

# Assessing Awareness, Understanding, Construction Practices and Innovation towards Green Construction

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**Abstract:** *Green Construction is the construction activities that conserved energy, land, water and material to reduce the negative effect to the environment while assuring essential demand on quality and safety during project construction. This paper critically examine the contribution of awareness and understanding, green construction practices and green construction innovation with the green construction benefits. A measurement model based on the theoretical framework and exploratory factor analysis was developed and tested using structural equation modelling technique. This study employs a survey research methodology involving a total of 346 respondents among construction contractors, developers, clients and consultants in the construction industry. The findings indicate that the awareness and understanding, green construction practices and green construction innovation are significant predictors of the green construction benefits. From the practical perspective, the findings should alert the construction participants on the need of awareness and understanding, green construction practices and green construction innovation towards the green construction benefits. In addition, the findings can be used as diagnostic tool for continuous improvements in the Malaysian construction industry.*

**Keywords:** *Awareness and understanding, green construction practices, green construction innovation, green construction benefits, survey, Malaysia*

## I. INTRODUCTION

Construction is a major industry throughout the world, accounting a sizeable proportion of most countries' Gross Domestic Products [1], [2]. The growth of countries, especially developing countries, is measured by the physical development of construction projects. It has become more critical and generated more interest and attention from the government and construction project stakeholders in view of improving the performance in terms of cost, time and quality [3]. Green construction is relatively new compared to more mature disciplines like conventional construction. There are limitation and scarcity of information on certain aspects of green construction in the context of the construction industry. These areas include current practice, benefits, awareness and understanding and green construction innovation.

## II. LITERATURE REVIEW

It is important to discuss the current practice, awareness and understanding, green construction innovation and its benefits in green construction.

### A. Green Construction Practices

Green construction practices are currently focusing on enhancing biodiversity, improving air and water quality, controlling noise, reducing solid waste and conserving natural resources [4], [5].

The construction industry in China, for example is facing a great problem on energy consumption and pollution emissions. These impacts reflected in consumption of natural resources (e.g. water, energy and materials) [6]. Therefore, it is a great importance to solve the problems of land saving, energy saving, material saving and environmental protection during the construction process.

This can be realised through proper planning, design, production of construction materials, construction, installation, operation, maintenance and management of construction environment [7]. Besides, appropriate scientific management, for instance, the occupational health and safety management: OSHAS 18001, and advanced technology are important at guaranteeing the health and safety during construction of the project [8].

Research and development (R&D) is also one of the current practices in most of the construction firms to improve environmental performance [9]. In addition, [8] suggests the importance to recycle and

reuse the construction materials and control the discharge amount of carbon dioxide (CO<sub>2</sub>).

Country like Japan, UK, Sweden, Spain, Australia and the USA are actively implementing the environmental management system (EMS): ISO 14001 standard in construction industry to encourage the use of natural resources [10]. EMS is a standard emphasising the importance of managing elements of organisation's activities, products and services that interact directly with the environment [11].

EMS enables organisations to resolve environmental problems, reduce product cost, enhance the competitiveness of products in the international market, and increase the profit margin for the construction organisations [12]. In Hong Kong, for example, 150 construction firms are obtaining EMS: ISO 14001 as of September 2009 [13].

### B. Awareness and Understanding in Green Construction

Awareness of green construction is closely related to the public awareness of environmental issues. At present, the knowledge and cognition on the sustainability of all parties, including policy makers, owners, designers, construction personnel and the public need to be further enhanced [14]. Analysis from literature culminates the awareness and understanding are crucial to ensure a successful implementation of green construction [4], [5], [11], [15]–[19].

### C. Green Construction Innovation

There are a few suggestions and strategies for green construction innovation. One of the green construction innovations is waste minimisation that was developed from [21]–[24]. A proper waste management system [4], [5], [11], [16], [17], [19], [20] is required and as the key factor for a successful implantation of green construction. Among other green construction innovation: standardization of design, stock control to minimize over-ordering, environmental education for the workforce, recycling and waste disposal companies as part of the supply chain, practicing just-in-time delivery approaches, penalties for poor waste management, incentives and tender premiums for waste minimization, waste auditing, increased use of off-site techniques, use of on-site compactors, suppliers required to provide materials and products in small batch sizes, reverse logistics, imposition of stricter regulations, establishment of longer customer-supplier relationship, increased awareness of environmental, social and economic impact, implementation of environmental management system, support and push from top-level