Identifying the Environmental Strategies in Construction Site for Malaysian Contractors in Johor

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Abstract. The construction industry needs to make a significant positive impact on the environment. Although there were a number of successful initiatives, nevertheless, those initiatives are deemed inadequate. There is evidence of lacking in self-inventiveness in applying the concept of sustainability among local construction contractors. Part and parcel, this shortfall stems from a scarce availability of practical guideline for sustainable methods that can be applied during the construction phase. Thus, research was mooted grounded from the issues identified, and further discusses the environmental strategies in construction sites for Malaysian contractors. Therefore, rooting for qualitative endeavours within the initial stages of the research, in-depth literature analysis and semi-structured interview were conducted respectively. Subsequently, for both undertakings, manual-type of analysis were selected. The former was utilising systematic literature review with multi-layered thematic analysis; meanwhile the latter was embedding a simple themes’ agreement analysis. The outcomes from the first stage of research have outlined five (5) main environmental strategies, namely; (1) protection of the natural environment, (2) waste management, (3) reuse and recycle of resources, (4) general site management, and (5) resource consumption. These strategies were further strengthened based on the subsequent interview conducted towards G6 and G7 contractors. Nevertheless, the research also recorded several important points from the open-type questions, which may influence the suggested strategies. Finally, the research proposed for succeeding quantitative stage (i.e. questionnaire surveys) in order to generalise the previous outcomes to a large population of contractors.

1. Introduction
Sustainable construction is an obligation for the construction industry to implement the concept of sustainable construction. The policy was first proposed during the "First International Conference on Sustainable Construction” in Tampa, Florida, United State of America in 1994 [1]. According to ISO 15392: 2008, sustainability is a component in which ecosystem functions are maintained for the present and future generations [2]. In this case, the concept of sustainability takes longer term perspectives when making a decision. Thus, sustainable construction should be emphasized and became an obligation for the construction industry to implement the dire-need initiative.

On the other hand, Construction Industry Transformation Program (CITP) 2016-2020 is the mission of transforming Malaysia into a sustainable construction industry productive, environmental, and competitive global members while in the same time focusing on safety and quality standards [3].
Environmental sustainability is one of the four strategic cores of CITP that will be developed steadily and launched as a model for emerging worlds [4-5]. Thus, environmental sustainability practices will make Malaysia a country with low carbon levels, sustainable development and infrastructures.

Through the conservation of energy, water and natural resources by reusing, recycling, innovative design, and minimizing waste and pollution, we can meet our needs without compromising the needs of future generations [6-7]. According to Eleventh Malaysia Plan [8], the encouragement of sustainable construction is a part of the Government's policy on Sustainable Development, which recognizes that the economic, environmental, and welfare are interdependent.

In this case, contractors must actively participate in the environment, constantly improving the efficiency of the construction process, energy conservation, water use, and other resources during construction, as well as minimizing the construction waste and managing all processes. Unfortunately, the said initiatives were seen as not thriving enough. One of the factors that contributed to this issue was the attitude of a few contractors who did not adopt a sustainable strategy in construction projects [9]. This is due to the fact that contractors have no guidance for applying sustainable strategies in construction [10-11]. Nevertheless, there were evidences of rational approaches on sustainable strategies that can be applied by contractors to resolve environmental issues at construction sites.

In addition, due to the lack of studies that look into the issue from the point of the actual scenario on construction sites, this study has taken the initiative to explore relevant factor and application of the concept of sustainable construction at the construction site. Hence, the authors intend to identify the environmental strategy in construction site for contractor, and further validated the strategy as a term of reference for contractor before subsequent establishment are conducted.

2. Sustainable Development in Malaysia's Construction

Malaysia is a developing country leading towards rapid industrialization. The concept of development today is moving towards sustainable development, which means a development that harmonizing economic development with the environment to meet the needs of the present without threatening the sustainability of life in the future [12]. Based on the definition from “The World Commission on Environment and Development of United Nations”, the concept of sustainable development can be seen as a process of enhancing the economic and social conditions of a community and maintaining the development for a long time without undermining the community's natural resources [6,13-14].

The development implemented should not only be seen as economic development, but it should pay attention to social dimensions. Through this approach, it need to have a policy of sustainable development and a stronger platform to be applied and the concept still needs to be socialized more broadly [15]. There are many environmental pollution cases that have taken place lately and the reduction of natural resources, which has led to the development of sustainable construction and attention for future generations [16-17]. Consequently, the world is facing global warming and the depletion of the ozone layer due to the release of gases that pollute the air such as excessive carbon emissions. Studies show that factors that cause excess carbon emissions are from the construction industry. International studies have found that, the construction sector has used the world energy by 40%, waste materials by 40%, and 12% are water [18]. Hence, several steps are taken to eradicate this problem by applying sustainable construction within the site phase.

3. Sustainable Construction in Malaysia

Referring to the Malaysian Construction Industry Development Board Act 1994 (Act 520) under Section 2, Part 1, the construction industry is defined as construction, connection, installation, repair, maintenance, renewal, transfer, modification, maintenance, and demolition [19]. Based on the definition, it is clear that the field of this industry is extensive and not limited to construction work alone and usually takes a long time to complete. The construction industry in Malaysia is a rapidly developing industry since the 1980s in line with the government's goal of becoming a high-income nation by 2020.

Sustainable construction activities may create sense of responsibility towards the environment, the awareness among parties involve, and economic profitability [20]. According to Kibert [21], sustainable construction is capable of addressing the ecological, social and economic issues of a
construction. Kibert et al. [22] highlighted that the practice of sustainable building refers to the creation and operation of a healthy built environment based on resource efficiency and ecological design with an emphasis on seven core principles across the building life cycle which are, 1) reducing resource consumption, 2) reusing resources, 3) using recyclable resources, 4) protecting nature, 5) eliminating toxics, 6) applying life cycle costing, and 7) focusing on quality. By adopting this concept, effects on the construction sustainable development may be considered as the emphasis on the balance between social development, economic development and environmental sustainability [23-24]. Therefore, sustainable construction industry should be able to cover all aspects, especially the aspects of use of natural resources, waste management and recycling, the reuse or repurpose of the old building and materials, the efficiency in the construction industry, and the cost of ownership of the building. A first step towards sustainable construction is to improve the quality of construction products and the efficiency and safety of the construction process [25]. Creating the built environment with environmental awareness and sensitivity would be the outcome of using the principles. Hence, sustainable construction, has been address as 'green construction', which describes the responsibility of the construction industry in attaining sustainability.

4. Identifying the Environmental Strategies in Construction

In order to achieve the first research objective, a systematic literature review through various existing sources such as books, journals, theses, and websites were used to find research related information by searching from reliable databases such as SCOPUS, IEEE, Science Direct, and Google Scholar. The etiquettes specifies that initial primary source selection is based only on title, keyword, and abstract review [26-27]. As soon as all the relevant research information has been collected, a qualitative method through Multi-Layered Thematic Process (MLTP) is used subsequently to identify and finalising the factors of environmental strategies at the construction site. By using MLTP, the data was filtered and analysed to maintain the reliability of the data. Several layers of themes were purposely produced to collect, filter, and analyse related information [28-29], which is focussed on the environmental strategy in construction site. The following Figure 1 illustrates the MLTP usage in this study, which related to the secondary sources of information [30].

Figure 1. Multi-Layered Thematic Process (MLTP) diagram

In line, given the qualitative undertakings were conducted on manual basis, a matrix table of literature review from worldwide sources was prepared in order to summarize the outcomes. Finally, there are five main factors of sustainable construction methods in environmental aspects, where each major factor has contributed with several sub-factors. The factors are; (1) protection of the natural environment, (2) waste management, (3) reuse and recycle of resources, (4) general site management, and (5) resource consumption. The ensuing Figure 2 shows a summary of generic factors for environmental strategies in construction site.
5. Validating the Environmental Strategy in Construction

As a succession from the previous objective, a semi-structured interview is conducted to validate the environmental strategies in construction site for Malaysian contractors. The semi-structured interview consists three section which are; Section I: Respondent background & general information, Section II: Analysing the significance of the environmental strategies in construction site for Malaysian contractors, and Section III: Agreement on the proposed environmental strategies in construction site for Malaysian contractors.

The first part (Section I) of the interview questions is focused on the background of the respondents. The process involves nine (9) contractors registered under the Construction Industry Development Board Malaysia (CIDB), which comprises higher grades contractors of Grade 6 (G6) and Grade 7 (G7) who had experienced in the construction field for more than 5 years. Within the interviewees, eight (8) of them are from G7, and the research only managed to secure one (1) from G6 as shown in the Table 1 below.

Table 1. Respondent Demography

| Respondent demography | Grades of contractor |
|------------------------|---------------------|
|                        | G6  | G7  |
| Types of project       |     |     |
| High rise              | -   | 2   |
| Housing                | 1   | 5   |
| Power plant            | -   | 1   |
| Work experiences       |     |     |
| 4 years and below      | -   | -   |
| 5 – 9 years            | -   | 2   |
| 10 years and above     | 1   | 6   |

During the semi-structured interview, all the feedbacks from the respondents were taken into account. The usage of both voice recorder and paper during the interview sessions were applied due to the concerned of conclusively of interview data. Subsequently, to analyse the data obtained, the research used the NVivo version 10 software. Accordingly, findings from Section II analysed that the majority of respondents were responded “Yes” for all environmental strategies composed from the
previous finding. As shown in Figure 3, “Yes” is frequently recorded followed by “strategy”, “construction”, “contractor”, and “environmental”. Meanwhile, findings from Section III which seek their agreement on the proposed environmental strategies to be implemented within the construction site, all of them agreed that the strategies were applicable. Nevertheless, a number of comments and/or suggestions were recorded alongside.

![Figure 3](image_url)

**Figure 3.** Result for word frequency analysis for Section II (open ended questions) on the significance of environmental strategies

Briefly through respondents’ comments and/or suggestions, all of the respondents admit that they have not heard any environmental strategy for construction site in Malaysia, and agreed that it is important to have the environmental strategies for construction site as a term of reference (especially towards local contractors). Additionally, most of the respondents claimed that they have their own sustainable/environment strategies applied on their construction site, albeit simpler one such as recycling waste materials. Furthermore, there were also suggestions by them, including; providing adequate training for contractors and workers on environmental strategies, and also the use and installation of IBS product – since IBS is considered as one of sustainable material. Nevertheless, all comments and/or suggestions by the respondents were not affecting the core sustainable strategies proposed by the research. Finally, the respondents have given their thoughts on constraints to contractors if the strategies were to be applied. From the analysis, five (5) respondents (named as R1, R2, R5, R6 and R7) has stated that the cost of the construction may slightly increase, which will affect the contractor the most.

6. Conclusion
The majority of respondents responded that environmental strategies in construction site is significant. Thus, the establishment of the said strategies is inevitable, as a term of reference for Malaysians contractors. Thus, the research had identified and validated the generic environmental strategies that able to be self-implemented by Malaysian contractors. These strategies were considered as manifestation of the importance of conservation and preservation of the environment – as a result from the alarming effects of construction industry on the environment. Hence, the research proposed for subsequent research undertakings through quantitative endeavour, where generalisation and feedback from all construction practitioners are concerned. This is crucial in order to have comprehensive results before the actual implementation at construction site are conducted.
7. References

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