

Literature review on sustainable construction



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Literature Review

Literature review consists of providing the author knowledge about the research area that is being undertaken. It shows what authors have to say about the research area and to criticise works done previously, this is to be related to the topic area and to identify the central issues as part of the study. According to Dr S. G. Naoum (2007) there are five main activities involved in undertaking a literature review:

1. Knowing the sources of information.
2. Understanding how the library works.
3. Collecting existing knowledge on the subject, reading and note-taking.
4. Systematically organising the literature.
5. Appraising and writing up the literature review.

The literature review is conducted through primary and secondary research. Research can be conducted by using textbooks, journals, newspapers, magazines and websites and also on-line databases. Following structured and extensive literature reviews, key issues to sustainable construction and construction SMEs studied which result in identification of “barriers” associated with implementing sustainable construction by SME contractors. Such barriers are divided into six categories. These are cost, time, people, technology, market and law.

The literature review is two separate topics of “sustainable construction” and “construction SMEs”. Both topics provide the author with in depth knowledge about development and issues concerning sustainable construction, as well as the nature and characteristics of construction SMEs and their approaches to construction innovations. Combining the

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understanding and knowledge from both perspectives, the author carry out deeper exploration into the “ barriers” faced by the construction SMEs in implementing sustainable construction techniques and practices.

The barriers found in the literature are categorized under 6 “ key barriers” of cost, time, people, technology, market and law. These will form main questions in primary research.

Sustainable Construction

Within the UK construction industry, the concept of sustainable construction has emerged as a result of growing concerns on the environmental and social impacts created by the construction activities. By definition, sustainable construction is (Khalfan, M. M. A, 2002: 15):

“ The creation and responsible management of healthy built environment based on resources efficient and ecological principles”.

In general, sustainable construction is used to describe the application of sustainable development within the context of the built environment. The discussion and practise around sustainable construction often focus on the efficient processes of construction, use of materials, availability of technology and other technical side, which does not compromise the health of the environment or the associated health of the building occupants, builders, the general public or future generations (Rhydin, Y. & Vandergert, P, 2006: 5)

The Triple Bottom Line of Sustainable Construction

It is important to acknowledge and identify the other aspects of sustainable construction. As a whole, sustainable construction comprises of three broad themes of people, planet and profit often known as the “triple bottom line”.

The objectives of these three themes are (Constructing Excellence, 2004):

People

To recognise the needs of everyone impacted by construction, from inception of a project to demolition. The list includes construction site workers, local communities, the supply chain and people that will use the finished product.

Planet

To protect the planet from the impact of emissions and waste matter and where possible, to enhance it and use natural resources, carefully.

Profit

To increase profitability by making more efficient use of resources including labour, materials, energy and water.

(Source: <http://www.gcbl.org/economy>)

Sustainable construction takes account of these objectives in a balanced way at all stages of a construction project. However, within the context of this research, emphasis will be given the environmental aspect of sustainable construction, at production/construction phase.

Strategies and Drivers for Sustainable Construction

Strategies for sustainable Construction

There are many compulsory strategies as well as voluntary. These are aimed to encourage and enforce sustainable construction practices in the construction industry. One of the earliest strategies for changes in the construction industry has started with the publication of “ Rethinking Construction” in July 1998, which is famously known as The Egan Report. This report has criticised the under-achievement of the construction industry and hence, has urged for changes and improvements in delivering construction projects.

Following the Egan Report, the UK Government has taken an initiative in promoting sustainable construction through the publication of “ Building A Better Quality of Life” published by DETR in 2000. Within the publication, the government has suggested the following key themes for action on sustainable construction strategies by the construction industry:

- Re-use existing building assets.
- Design for minimum waste.
- Aim for lean construction.
- Minimise energy in construction.
- Minimise energy in use.
- Do not pollute.
- Preserve and enhance biodiversity.
- Conserve water resources.
- Respect people and local environment.

- Set targets (i. e. monitor and report, in order to benchmark performance)

Later in March 2005, the government has further emphasised its commitment towards sustainable construction through the publication of “Sustainable Development Strategy, Securing the Future”. As a substitute to the previous strategy, this publication has proposed four key themes for action, as follows:

- Sustainable communities.
- Natural resources protection and environmental enhancement.
- Climate change and energy.
- Sustainable consumption and production.

Drivers for Sustainable Construction

In promoting and encouraging the take up of sustainable construction, the UK Government has introduced more tough legislation and economic policies such as Revision to Building Regulation Part L, Landfill Tax, Quarry Tax, Aggregate Levy and Climate Change Levy. It has been acknowledged that legislation is the main driver for change towards sustainable construction. However, there are also other drivers, which play significant roles as well. These other drivers include (Vetter, A et al, 2006; DBA, 2002)

Improved technology

The new technology and innovation such as Modern Method of Construction and Lean Construction could offer a lot of benefits such as increase speed of construction, costs savings and better delivery of products and services.

Requirements from funding bodies

Funding bodies are laying more stress on the risks associated with unsustainable development. The risks will affect future profitability and shareholder value.

Business advantage

In highly competitive field, sustainability is becoming a potent differentiator, capable of providing a vital competitive edge.

On-site Practices for Sustainable Construction

With regards to the activities on construction site, there are five main practices of environmental sustainable construction that need to be addressed carefully. The construction team must understand and implement these practices throughout the construction phase in order to achieve the objectives and benefits of sustainable construction. These practices are waste management, energy consumption efficiency, water consumption/efficiency, use and procurement of materials, and protection of natural environment (biodiversity/ecosystem).

Waste Management

In 2001, construction site and demolition waste in Britain was 94 million tonnes (24% of all waste generated). Each year there are around 13 million tonnes of materials that are delivered to site but never used. (Constructing Excellence, 2004: 2). Considering these facts, waste management on-site is extremely important to minimising the waste produced on the construction site. The first step required is to segregate or separate the waste, as it is being produced. The next step is to recycle or reuse the waste or alternatively, the waste can be sent or sold to waste management centre to

be recycled or reused for other applications. At the same time, waste due to materials that aren't being used and packaging can be returned to the suppliers through purchasing policy.

Waste Segregation

An effective way to deal with waste is to separate it at the point it is generated. This eases separation for recycling and is therefore more valuable to the merchants of recycled materials. Waste can be segregated into different skips under categories of plasterboard, plastic, timber, cardboard stones bricks and slates can be recycled for use in construction. Wood materials such as off-cuts can be reused as woodchip for landscaping or in stud walls. Similarly, substances such as debris, rubble and earth can be reused for land reclamation and site formation. Perry (2003) argues that waste segregation helps to make sure that percentage is high of recycled materials and saves money, also provides a greater return. The increased rate of return virtually always offsets the higher costs of training and labour involved in on-site waste segregation.

Waste Recycling and Reusing

Construction waste can be minimised by avoiding making waste, reusing waste without reprocessing and recycling materials. (WRAP) Waste and Resources Action Programme advises that up to 30% recycling and reusing can be achieved in construction, at no additional cost for some projects. (Kent Design Guide, 2006). Re-used and recycled materials during construction include aggregates, insulation, plasterboards bricks, concrete roof tiles, particleboard blocks and reclaim timber. The most effective recycling opportunity of materials can be derived from the re-use of the

existing site infrastructure element where possible. These include materials that are salvaged from existing construction or demolition job such as steel and concrete.

Meanwhile, other waste such as timber, cardboard, paper and also green waste can be composed within a recycling area on-site. The compost produced can be used to enhance topsoil suitability for use within the landscaping. Wood chipping mulch produced from timber pallets. Also off-cuts and topsoil can also be re-used when possible within the landscaping to further minimise waste.

Purchasing Policy with Suppliers

Integration collaboration with suppliers can help to minimise waste through purchasing policy. Unused materials and waste from packaging can be returned to the suppliers to be reused or recycled. The adoption of (JIT) Just-in-Time delivery will also contribute to minimise waste this is because so materials are ordered and delivered to demand. This will avoid waste resulting from unused materials and improper handling/storage.

Energy Reduction/Efficiency

Energy consumed on construction site is mainly for site services such as the site office and site lightings, use of plain, machineries and equipment also transportation mainly for materials delivery to and from the site.

Reduce Energy Consumption for Site Services

In order to reduce the energy bills for site services especially for site office and site lighting, more energy efficient approach methods are encouraged.

This includes using energy efficient lighting and heating equipments, as well as the monitoring and controlling the energy use according to requirements.

Maximise Efficiency of Plant, Equipments and Machineries

Plant, equipment and machineries used on-site should be chosen for their high energy efficiency. Through good site management and construction planning, sharing of plant, machineries and equipment among subcontractors and site workers can be achieved. This will help to reduce energy as well as construction costs.

Reduce Transportation for Materials Delivery

Transportation accounts for 25% of UK CO₂ emissions and about 10% of national energy consumption used in the production and transport of construction products and materials. Two ways of reducing transportation used in construction is through local sourcing for materials with other suppliers and efficient deliveries.

Number of materials delivered to site should be reduced by making sure that full vehicle loads are achieved through sharing deliveries. Sourcing materials and labour locally will also help to reduce transportation and bring cost and time savings as well. (Constructing Excellence, 2004). At the same time, reusing demolition waste and materials can help to reduce transportation and hence reduce costs and pollution.

Water Conservation/minimisation

Use of water on-site can be reduced through application of water conservation techniques and “ Dry Construction” methods.

Water Conservation

According to Kibert (2005), techniques such as the use of low-flow plumbing fixtures, water recycling, rain water harvesting and potable water can help to minimise the use of water. Water used for worker's hygiene and sanitary can also be reduced efficiently through systems such as cistern misers which is boiler collecting water and water board " Hippo" for urinal flushes. These techniques have been used successfully during the construction of Princess Margaret Hospital in Swindon.

Dry Construction

The most effective method for dry construction is to use Modern Method of Construction such as pre-fabricated cladding systems and pre-manufactured units (e. g. bathroom and kitchen pods). Innovative techniques under Lean construction such as using ready mix cement/concrete and dry plaster linings can also contribute to minimising water used on-site.

Use and Procurement of Construction Materials and Components

Materials in construction make up over half of all resource use by weight. A sustainability issue gaining momentum in construction industry therefore, is the use of reclaimed and recycled materials. Pressures on landfill also mean it is becoming increasingly costly to dispose of excess material acquire in construction.