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# CONTRACTORS' PARTICIPATION IN SUSTAINABLE CONSTRUCTION

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**Abstract**

*Construction activities consume high quantity of natural resources which give negative impact to the environment. Contractors are directly involved in these activities. Therefore, they are responsible to minimize this negative impact apart from maximizing their economic contribution. Based on literature reviews, this paper presents three aspects of contractors' participation in sustainable construction, which are improving the efficiency of the construction process, conserving energy, water, and other resources during construction and minimizing the amount of construction waste.Contractors should realize the importance of improvement of their sustainable performance in order to improve their business. In conclusion, contractors need to take serious actions for planning and managing their construction work with regards to minimize the environmental impacts related to the construction process.*

**Keywords:**Contractors' participation, Sustainable construction, Construction process, Conserving resources, Construction waste.

## 1. Introduction

The term sustainable construction is generally used to describe the application of sustainable development in the construction industry. Sustainable construction creates and operates a healthy built environment based on resources efficient and ecological principles. Later, the definition of sustainble construction has been extended to four pillars, namely social, economic, biophysical and technical (Hill and Bowen, 1997). Sustainable construction creates a healthy built environment using resource-efficient and ecologically-based principles. This could be achieved through a sustainability framework for small and medium contractors to improve their performance against four dimensions of sustainability namely economic, environment, social and process (Trufil and Hunter, 2006). Green building is the practice of creating structures and using processes that are environmentally responsbible and resource efficient throughout a building's life cycle (EPA 2012). Life cycle of a building starts from siting to design, construction, operation, maintenance, renovation and deconstruction. Green building also known as a sustainable or high performance building.

Contractors play an essential responsibility in promoting sustainable construction within the context of construction industry by assuming the responsibility to minimize their impact on environment and society and maximize their economic contribution. There are numerous benefits to contractor by implementing sustainable practice. In order to implement sustainable construction practice, there's a lot of research that has been done. A framework for implementing sustainable performance and business competitiveness to help contractors develope their sustainable strategies for meeting a changing competition in environment (Tan et al. 2011).

Green construction requires contractors to take actions for planning and managing the work regarding the minimization of environmental impacts related to the construction process. These actions include typically: (1) improving the efficiency of the construction process, (2) conserving energy, water, and other resources during construction, and (3) minimizing the amount of construction waste; and among other strategies that do not adversely impact the project budget or schedule and which may even reduce costs and increase productivity.

This paper focussed on three aspects of contractors participations in sustainable construction which are improving the efficiency of the construction process, conserving energy, water, and other resources during construction and minimizing the amount of construction waste

## 2. Review on contractors participations' towards sustainable built environment

Review on previous research on the innovation that has been implemented by the contractors in order to comply with sustainable construction practices. For examples, the challenges of innovation in sustainable development has been studied by Vollenbroek (2002). Contractors should realize the importance to improve their sustainable performance in order to improve their business. A role of environmental assessment tools in sustainable construction has been developed by Ding (2007). Contractors innovation during construction activities towards achieving sustainable construction can be classified into three category namely improving the efficiency of the construction process, conserving energy, water and other resources during construction, and minimizing construction waste.

### *2.1 Improving the efficiency of the consruction process*

Exploitation of new ideas which are more than just technology related can be related to process, market or management (construction research and innovation strategy panel (Manseu and Seaden, 2001). Construction process is a task or activity in construction project, generally viewed from the perspective of time. Efficiency in construction process can be defined as efficient construction site communication, managing time efficiently, managing waste and avoids waste production (Taib, 2010). Figure 1 shows the traditional construction process or activities, where contractors involved from site possession to handing over project to client. Within this process the contractor have the full authorities on the construction site.

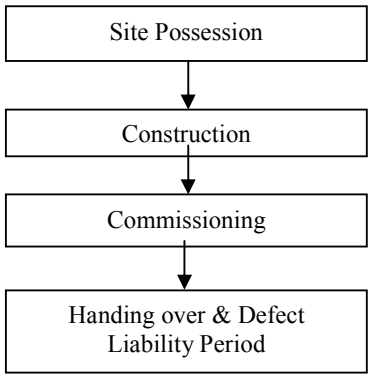


Figure 1: Traditional Construction Process

The contractor builds the building or infrastructure based on client's requirement that are translated in to plan and specifications and green construction only being implemented if required in the contract documents. Contractors has to control the construction process with or without green design and can take a proactive stance with respect to the environment and green construction (Glavinich, 2008). Contractor can strive to ensure that the construction process is efficient, uses renewable resources, and minimizes resources use and waste within the construction process through procurement, site layout and use, energy use, waste management and construction operation. During construction, the contractor can take the initiative to minimize the environmental impact of the construction process through procurement, site layout and use, energy use, waste management and construction operations.

Construction is a process and contractors can add green construction practices in the process. Figure 2 shows the green construction process. In this process there will be inputs that are process to output. The input will be labour, equipment and material. This input will be transform to output by construction means and method used by the contractors and during this process the contractors need to reduce waste as much as possible to save the ecosystem, because Green construction is about reducing waste and improving the overall efficiency of the construction process (Glavinich, 2008)

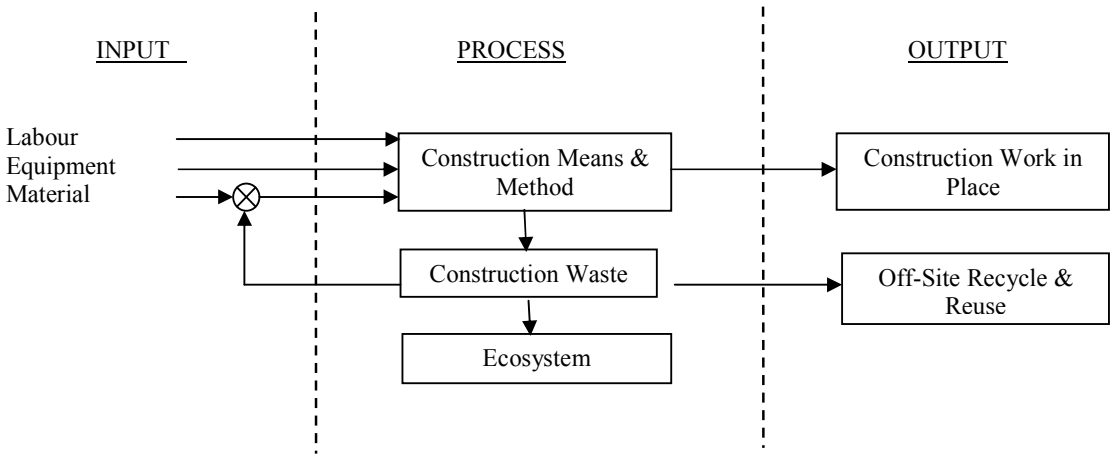


Figure 2: Green Construction Process
*Source: Glavinich (2008)*

Contractors can contribute to sustainable construction practices by innovation in management (Tatum 1987). Green project management practice can significantly improve the ability of a sustainable construction project to be delivered within acceptable cost constraints (Robichaud and Anantatmula, 2011).

*2.2 Conserving enervy, water and other resources during construction*

Seven principles of sustainable construction which would ideally inform decision making during each phase of the design and construction process, continuing throughout the building's entire life cycle Kibert (2005). The seven principles are:

1. Reduce resource consumption (reduce)
2. Reuse resources (reuse)
3. Use recyclable resources (recycle)
4. Protect nature (nature)
5. Eliminate toxics (toxics)
6. Apply life-cycle costing (economics)
7. Focus on Quality (quality)

These principles also affect the entire life cycle of construction from planning to disposal. In addition the principles also affect to the resources needed to create and operate the built environment during its entire life cycle: land, materials, water, energy and ecosystem.

***Land resources***
A philosophy of sustainable land use is based upon the principle that land particularly underdeveloped, natural or agricultural land (greenfields) is a precious, finite resource, and its development should be minimized. Effective planning is essential to creating efficient urban forms and minimizing urban sprawl, which leads to overdependence on automobiles for transportation, excessive fossil fuel consumption, and higher pollution levels. Like other resources, land is recyclable and should be restored to productive use whenever possible.

***Energy and atmosphere***
Energy conservation is best address through effective building design, which integrates three general approaches:
(1) Designing a building envelope that is highly resistant to conductive, convective, and radiative heat transfer
(2) Employing renewable energy resources; and
(3) Fully implementing passive design - Passive design employs the building's geometry, orientation and mass to condition the structure using natural and climatological features such as the site solar insulation, thermal chimney effects, prevailing winds, local topography microclimate and landscaping.

***Water issues***
The availability of potable water is the limiting factor for development and construction in many areas of the world. Water conservation technique include the use of low flow plumbing fixtures, water recycling, rainwater

harvesting, a landscaping method that utilized drought-resistant plants and resources conserving techniques. Innovative approaches to waterwaste processing and storm management are also necessary to address the full scope of the building hydrologic cycle.

***Ecosystems***

Ecosystem is one of the forgotten resources. Integration of ecosystems with the built environment can play an important role in resource-conscious design. Such integration can supplant conventional manufactured systems and complex technologies in controlling external building loads, processing waste, absorbing stormwater, growing food and providing natural beauty, sometimes referred to as environmental amenity.

Resource efficiency in construction is reflected by producing a building product with a minimum of resources and waste (Glavinch, 2008). Figure 3 provides a simple input-output model for the building product production process. In this simple model, raw material and energy are used to produce and deliver the finished building product to the building site for incorporation into the work. It should be noted that this simple two-step building product supply model comprising production process and delivery process actually represents the entire building product supply chain which would contain a myriad of sub-processes and activities depending on the building product being addressed.

Figure 3 shows the resource efficiency or reducing the material and energy inputs to the building product production process through production process design and waste minimization. Furthermore resource efficiency in the production of building products would necessarily deal with the use of other resources, such as labour, production equipment and capital, that are use to produce a building product. This is especially the case where increased efficiency in terms of raw material and energy used in the production building product is achieved through the substitution or increased use of other recourses.

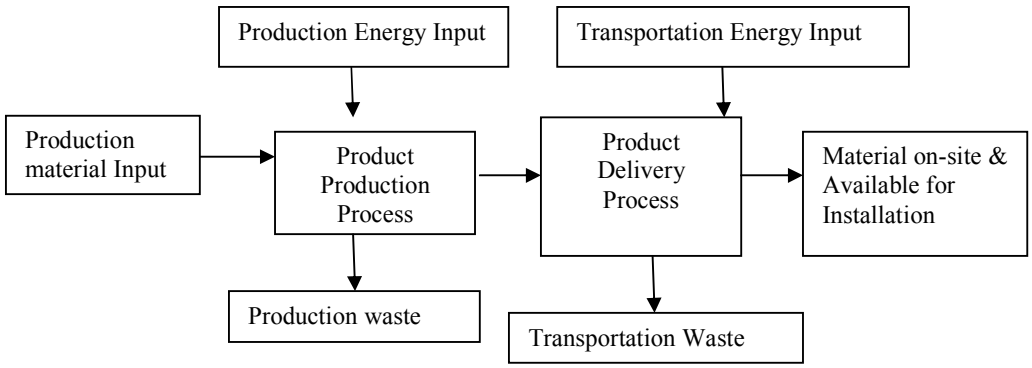


Figure 3: Input-Output Model for Building Product Production Process.
*Source: Glavinch, (2008)*

*2.3 Minimizing the amount of construction waste*

The built environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, both economic and environmental performance can be minimized. Green construction methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team takes an integrated approach from the earliest stages of a building project. For example, green buildings may incorporate sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources); create healthy indoor environments with minimal pollutants (e.g., reduced product emissions); and/or feature landscaping that reduces water usage (e.g., by using native plants that survive without extra watering).

Minimizing construction waste through new construction technologies implemented during construction activities will change how resources are used and wasted. Low wastage level through green technology in construction can be achieved by industrialized building system. In addition, the management practices to minimize construction waste by materials management should focused on thoroughly knowing and reducing the lifecycle impacts across the supply chain, using less material inputs (reduce, reuse and recycle), using less toxic and more renewable materials and considering services can be substituted for products.

## 3. Innovation in construction management practices: the way forward

Based on the literature reviewed, the contractors' participation in achieving sustainable built environment can be achieved through three aspects namely improving the efficiency of the consruction process, conserving enervy, water and other resources during construction and minimizing the amount of construction waste. New technologies in construction will influence the usage of resources and production of waste. However, the rapid changes or development in technological innovations could create demands on different types of resources and create new types of wastes. When many products in construction are quickly become obsolete, this probably will increase waste generation rates. Therefore, contractors should be more innovative in their construction management practices with holistic considerations of sustainable built environment.

Local construction industry is suggested to be more innovative in their construction management practices apart from the wide innovation in technologies available. The innovative practices of construction management should be able to be implemented by all local contractors regardless their project size.

The participations' of local contractors towards innovation in construction management practices based on three aspects as mentioned above, should consider the following factors:

- Level of knowldege on sustainable built environment
- Readiness and willingness of the contractors to change their traditional way of managing construction projects
- Contractors' awareness towards sustainable construction
- Elements of sustainble construction practices that practically can be implemented at local level

## 4. Conclusion

Although the impacts of construction activities on the environment are country dependent, the issues and problems created by the construction industry remains the same. Good practices from the developed countries should be analysed and assessed to suit local needs. The implementation of sustainable construction management practices should be emphasized for every construction works regardless of the project size and types. Despite constraints faced by developing countries, such as technical, financial, institutional, economic and social, it is hoped, with proper guidelines and enforcement from the authorities, the local contractors should be more innovative in their management practices to achieve sustainable built environment.

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