

Sustainable Construction in Malaysian Mixed Development Projects: The Barriers and Critical Success Factors

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Abstract

Malaysia is in a need of commitment to more sustainable development, rather than a traditional approach 'grow first, clean up later' to ensure the protection of environment and not to compromise needs of future generations. Although initiatives for the environmental protection have been introduced in 1960s, they have yet to receive a sufficient level of adoption amongst the construction stakeholders in Malaysia. Therefore, via questionnaire surveys to 130 professionals involved in mixed development projects, this paper aims at investigating barriers to, and critical success factors (CSFs) of sustainable construction (SC) in the mixed development projects in Malaysia. The outcomes translated via the Relative Importance Index (RII) technique reveal that the most critical barriers are SC projects are expensive, unwillingness to change to SC and high cost in purchasing technology, the learning curve cost and employing skilled labour, whilst the most significant CSFs are initial investment, commitment for changing behaviours, policy implementation efforts, guidance for SC, available of technology and materials and project procurement system. This paper focuses on the implementation of SC in delivering mixed development projects in Malaysia that is in line with the Malaysian sustainability goal in adopting the sustainable consumption and production concept. This paper is promoting sustainable development overseen by Malaysia via discussion of the SC directions and practices in delivering the Malaysian mixed development project.

Keywords: Sustainable construction; Mixed development projects; Barriers; Critical success factors; Malaysia.



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1. Introduction

Number of construction activities in the developing world has widely expanded due to the expeditiously economic growth and consequently urbanisation in those countries (Manowong, 2012), which made the construction industry is hindering to environment, economy and society (Chan A. P. C. *et al.*, 2018). In this way, change of development practices has diminished their destructive effects on the environment, economy and society, or as it were 'sustainability' (Hall and Purchase, 2006), (Ogunbiyi *et al.*, 2014) has gotten a wide consideration of authorities and also of construction professionals (Sev, 2009), (Mustafa and Adem, 2015). Consideration regarding sustainable building sector has expanded because of its raising vitality and water utilisation, and undermining air contamination (Dixon, 2010), (Mustafa and Adem, 2015) as well as measure of the ozone harming substance emanation, which subsequently prompted moves are made towards the advancement of green innovations in development industry (Berardi, 2012), (Reads and Profile, 2017). Furthermore, UNEP (2003) and Mohamad *et al.* (2015) warns about the detrimental effect of the industry if the current patterns remain the same, where normal living spaces and untamed life, which represent 70 percent of the world's territory, will be bothered or annihilated. On the other hand, it is proposed that the construction industry can possibly diminish energy consumption and air pollution comparing to any other sectors related to it Ghaffarian *et al.* (2013).

Sustainable construction (SC) is characterised as an integrative and comprehensive idea offering agreement among the three pillars (environment, economic and social) of sustainability (Tomkiewicz, 2011). Decrease of environmental impact and resource efficiency were the underlying worries of SC idea; economic and social viewpoints were, notwithstanding, neglected. In any case, in creating world, the selection of the idea is still in its early stages. For example, while creating the world, due to non-presence of the applicable codes, which are still at a lower level of accomplishment, created nations have been contributing their endeavours on productive use of resources and diminishing their impacts on indigenous habitat. As a developing country, the circumstance in Malaysia is detached contrasting with those with same socio-financial aspects status. Du Plessis (2005) claims that absence of comprehension of SC standards prompts negligence by the industry stakeholders. Nevertheless, the

Eleventh Malaysian Plan (11MP) states that successful implementation of sustainable practices will reduce detrimental impact of socio-economic activities on the environment as well as on wellbeing of the nation. Successful implementation; however, requires a radical move far from a 'develop first, tidy up later' development model.

Due to the expanding interest for more sustainable building, the SC standards and practices have pulled in consideration of the researchers in the construction industry over the globe [2]. While a few researches detailed drivers of, and boundaries to the appropriation of SC standards (Gan *et al.*, 2015), (Abidin, 2010), (Akadiri *et al.*, 2012), (Chan A. P. C. *et al.*, 2018) different researches created models towards the execution of the idea. Audit of the ebb and flow inquiry about vault regarding the matter uncovers that the appropriation of SC standards in creating nations is not promising; in any case, the created world has alike picture. The survey likewise found that the present spotlight is on the "endpoint", for example, offices that are more economical with less vitality and material utilisation (Glass, 2012). The accord is that the reception and after that usage of SC ideas is far to go, which requires contribution from all construction stakeholders, as effective execution is driven by stakeholders' motivation (Berardi, 2012). Almost certainly, SC standards offer a noteworthy change for the protection of the nature, financial strength and prosperity of the present and future generations; yet, the rate of the implementation still cannot seem to coordinate its advantages.

In spite of the presence comparable research results revealed around the world, every country requires a particular diagnosis due to the uniqueness of its socio-economic-politic characteristics. In addition, although many studies reported on barriers to SC applying various techniques (i.e. ranking techniques), these studies are failed to quantify the influence of barriers to SC. Quantification of the correlations between various identified barriers to SC is of strategic importance; hence, the industry's frontline players can invest resources toward addressing the most influencing barriers for sustainable results. Thus, with a hope to fill the gap of the body of knowledge, this survey-based study intends to quantify the construction professionals' feedback on the SC in Malaysia. Hence, the aim of this paper is to investigate the barriers to, and critical success factors (CSFs) of SC in the Malaysian mixed development projects. It is hoped that the findings of this paper would provide a better understanding of know-how and best practices towards the implementation of SC in the Malaysian mixed development projects.

2. Literature Review

Sustainable construction (SC) is a change that keeps an eye on the issues of the present without managing the breaking point of future ages to address their own specific issues. It goes for guaranteeing the on-going efficiency of exploitable normal assets and saving all types of flora and fauna (UNEP, 2003). It has three parts: environment, social and economy. In the event that the three are thought to cover circles of a similar size, the zone of cover in the middle is human prosperity. SC has rose as a supervising viewpoint to make another sort of created condition, one that keeps an eye on the issues of people in the present without constraining the utmost of future speculations to address their own particular issues (Ofori, 2015). Yao (2011) found that SC recommends the mix of natural, social and economy related considerations into change business structures and practices. It is the use of the rules of moderate change to the broad headway cycle from the extraction of structures and framework, until their last deconstruction and association of the resultant waste.

SC had turned out to be the fundamental research points from the late 1980s, however its viability in implementation is restricted (Kibert, 2016). SC ordinarily referred as the creation and responsible management of a solid constructed condition in light of asset effective and environmental standards. Essentially, SC traces the creation and administration of a sound constructed condition in light of asset proficient and natural standards and plans to strike an exchange between the economy, social and environment (triple primary concern) measurements of supportability (Zhang, 2015). Receiving reasonable development includes coordinating the greater part of the standards of manageable development into the development exercises of the undertaking life cycle, with each partner having an obligation regarding completing manageability hones (Czuchry and Andrew, 2003 and 2012).

An attentive procedure can convey an arrangement of pointers that constitute a model of the arrangement of enthusiasm, so as to control system determination, execution and observing (Wang *et al.*, 2015). The study on critical success factors (CSFs) has turned into a vital part of project management since 1960s. With a specific end goal to make extend progress, the prior looks into recommended distinguishing CSFs. The identification of CSFs can help the Project Managers to gauge project performance and resulted the accuracy in project resources allocation (Chua, 1999), (Cox, 2003), (Wang *et al.*, 2015).

Lately, project management had gotten its noticeable quality in business advantage, explore foundations, non-profit affiliations and open zones, where there is a broad number of requests on fundamental accomplishment factor for wander organisations in various parts of industry. For example, Wang *et al.* (2015) revealed four groups of elements as environmental-impact, consumer loyalty, quality and cost and time for mass house building ventures in creating nations. Larossi (2006) in Wang *et al.* (2015) discovers connection between basic achievement factor and the 'administration data emergency'. Hence, as the advancement procedure goes, blended improvement ventures require careful examinations on the usage of SC as Sekaran and Bougie (2016) in Wang *et al.* (2015) presents basic achievement factor technique and recognises basic achievement factor in nine measurements and give more itemised clarification of CSFs.

3. Research Methodology

This paper is started with a structured literature review on the sustainable construction (SC) and mixed development projects in Malaysia, where the questionnaires were designed in view of the issues featured in the

problem statement to address the aim of this paper. At first, an aggregate number of 13 industrial experts were reached for eye-to-eye organised meeting and consequent pilot study for the questionnaire survey. Their perspectives and assessments were requested amid the interview session, where the consequences of the pilot study contemplated overall agreeable picture of the questionnaire items, scale and measures. The fundamental explanation behind the pilot study survey is to assess the dependability of using Cronbach’s alpha coefficient. In a perfect world, as per (Daniel, 1961), the Cronbach alpha coefficient of a scale ought to be more noteworthy than 0.70. The Cronbach’s alpha outcome generated via pilot study to test the reliability of questionnaires were recorded between 0.860 to 0.986, which show that the questionnaire survey was fit and solid for the real questionnaire survey. Content validity was performed to guarantee that the measures incorporate a satisfactory and agent set of things that tap the idea (Rockart, 1979).

Total numbers of 400 Grade G7 contractors were haphazardly chosen from Construction Industry Development Board (CIDB) Malaysia database. This sample size was chosen from the rundown of 2500 for Klang Valley based contractors. In Malaysia, Grade G7 licensed holders approved by CIDB permits the contractors to undertake civil engineering construction and building construction projects for unlimited amount. Normally, these G7 for Klang Valley based contractors are huge contractors occupied with overwhelming and complex construction involving mixed development projects with no financial constraint. Hence, they are more acquainted with the topic in regards to SC for onsite construction exercises. At first, before the questionnaire had been conveying, it was properly affirmed that the greater part of the targeted respondents is doing construction business and engaging civil and infrastructure works in the mixed development projects (Bahaman, 2011).

Section A from the survey questionnaire included respondents’ demographic information and their experiences. Consequently, Section B and Section C depend on a Likert scale question, which requested the respondents to rate the significance of criteria on a five-point scale. A total of 150 responses were received and after removing invalid and incomplete responses, a total of 130 completed questionnaires were acknowledged and taken into consideration. This gives a general response rate of 37.50 percent. This response rate is well worthy in the perspective of researcher as the result of a web-based survey for the construction industry is normally between 20 to 30 percent following the suggestion by Akintoye (2000) and Siegel and Castellan (1988). Thus, the present percentages of feedbacks were sufficient for a healthy analysis.

4. Data Analysis

Relative Importance Index (RII) technique was utilised for investigating the sustainable construction (SC) barriers and critical success factors (CSF). The utilisation of parametric strategies in this paper is not practicable and relevant for evaluating inclinations of the respondents (Kometa et al., 1994). Kaming et al. (1997) guarantee that RII is a non-parametric procedure, which is broadly utilised by development and offices administration scientists for breaking down organised survey reactions for information including ordinal estimation of mentalities. The weightage depends on the reactions of the poll overviews. It is represented by the equation beneath (Chan D. W. M. and Kumaraswamy, 1997); (Gilad et al., 2001):

$$RII = \frac{\sum w = \{[n1x1] + [n2x2] + [n3x3] + [n4x4] + [n5x5]\}}{AxN} \quad \frac{5xN}{}$$

Where *w* shows the weighting that is assigned to each variable by the respondents, *A* is the highest weight and *N* is the total number of the respondents. The RII value ranges from 0 to 1 with 0 is not inclusive. It shows that higher the value of RII, more important was the sustainable criteria and vice versa. The importance level from RII are as shown in Table 1.

Table-1. Importance level of RII

Importance indicator	RII value
High	0.8 < RII < 1.0
High-Medium	0.6 < RII < 0.8
Medium	0.4 < RII < 0.6
Medium-Low	0.2 < RII < 0.4
Low	0.0 < RII < 0.2

Table-2. Barriers towards SC implementation in mixed development projects in Malaysia

Variables	Mean	Relative Index	Ranking
Barriers towards SC implementation			
SC projects are expensive	4.21	1.95	1
Unwillingness to change to SC in delivering mixed development projects	4.31	0.86	2
High cost in purchasing technology, the learning curve cost and employing skilled labour	4.29	0.86	3
Lack of clear benefits of SC projects	4.27	0.85	4
Fewer developers undertake SC projects	4.22	0.84	5

Lack of qualified staffs associated to SC in mixed development projects	4.15	0.83	6
Lack of awareness and understanding of SC projects	4.15	0.83	7
Risk associated with implementation of new practices	4.12	0.82	8
No existing rule in Malaysia to adopt SC projects	4.11	0.82	9
Lack of government supportive and no incentives for SC projects	4.09	0.57	10

Table 2 illustrates the RII for barriers towards the implementation of SC in the mixed development projects alongside with the correspondence ranking and their significance impact. It is the proof from the ranking that respondents had chosen “SC projects are expensive” as the highest ranking for current problems towards the implementation of SC in delivering mixed development projects (RII = 1.95). This is followed by unwillingness to change to SC in delivering mixed development projects (RII=0.86), high cost in purchasing technology, the learning curve cost and employing skilled labour (RII=0.86), lack of clear benefits of SC projects (RII=0.85), fewer developers undertake SC projects (RII=0.84), lack of qualified staffs associated to SC in mixed development projects (RII=0.83), lack of awareness and understanding of SC projects (RII=0.83), risk associated with implementation of new practices (RII=0.82), no existing rule in Malaysia to adopt SC projects (RII=0.82), and lastly lack of government supportive and no incentives for SC projects (RII=0.57).

Table-3. CSFs of the SC implementation in mixed development projects in Malaysia

Variables	Mean	Relative Index	Ranking
Critical Success Factors			
Economic Feasibility			
Initial investment	4.41	0.88	1
Time constraint	4.33	0.86	2
Payback period	4.29	0.86	3
Realisation of incentive policy	4.22	0.84	4
Competition	4.23	0.84	5
Intangible benefits	4.19	0.84	6
Awareness			
Commitment for changing behaviours	4.41	0.88	1
Information/ knowledge of SC	4.40	0.88	2
Support from project stake holder	4.38	0.88	3
Support from financial institution	4.37	0.87	4
Support from professional institution	4.37	0.87	5
Cooperation between project stakeholders	4.37	0.87	6
Education and training of SC	4.34	0.87	7
Market demand of SC	4.34	0.87	8
Industrial culture	4.23	0.85	9
Policy and Regulations			
Policy implementation effort	4.34	0.87	1
Efficient monitoring system	4.27	0.85	2
Legal/regulatory framework	4.26	0.85	3
Operability of SC			
Standard, code and certification	4.34	0.87	1
Guidance of SC	4.40	0.88	2
Performance measurement of SC	4.30	0.86	3
Resource Risk			
Available of technology and materials	4.22	0.88	1
Qualified workers and expertise	4.22	0.88	2
Maturity of related technology, materials	4.22	0.86	3
Project Management Model			
Project procurement system	4.40	0.88	1
Project organisation structure	4.40	0.88	2

Table 3 shows RII for the critical success factors (CSFs) of the SC implementation in the Malaysian mixed development projects. Based on Table 3, respondents ranked initial investment (RII=0.88) in the economic feasibility as the most important CSF that needs to be taken care of towards the implementation of SC in delivering mixed development projects in Malaysia. This is followed by commitment for changing behaviours (RII=0.88) in the awareness section, which has been ranked by the respondents as the most important CSF. It seems that the negligence of the commitment for changing behaviours are the most important driver in the implementation of SC in

the delivery of the Malaysian mixed development projects. “Policy implementation effort” (RII=0.87) is ranked as the most important CSF in the policy and regulation section as the respondents claimed that the government needs to take rigorous action in terms of policy and regulations enforcement. In terms of operability of SC, respondents ranked “guidance of sustainable construction” (RII=0.88) as the most important CSF, whilst “available of technology and materials” (RII= 0.88) as the most important CSF in the resource risk section. Finally, “project procurement system” and “project organisation structure” (RII= 0.88) are the most important CSFs in the project management model section.

5. Research Findings

Despite the fact that SC is a complicated engineering system that merged economic, social and environment aspects, sustainable construction (SC) is considered as a route for the construction industry to push ahead while in the meantime ensuring the earth’s resources. SC researchers keep on receiving debate from construction stakeholders about their perceptions towards the implementation. Construction activities not only take up space of lands and materials’ utilization but also harms the environment. Fortunately, all of the constructions’ stakeholders are now starting to realise the pitfalls of building unsustainably and are currently moving towards better and more responsible actions towards the environment in developing the nation. The advantages and disadvantages of SC have been revealed through much researches and case studies conducted abroad.

In Malaysia, government is actively promoting the sustainable development through its Malaysian Plan since the Tenth Malaysian Plan (10MP) until the recent Eleventh Malaysian Plan (11MP). Through that have shown some encouraging progress in sustainability development. However, SC in the delivery of mixed development projects in Malaysia shows that the implementation has not been firmly seized due to the very low awareness of its practice. People are only noticing about SC in building housing and offices, but not in the mixed development projects. In fact, many construction practitioners observe this concept as contributing very high in costing. In this paper, the conclusions are made based on the aim set earlier. Recommendations to further improvise the paper as well as limitations in conducting this paper are also highlighted to provide a thorough assessment on the subject matter.

5.1. Barriers to Sustainable Construction (SC) in the Malaysian Mixed Development Projects

The analysis of the results portrays that the fundamental barriers of sustainable construction (SC) in delivering mixed development projects for the Malaysian construction industry are the high cost that involved in the whole process as well as high cost in purchasing technology, the learning curve costs and employing skilled labour due to lack of qualifies staffs associated to the SC projects in mixed development projects. Therefore, they cannot see the clear benefits of SC projects in addition to very few developers undertake SC projects. On top of this, the unwillingness to change to SC in delivering mixed development projects among construction stakeholders and lack of awareness and understanding about SC projects led to the problems in the implementation process. They cannot take risk associated with the implementation of new practices due to no existing rule in Malaysia to adopt SC projects as well as lack of government supports and no incentives for SC projects.

To break up these problems, this paper perceives that policy guidance assumes basic part in providing funding because most of the respondents rank that they cannot see clearly the benefits of implementing SC. By establishing incentives measures, SC can profit the company too. In addition, the Malaysian government can consider a few rewards as honour endowments, deficiency appropriations, budgetary rebates, pre-assess advance and many more. For this, government has to issue special legislation, code of conduct or standards relating to SC specifically to the mixed development project in the Malaysian construction industry to ensure their proper and effective implementation, while at the same time enhancing the awareness in terms of the implementation of SC that could make a large impact at the larger scale especially for the stakeholders of the industry who are dealing directly in the construction industry. This could be accomplished by presenting legitimate rules, apparatuses and strategies to improve the level of mindfulness and knowledge of SC.

5.2. Critical Success Factors (CSFs) for Sustainable Construction (SC) in the Malaysian Mixed Development Projects

The critical success factors (CSFs) distinguished from the literature review and confirmed by construction stakeholders were rated accordingly to their significance level. Findings show that there are three most important CSFs towards the implementation of sustainable construction (SC) in the Malaysian mixed development projects, namely economic feasibility, awareness, policy and regulations and technical. The discussion of this part of the paper is centered around six classifications according to their ranking.

5.3. Economic Feasibility

This classification included “fear of higher initial investment costs”, “fear of time constraint”, “fear of long term payback period”, “fear of realisation of incentive policy, competition” and “intangible benefits”. The influence of economic feasibility on the implementation of sustainable construction (SC) has been all perceived. The “fear of higher investment costs” for SC of the mixed development projects and the danger of unanticipated expenses are frequently tended to as difficulties for SC. Despite the fact that SC is assessed to build the underlying capital costs, this is counteracted humongous investment funds in the operational expenses and end client comforts in the mixed

development projects. Although it is reported that the long-term benefit is justified regardless of the underlying initial investment, the perceived long term is typically not communicated in terms of financial return, yet engaged on the ecological and social advantages that the principle contractors in the mixed development projects trusted the innovation or approach could convey.

5.4. Awareness

The awareness in the delivery of mixed development projects in Malaysia consists of commitment for changing behaviours, information/knowledge of sustainable construction (SC), and support from project stakeholder, financial institution and professional institution, cooperation between project stakeholders, education and training of SC, market demand of SC and industrial culture. Stakeholders of the mixed development projects noticed that they are being unaware of SC assessment. The construction business is comprised of decent varieties experts with various foundations and interests who have come to cooperate and work in a group to guarantee the project success and completed on time to meet the customer's requirements. Therefore, it is crucial to develop such awareness and enhance the understanding of SC among construction industry stakeholders in the Malaysian mixed development projects.

5.5. Policy and Regulations

This classification comprises of lack of policy implementation efforts, lack of efficient monitoring systems and lack of legal/regulatory framework. Sustainable construction (SC) concept would be successfully implemented in the mixed development projects if stakeholders, particularly government, had the enactment that will require full collaborate supportability arrangements and furthermore the advancement of different strategies. The absence of legal and regulatory framework comprises government commitment in the implementation of SC in Malaysia especially in the mixed development projects. In addition, the success of SC in the mixed development projects is subject to the responsibilities of government and the enactment of the regulations. Since government is the principle player in the construction industry, SC cannot be effectively executed in the Malaysian mixed development projects without the full duty of government. Hence, the government needs to play a major role, such as providing the platform to enable SC environment for efficient SC implementation in the mixed development projects in Malaysia. Government and their agencies should spearhead the movement in gradually mitigating with the SC practices into new construction projects, especially the mixed development projects so that the private organisations and experts can coordinate towards the implementation of SC in the mixed development projects due to the advantages related with SC.

5.6. Technical

The technical aspect comprises “operability of sustainable construction (SC)”, “resource risk” and “project management model”. These critical success factors (CSFs) are viewed as specialised on the grounds that they directly affect the fruitful execution of SC standards in the conveyance of the Malaysian mixed development projects. Items must be transported in from somewhere else much of the time, either straightforwardly by the task group or through a privately endorsed merchant. Inadequacy of legitimate direction seemed to appear for consultants in the execution of SC mixed development projects. Critically, technical information on SC in the mixed development projects is made accessible to outline experts in proper organisation and to the contractors eventually in charge of actualising the plan. The absence of project management model in the implementation of SC in the mixed development projects has a significant impact in achieving successful implementation of SC in Malaysia. Hence, the accomplishment on SC implementation in the mixed development projects lies on dedication of leaders in building up a powerful arrangement and satisfactorily giving the required resources and support to oversee changes emerging from the usage itself. Thus, without this, the concept of implementing SC in delivering mixed development projects in Malaysia may face numerous difficulties.

6. Discussion and Conclusion

This paper has successfully achieved its aim to investigate the barriers to and critical success factors (CSFs) of sustainable construction (SC) in the Malaysian mixed development projects. Hence, this paper is valuable especially for the main contractors, particularly tender and procurement team, construction team as well as clients from the construction industry with the end goal for them to comprehend the CSFs that contribute to the SC in delivering mixed development projects in Malaysia. This paper has successfully indicated the main factors in terms of principles, characteristics and implementation of SC for their project site. Finally, the paper is hoped to be able to gauge the construction parties in their construction field among other well-established contractors in the country in terms of project deliverable and sustainable quality to the clients and customers.

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