comes as a response plan to the significant quantity of natural resources and massive quantities of waste produced by construction activities (Zuo et al., 2012). In fact, a recent study done in China has shown that the construction demolition waste has reached an estimate of 1.55 to 2.4 billion tons (Hao et al., 2020). Similarly, the carbon dioxide emissions resulting from construction activities are among the highest rates in Gulf Cooperative Council countries (Al-Saleh and Taleb, 2010). Not only does sustainable construction mitigate these environmental impacts, but studies have also shown that sustainable buildings reduce energy consumption and improve the indoor air quality as well as thermal comfort for the occupants (Baird and Field, 2013)

The two most famous environmental rating systems that are available in practice are LEED in the US and BREEAM in the UK (Nguyen and Altan, 2011). Countries around the world have similarly developed several initiatives to promote sustainable construction practices. For instance, in the UAE, specifically in Abu Dhabi, the Estidama Pearl System was launched in 2008 in an attempt to localize the definition of sustainability and incorporate sustainable criteria that satisfy the cultural, climatic and financial settings in the country (Mezher et al., 2011). Furthermore, in 2014, Dubai Municipality introduced the green building initiative to impose sustainable construction on all buildings (Small and Mazrooei, 2016).

However, the delivery of sustainable construction projects is accompanied with several challenges that impede their success. Lam et al. (2009) concluded that the three most critical barriers to sustainable construction were additional costs, delays and lack of competent suppliers in the market. Similarly, a study done in Kuwait has revealed that lack of awareness and government support were the most significant barriers that hinder the implementation of

green practices in the country (Alsanad, 2015). Other challenges that were highlighted from literature included longer time during preconstruction phase, difficulty in selection of skilled contractors as well as owner-related barriers and gap existence between actual project delivery and policy formulation (Hwang and Ng, 2013; Tafazzoli et al., 2020; Alqadami et al., 2020).

Therefore, the aim of this research is to evaluate the challenges associated with sustainable construction projects delivery with evidence from the construction professionals in the UAE. The UAE had been selected as the construction industry in the country is booming with expansive measures of sustainability being implemented in construction projects throughout the country. In order to achieve this aim, the following objectives must be met:

1. Identify key challenges in the delivery of sustainable construction projects
2. Measure the relative importance and rank each of the identified challenges

This paper provides invaluable insight into the main challenges accompanied with sustainable construction projects delivery. It also provides recommendations in order to overcome the most significant challenges in an attempt to increase the success rate of sustainable construction projects delivery.

2. Materials & Methods

The first step was to identify the challenges of sustainable construction project delivery. This was done primarily through literature review. A comprehensive list of 33 challenges was developed. A questionnaire was then structured to get the perceptions of construction experts in the UAE. The questionnaire consisted of two sections. The first section was to gather general information about the respondents' profile such as years of experience. The second section was to get the perception on the significance of each risk. A Likert scale of 1-5 was adopted where 1 indicated very low significance and 5 indicated very high significance. The questionnaires survey forms were distributed among construction professional within the UAE construction industry and the completed responses were received online. 82 responses were collected out of a total 200 surveys sent. 12% of the respondents had more than 20 years of experience and 61% of the respondents worked in local companies while 39% worked in international companies. The Relative importance index was then calculated for each challenge using Equation 1 (Aghimien et al., 2018; El-Sayegh et al., 2018).

$$RII = \frac{\sum_{i=1}^5 w_i x_i}{\sum_{i=1}^5 x_i} \dots\dots\dots (1)$$

i=1

Where;

w_i is the weight assigned to the *i*th response; *w_i*=1,2,3,4,5 for *i*=1,2,3,4,5 respectively

x_i is the frequency of the *i*th response

i is the response category index=1,2,3,4,5 for very low, low, average, high and very high significance respectively.

Post computing the relative importance index, each of the identified challenges will be ranked in order to determine the top 5 challenges associated with the delivery of sustainable construction projects which will then help generate recommendations to overcome these challenges and possibly improve the delivery of sustainable construction projects.

3. Results

3.1 Challenges of Sustainable Construction Projects Delivery

Thirty-three challenges of sustainable construction projects delivery were collected from literature review and categorized into 7 categories according to Ahmed and El-Sayegh (2022) who used factor analysis to cluster the challenges as shown in Figure 1. The first category is financial which includes all monetary challenges, the second category includes all challenges associated with the uniqueness of the sustainable materials and technology. While the third category is contractual which includes incentives, risks and reward sharing as well as involvement and co-ordination among team players. The fourth category deals with all design challenges associated with sustainable construction. The fifth category emphasizes the lack of experience in terms of skilled workforce to conduct sustainable construction projects. The sixth category includes the regulations and approvals required for sustainable construction projects and the last category is limited organizational awareness towards sustainable construction.

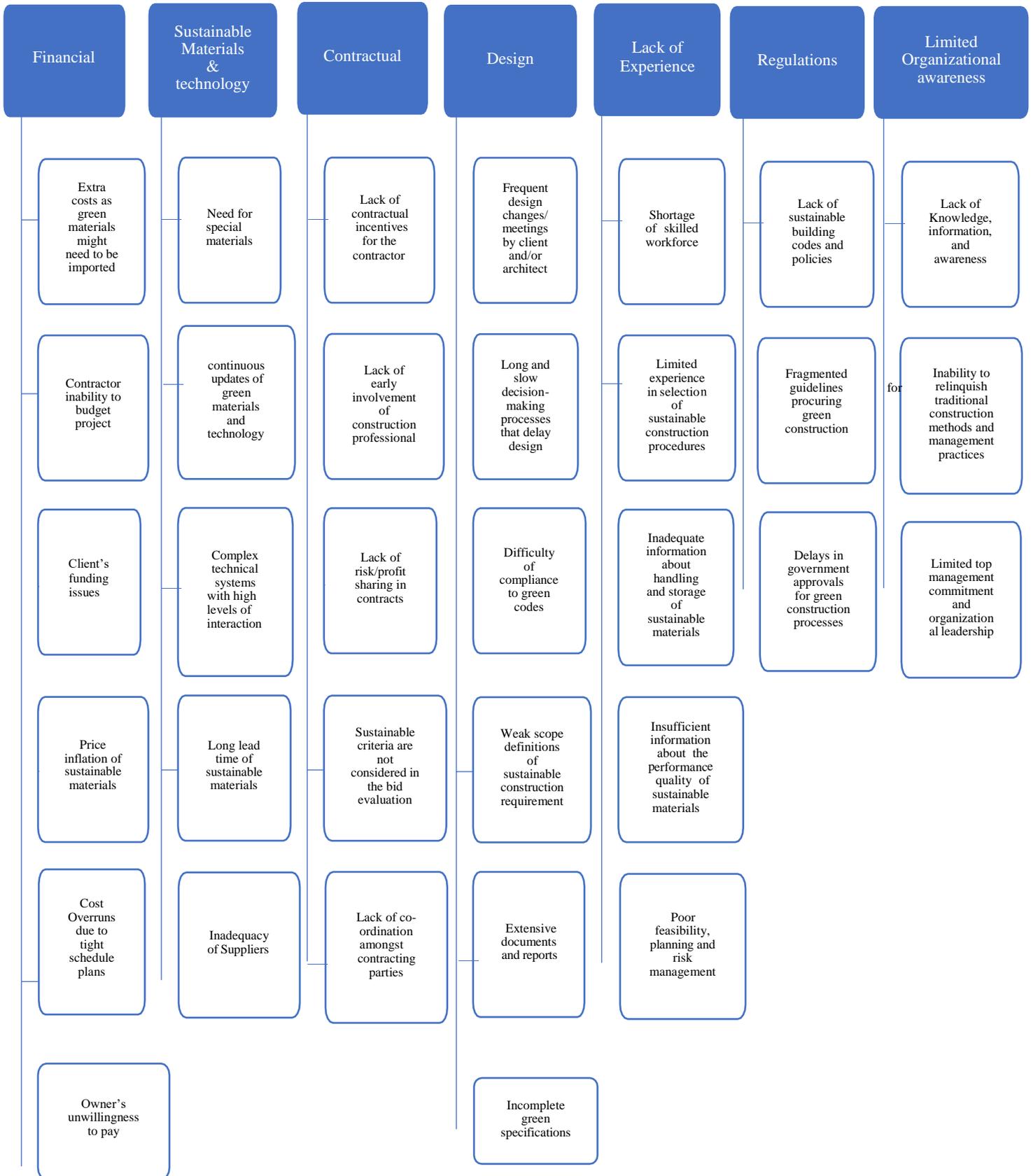


Fig. 14. Challenges of Sustainable Construction Projects Delivery

3. 2 Significance of The Challenges

Based on the survey results, the relative importance index was calculated for each challenge. The challenges were then ranked according to their RII. The results are presented in Table 1.

Table 14. RII and Rank of Sustainable Construction Projects Delivery

Challenges	RII	Rank
Owner's unwillingness to pay	4.23	1
Client's funding issues	3.88	2
Cost overruns die to tight schedule plans	3.87	3
Lack of early involvement of construction professionals	3.85	4
Lack of contractual incentives for the contractor	3.80	5
Additional costs as green materials might need to be imported	3.78	6
Frequent design changes/meetings by client and/or architect	3.77	7
Sustainable criteria are not included in the bid evaluation	3.76	8
Shortage of skilled workforce	3.70	9
Inability to relinquish traditional management practices	3.68	10
Contractor's inability to budget project	3.66	11
Lack of co-ordination among contracting parties	3.65	12
Long and slow decision-making process that delay design	3.63	13
Lack of risk/profit sharing in contracts	3.62	14
Need for special materials	3.62	15
poor feasibility, planning and risk management	3.62	16
Limited top management commitment and organizational leadership	3.60	17
weak scope definitions of sustainable construction projects	3.59	18
Limited experience in selection of sustainable construction projects	3.59	19
Inadequacy and unreliability of suppliers	3.55	20
Price inflation of sustainable materials	3.54	21
Delays in government approvals for green construction procedures	3.54	22
Lack of knowledge, information and awareness	3.49	23
Complex technical systems with high levels of interaction	3.45	24
Insufficient information about performance quality of sustainable materials	3.44	25
Incomplete green specifications	3.38	26
Inadequate information about handling and storage of sustainable materials	3.32	27
Long lead time of sustainable materials	3.29	28
Difficulty of compliance to green codes or certification	3.24	29
Lack of sustainability building codes and government policies	3.23	30
Continuous updates of green materials and technology	3.22	31
Extensive requirements for documentation and reporting	3.17	32
Fragmented guidelines for green procurement	3.15	33

4. Discussion

The results have revealed that 3 out of the top 5 challenges of sustainable construction projects delivery belong to the financial challenges category. The most significant challenge which is the owner's unwillingness to pay has been emphasized by Taffazoli et al.(2020) who also added that funding issues arise in sustainable construction due to poor

cost and schedule planning. Furthermore, literature review has also concluded that tight schedule plans are not always the perfect strategy when conducting sustainable construction projects as they require more time than traditional ones and trying to enforce those tight plans will only lead to cost overruns (Hwang and Ng, 2013). This matches the results of this paper as cost overruns due to tight schedule plans is the third most significant challenge. Other financial challenges that were collected from literature included price inflation of sustainable materials (Hwang et al., 2017), additional costs of green materials especially if they are not available in the local market as they might need to be imported (Hwang et al., 2017), as well as the inability of contractors to properly budget the project due to their unfamiliarity with sustainable construction (Zou et al., 2007). Indeed, this is closely related to the lack of awareness about sustainable construction procedures which is one of the most cited challenges in literature (Aghimien et al., 2019) as well as the limited experience of contractors and consultants when dealing with sustainable construction projects (El-Sayegh et al., 2018). It is indeed essential to invest more in innovation and technological research to explore more of sustainable construction practices.

The 4th and 5th most significant challenges are lack of early involvement of construction professionals and lack of contractual incentives for the contractor which belonged to the contractual category. In fact, Suprpto et al. (2016) highlighted that contractual incentives such as risks and profit sharing motivate contractors to perform better in construction projects. Moreover, Korkmaz et al. (2010) stated that sustainable construction projects demand a higher level of integration that allows for early involvement of construction professionals, better communication and collaboration amongst stakeholders as these projects are more complex than traditional ones and comprise of a lot of interdependent technical systems. Other challenges that belong to the contractual category include the lack of sustainability criteria in the bidding evaluation which was highlighted by El-Sayegh et al. (2020) as traditional contractor selection methods that rely solely on lowest price methods need to be updated. In fact, Opoku et al. (2015) stated that the delivery of sustainable construction projects require organizational awareness and top management commitment to be able to relinquish traditional management practices and implement sustainability measures.

Other challenges that were collected from literature include design challenges and sustainable materials. Al-Hajj and Hamani (2011) explained how weak scope definitions and incomplete green specifications might impede the successful delivery of sustainable construction projects. As this may lead to frequent design changes that may prolong decision making processes that further delay the design phase (Ayman et al., 2020). Additionally, sustainable materials are unique and are not readily available everywhere (Aghimien et al., 2018; Asaad and El-Sayegh, 2021). They also have long lead time that delays the approvals process and hence delays construction activities. Besides, there are limited number of suppliers with sufficient experience in how to handle and store these sustainable materials which adds another challenge to the delivery of sustainable construction projects (Lam et al., 2009; Qazi et al., 2021).

The least significant challenges according to the results of this paper belong to the regulations challenges category that included fragmented guidelines for green procurement as well as lack of sustainable building codes and policies. In fact, AlSanad (2015) stated that sustainability codes are constantly being updated which makes it challenging to deliver sustainable projects that comply to the continuously changing codes and policies. Similarly, Bohari et al. (2017) explained that the green procurement guidelines that are available in practice are fragmented and are missing invaluable information such as the effectiveness of the different delivering methods in accomplishing sustainability criteria.

5. Conclusions

As the projects in the construction industry grow more in size and complexity, they become more liable for the emission of greenhouse gases and environmental pollution. This has therefore, encouraged the shift towards sustainable construction. However sustainable construction comes with complex challenges that are different from traditional construction. Which necessitates the need to further explore these challenges to be able to come with up recommendation that can help overcome them and achieve more successful sustainable construction projects. Thirty-three challenges were identified from literature review and built into a survey to measure the significance of each of the identified challenges. The top five challenges according to perceptions of construction professionals in the UAE are: owner's unwillingness to pay, client's funding issues, cost overruns due to tight schedule plans, lack of early involvement of construction professionals and lack of contractual incentives for the contractor. These results highlighted the fact that financial challenges are the main challenges in sustainable construction. Additionally, the

results also emphasized the need for higher levels of integration and advancement in technological research to increase the success rate of sustainable construction projects, as well as the need for top management commitment to relinquish traditional management practices.

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