

## EXPLORING CONTRACTORS' VIEWS ON GREEN CONSTRUCTION (CM-027)

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### ABSTRACT

Construction is known as one of sectors which contribute a significant amount of carbon dioxide (CO<sub>2</sub>) to the environment. Data from World Resources Institute 2010 shows the Indonesian construction/manufacturing industry contributes 18% of national CO<sub>2</sub> production and rank 7<sup>th</sup> in the world with production of 135,9 megaton of CO<sub>2</sub>e. Contractors, one of main construction stakeholders, play an important role in managing CO<sub>2</sub> production during construction processes. Their knowledge and policies on green construction will determine their actions towards green construction. This research aims to explore the current state of the contractors' view on green construction and how they respond to the green issues in construction. Data collection was done through structured interviews with four main government-owned contractors in Indonesia. The results show that they, in general, have recognized, have had some understanding of and have applied to some extent the concept of green construction, with one of them even made it as a company policy. Although detailed measures, standards, or guidance of their green actions are not yet available, some actions towards green construction were already done in the construction processes, such as in the material selection, site waste management, reduction of energy consumption on site, etc. These contractors' green actions should very much be appreciated, particularly as they were done in the absence of government regulations. In the future, more incentives from government are needed to encourage other contractors to follow their pioneers and to push more significant reduction of CO<sub>2</sub> in the Indonesian construction industry.

*Keywords: Carbon dioxide reduction, contractors, government incentives, green construction.*

### 1. INTRODUCTION

Construction is known as one of sectors which contribute a significant amount of carbon dioxide (CO<sub>2</sub>) to the environment. Data from World Resources Institute [1] shows the Indonesian construction/manufacturing industry contributes 18% of national CO<sub>2</sub> production and rank 7<sup>th</sup> in the world with production of 135,9 megaton of CO<sub>2</sub>e, while China ranks number one with 1887.2 MtCO<sub>2</sub>e, followed by USA and EU with 638.1 and 632.7 MtCO<sub>2</sub>e, respectively. It can be argued that the construction industry contributes a significant amount of Green House Gas emissions, and the Indonesian construction industry is among the top seven countries with 135.9 MtCO<sub>2</sub>e.

To anticipate the risings problem of global warming, the players the construction industry are expected to de-carbonise their own business, provide people with buildings that enable them to lead more energy efficient lives and provide the infrastructure which enables the supply of clean energy and sustainable practices in other areas of the economy [2]. Contractors, one of main construction stakeholders, play an important role in managing CO<sub>2</sub> production during construction processes. Their knowledge and policies on green construction will determine their actions towards green construction. This research aims to explore the views of government-owned contractors in Indonesia of green construction and how far this concept has been applied in the construction industry.

### 2. GREEN CONSTRUCTION

Traditionally, the design and construction of a project focuses on cost, performance and quality objectives. The raising awareness of preserving the environment has shifted this traditional view to a new paradigm which adding sustainable context to the design and construction of a project, e.g. minimization of resource depletion, minimization of environmental degradation, and creating a healthy built environment [3, 4]. In relation to this new paradigm, Huovila and Koskela [5] describe the evolution and challenges of the sustainable construction concept in a global context as shown in figure 1.

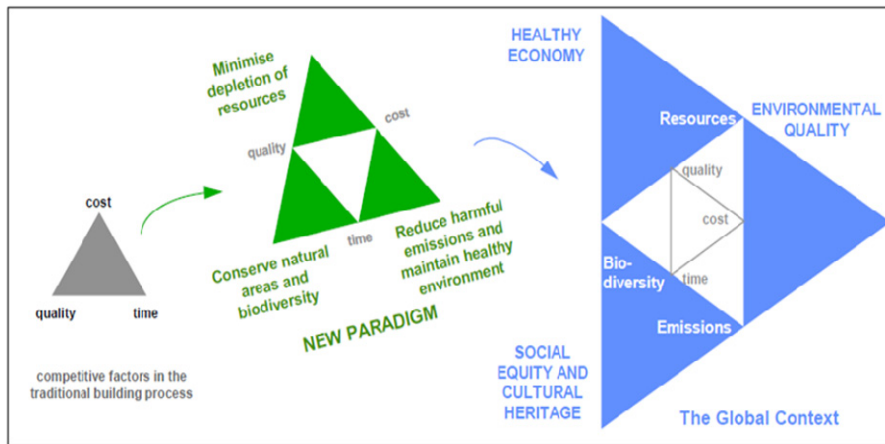


Figure 1. Evolution and challenges of the sustainable construction concept in a global context [5]

Sustainable construction, also known as green construction, is concerned with environmental issues by minimising the environmental degradation due to construction activities. In construction processes there are many activities which contribute to the emission of CO<sub>2</sub>. The scope for the application of green concept in construction processes includes the transport, enabling works, assembly, installation and disassembly activities necessary to deliver the service of construction [6]. Figure 2 below shows areas which become the scope and target of an action plan to reduce the carbon footprint of the construction industry in the United Kingdom. This action plan focuses on four areas highlighted as the largest emissions sources from construction processes, i.e. on site construction (plant and equipment) and site accommodation, transport associated with the delivery of materials and removal of waste, business travel and corporate offices.

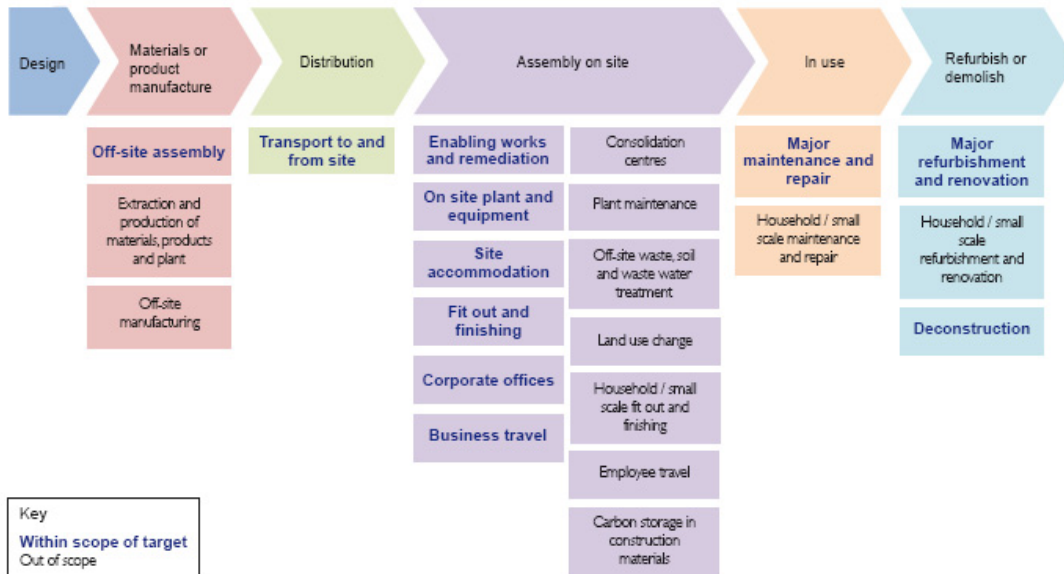


Figure 2. Scope and target of an action plan to reduce the carbon footprint of the construction industry in the United Kingdom [6]

In the United Kingdom, reducing carbon and other greenhouse gas emissions is now a matter of legal obligation. Under the Climate Change Act 2008, emissions are targeted to fall by 26% by 2020 (by comparison with a 1990 baseline) and by no less than 80% to 2050. A range of policies of tax, levy and market mechanisms are prepared to support this commitment, and broader issues around energy use. The broad strategy is increasingly important as the implications of a low carbon economy reach deep into every aspect of the construction industry, and that any plan for carbon reduction will depend upon the industry to be effective.

Currently many standards and guidelines are available to define or rate the “greenness” of a completed building or building components, such as LEED<sup>®</sup>, Green Globes<sup>™</sup>, EPA’s ENERGY STAR, and Building

for Environmental and Economic Sustainability (BEES). The International Organization for Standardization (ISO), American National Standards Institute (ANSI), and ASTM International have standards available for use or under development that address green building concerns. Indonesia's standard for Green Building called Greenship, has six aspects: Appropriate Site Development, Energy Efficiency & Refrigerant, Water Conservation, Material Resources & Cycle, Indoor Air Health & Comfort, Building & Environment Management [7].

### 3. CONTRACTORS' ROLES IN GREEN CONSTRUCTION

The green construction can be applied in many stages of a project's life cycle, as shown in figure 2. It can be seen there are many potential areas post design stage in which contractors may contribute to the application of green construction. It can be argued that, in general, the design of a green construction project might have already been determined by the clients and architects in the first place, hence the contractors' role in the implementation of a project is often limited by the project delivery system and the specifications already outlined in the contract. However, the contractors still can play an important role particularly during the process of the construction. When contractors are involved in the design process, they can add innovations and expertise based on practical experience with materials supplies and application. Below are what contractors may be capable of undertaking in terms of green construction [8]:

- Recycling and reusing construction and demolition debris
- Limiting the use of hazardous materials on the jobsite
- Protecting existing vegetation, donate cleared trees or mulch for use on site
- Making environmentally friendly purchasing decisions
- Procuring and installing more energy efficient mechanical and electrical systems
- Performing building commissioning activities
- Reducing particulate matter and nitrogen oxide emissions from existing equipment (to the extent economically and technologically feasible)

Despite the potential benefits of green construction, there are barriers on the application of this concept. Zhang et al [9] found three top barriers in the implementation of green strategy in real estate projects, i.e. higher green appliance design and energy-saving material costs, lack of motivation from customers' demand, and insufficient policy implementation efforts. They suggest that these barriers are related to lack of knowledge of green technologies and lack of green awareness and expertise.

### 4. RESEARCH METHODS

Data was collected through in-depth interviews with four main government-owned contractors in Indonesia. Interviews were carried out in the local branches of the companies. Emails and phones were also used for communications. This data collection technique allows deeper understanding through the vivid pictures elicited from the participant's perspective on the research topic which is suitable for an exploratory research. A descriptive qualitative analysis technique is used to compare the contractors' views and draw conclusions.

All contractors are national companies which have several branches throughout the country and were established more than 45 years ago in average. With the national scale of the contractors and the long years experience in the industry, they might be considered to be advanced in the current construction issues including green construction and, thus, can share their views and experience on this concept.

### 5. RESULTS AND DISCUSSIONS

The views from the contractors are described and summarised in table 1 below, so that they are comparable and lessons are more easily learned from them.

Table 1. Views of contractors on green construction

No	Parameters	Company I	Company II	Company III	Company IV
1	Knowledge of Green Construction (GC)	Yes, we know it.	Yes, we know it, but not in comprehensive way	Yes, we know it	Yes, we know it, but not in comprehensive way. Many criteria must be fulfilled such as working methods, equipment used, and human resources
2	Definition of Green Construction	A construction concept which emphasize on the energy efficiency, space layout, air circulation while preserving the nature.	A construction concept which emphasize on reduction of environmentally harmful activities while keeping the nature balance	A construction concept in which the construction stages are environmentally friendly; from material procurement, construction processes and products.	A concept in running the company while preserving the environment
3	Application of Green Construction	Energy efficiency, building design which is in harmony with the surrounding environment, eco-friendly materials	The use of Self Compacting Concrete (SCC), reduction of the amount of wood used in the project, the use of long-lasting materials	The used of light weight concrete to reduce the use of crushed stones, non Pb fuel, substituting fuel with coal to operate Asphalt Mixing Plant (AMP).	The use of bio septic tank which is more eco-friendly
4	When to apply the concept of green construction in a project	Depending on the owner, we just do as planned	Depending on the owner	In every project	Depending on the owner, the funder and decision maker
5	Does green becomes company's mission?	Yes, but depends on the owner	Not yet officially, but we are going towards green as we adopt ISO 14001	Yes, it now becomes our top management's commitment	Not yet, the government regulation is not yet available, but we care with the environment
6	Benefits of Green Construction	Business opportunity to win a green construction project. Help the customer preserve the nature.	Saving cost due to efficiency & alternative solution which is low cost & last longer. Trust from customer	Minimizing the costs by optimising the resources. No difference in terms of quality	Easier in terms of construction techniques, hence saving the time and cost
7	Disadvantages of Green Construction	None	None	None	None
8	Innovations to support Green Construction	The use of steel formwork and scaffoldings which can be used repeatedly to reduce the use wood materials	The development of Self Compacting Concrete (SCC) to reduce the energy used in concrete compaction	The used of light weight concrete to reduce the use of crushed stones and precast concrete to reduce the use of wood formwork.	No innovation yet. Eco-friendly Bio septic tank
9	Green Construction vs conventional terms of working method	About the same, No significant difference	No significant difference	No significant difference, but easier for certain job	It is harder for certain jobs due to different working method

No	Parameters	Company I	Company II	Company III	Company IV
10	Green Construction vs conventional in terms of Cost	GC more expensive, but lower maintenance costs	GC a little bit more expensive, but lower costs due to efficiency	GC more expensive in project cost, but lower maintenance costs	GC more expensive, but lower maintenance costs
11	Criteria for environmentally-friendly materials	Minimizing the use of glasses, the use of more durable materials, environmentally friendly paint	Minimizing the use wood, the use of concrete additive to reduce the cement	environmentally friendly paint	Minimizing the use wood
12	Manual procedures for GC	Not available	Not available	Available, embedded in the working method procedures.	Not available

From the results as summarised above, it can be learned that in general all contractors show some understanding and knowledge of green construction. Most of them are able to explain the concept of green construction in general terms and see the potential benefits on the application of this concept. They define green construction as a concept in construction in which the construction stages are environmentally friendly; from material procurement, construction processes and products. This suggests a good starting point to the application of green concept in the construction industry in which they play in an important role.

Regarding the application of the green construction, two contractors refer to the application within the construction processes, e.g. the use of Self Compacting Concrete (SCC), reduction of waste of materials, etc. The other two refer to the application in the design of the building, e.g. the energy efficient building design, material choices, etc, which are mostly the scopes of designers (architects). The ability of the contractors to explain the application of green construction during the construction phase suggests a good understanding on the roles, contributions, responsibilities and opportunities of contractors as the main executor in a project to take part more actively in a green construction project. On the other hand, those who view the green concept more in the design of the project might not fully understand which parts in green construction are the contractors' responsibilities. They might simply follow the green design of the architect which might, unfortunately, lead to the failure to make more contributions in greening the construction process.

The initiatives to apply the concept of green construction in a project are mainly still depending on the owner. This is also reflected in the absence of green concern in the companies' mission statements. Furthermore, the manual procedures for the application of green construction are also not available. Clearly, the absence of manual procedure will not guarantee further applications of green construction. This is somewhat contradictory to their initial claims that they are green-aware companies.

Only one contractor mentioned the application of the green concept in its every project, not depending on the request of the owner. This company also consistently state green as its mission, supported by commitment from top management and manage to explain the application of this concept very well. In addition, it also claimed that it has manual procedures for green application during the construction phase which are embedded in the working method procedures.

The contractors' dependency on the owners' request on the implementation of green construction might be a hindrance to more contribution of the contractors. Although they recognise the benefits, they also realise that construction of a green project costs more than conventional project. The use of eco-friendly materials as designed by the architects may cost more than the regular materials. The absence of government regulation has been seen as one of the main factors the underdevelopment of the application of green construction. Most contractors mentioned that this depends on whether or not the clients ask for it. These factors are similar to the top three barriers of the implementation of green strategy in real estate projects as suggested by Zhang [9].

To promote and enhance the current practice of green construction, push and pull strategies can be applied. In the push strategy, the contractors as the main executor in the project are internally strengthened by educating and challenging them to show their commitments to the environments. To gain wider impacts, this can be done through the association of contractors as they can encourage their members to go green. Basically, when the contractors can be made to believe that their commitments to green construction will benefit them and the society, they will voluntarily apply this concept. The fact that the awareness of green life style is increasing, could also mean more opportunities in the construction market. At the same time, in the pull strategy, the government should provide regulations and start giving

incentives for the application of green construction. In terms of regulation, the construction processes which comply with green practices can be regulated. Incentives can be introduced such as tax reduction for green projects or green materials. This could eliminate one of the barriers of green construction related to costs.

## 6. CONCLUSIONS

This research has explored the views of government-owned contractors of their understanding and application of green construction. In general most contractors have a good understanding of the concept of green construction, know the benefits and claim that they have done something in terms of green construction. These claims, however, are not fully supported by the existence of manual procedures as guidance. This indicates that the current state of green construction is driven by the designers or architects who focus on the green design of the buildings, especially in reducing the energy used in the building during the phase of operationalisation. The challenges still remain for the contractors to work out how they can apply the green concept during the construction phase, and not only doing the projects as usual.

It is admitted that the views were only collected from 4 out of 9 government-owned contractors which might limit the generalization of the results, and this is only an early stage of a bigger research scenario to explore the current state of green construction in Indonesia. Yet, the results give some understanding of the contractors' views and applications of green construction. For future research, to have more thorough views, it is suggested to look at views from more number of contractors in the survey, as well as other construction stakeholders, such as clients, designers and users.

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