

Promoting Sustainability as a Strategy to Mitigate the Effects of Economic Downturn on the Construction Industry

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ABSTRACT: During the recent years followed by the Global Financial Crisis (GFC), most of business and industries around the globe have been hardly hit to the limit that it still struggling to survive, suffering from the crisis financial consequences. For instance, in the construction industry; many construction projects have been suspended or totally cancelled. Nevertheless, among this dilemma, a call has been raised to use the sustainable practices to mitigate the effects of the GFC on construction industry.

For the first look, it seems that there is contradiction since the sustainable solutions are often associated with an increase in the initial cost, undoubtedly, the sustainable practices have many advantages in both economic and environment aspects, however, the question which needs to be addressed here is, to what extent using such sustainable practices can mitigate the negative effects of the economic downturn on construction industry.

Therefore, it is a challenging argument for using such sustainable construction from its economic perspective, however, this paper is aiming to present the economical benefits of sustainable practices in construction industry, and trying to clear the doubt of the high initial costs of the sustainable construction through studying the life cycle benefit of green building.

Keywords: sustainable construction, economic crisis, life cycle analysis (LCA), green buildings.

1 INTRODUCTION

The awareness of the necessity of sustainable development including sustainable construction as an industry is growing around the globe especially in the last decade due to the increase of different concerns such as environmentally and economically ones. However, it still faces challenges in application, especially in the construction industry, moreover, and for the first look, it seems that the sustainability in construction projects increase the initial cost of the project, which adds a significant challenge. Nevertheless, taking the long life cycle in consideration, it can make a profit, moreover, according to (Santos, Carvalho et al. 2012) investing in sustainability will provide great opportunities for growth, competitiveness and innovation to manufacturing companies.

1.1 Definition of sustainable construction

To start analyzing the performance of the sustainable construction, the term of sustainable construction should be clearly defined first. In fact, the sustainability in general and particularly in the construction industry is a broad subject, in which a huge area of knowledge has been done

by different researchers and experts. As a result, there are numerous definitions for the term of sustainable construction, for instance, (Kibert 2012) has mentioned some of them such as "the creation and operation of a healthy built environment based on ecological principles and resource efficiency", another definition which is more closer to the aim of this paper is " how the construction industry together with its product the 'built environment', among many sectors of the economy and human activity, can contribute to the sustainability of the earth including its human and non-human inhabitants".

In addition, (Pitt, Tucker et al. 2009) confirmed that sustainable construction includes 3 main key area; Environmental responsibility, social awareness, and economic profitability. Kibert added that the sustainable construction concept works in 3 directions; principles, resources and phases (figure.1)

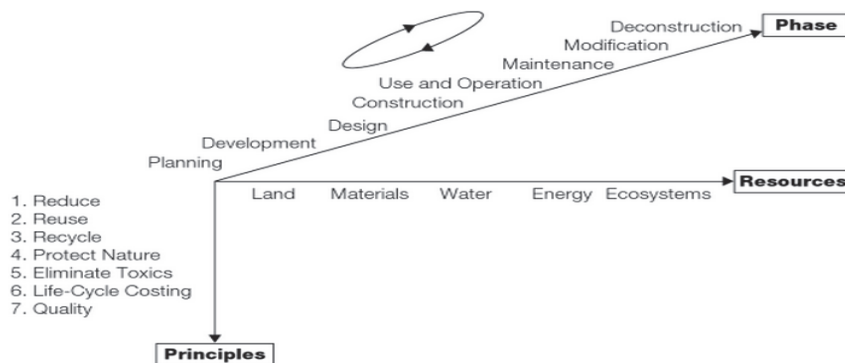


Figure 1 Sustainable construction supply chain, adapted from (Kibert, C. J. 2012).

1.2 The motivation of sustainability in construction

The sustainable construction is a major part from whole ongoing process of the sustainable development which mainly focuses on the sustainable built environment (Feige, Wallbaum et al. 2011), it depends on material and operation that are environmentally friendly. More closely, as a result of many crises we live today, especially the environmental ones such as the global warming, climate changes, and greenhouse gas emissions, a necessity has emerged to the surface to use sustainable practices. In fact, the built environment including construction industry is responsible for 40% of CO₂ emission, 30% of waste generation, and 20% of water effluent (Dent, Patrick et al. 2012), these figures raised the alarm to the construction stakeholders in order to change their way of construction practices and reduce the contribution of construction in environmental problems.

On the other hand, sustainable construction came to put a solution not only for environmental issues, but also economical as well, for instance using sustainable resources such as solar energy and the emphasis on waste recycling, can achieve economical sustainability rather than environmental one, comparing to the conventional construction.

2 The ECONOMIC MODEL OF SUSTAINABLE CONSTRUCTION

2.1 Introduction

Beside the positive environmental contribution to many critical issues such as global warming and greenhouse gas emissions, the sustainable construction have economic advantages when the following points is considered:

- the primary life-cycle savings for a high performance building will be a result of superior energy performance;
- life cycle savings can also be easily demonstrated for water and wastewater conservation measures;
- saving due to good indoor environmental quality (IEQ);

- saving due to materials conservation and recycling (Kibert 2012).

Furthermore, the green building council of the United States (USGBC) mentioned that, in order to have high-performance green buildings, the business case of this module should include the following principles:

- are designed for cost-effectiveness;
- boost employee productivity;
- enhance health and well-being;
- create value for tenants;
- increase property value;
- take advantages of incentive programs;
- benefit your community;
- achieve more predictable results(Kibert 2012).

2.2 The argument of high initial cost

A study done by (Rodriguez-Melo and Mansouri 2011) concluded that the sustainable practices in construction is crucial source for competitiveness and making profit, furthermore, (Chau, Tse et al. 2010) in their study mentioned that some users of these building are willing to pay more for this sustainable services. Nevertheless, the high initial cost of the sustainable construction is a main concern for most of the construction stakeholder especially the investors who have to pay extra money in order to meet sustainable criteria. For instance, in a survey done by the global green building trends in 2008 include about 700 of construction professionals, 80% of them believed that the main obstacle for the spreading of sustainable construction is the high initial cost (Kats 2013), and further studies have also shown that (Pearce 2008, Häkkinen and Belloni 2011, Robichaud and Anantatmula 2011).

Furthermore, this high initial costs is mainly divided in two groups of costs according to (Kibert 2012); Hard costs which is easily documented such as electricity, water, waste water, gas, solid waste; the other group is called Soft costs which is less easily to document such as maintenance, employees health, comfort and indoor environmental quality in general. Nevertheless, this additional cost formed an argumentative subject between the construction stakeholders, while some of them believe that it is necessary to reduce the price of sustainable alternative to make it equal or less than the conventional building through an integrated design that could reduce the costs of sustainable alternatives, others believe that the sustainable alternative pays back its initial high cost later through the life cycle of the building and there no doubt about it.

However, to give fare judgment about the high initial cost of the sustainable construction the life cycle analysis should be taken in to the consideration.

2.3 Life Cycle Analysis (LCA) of green building

As an application of the sustainable construction, the green building is by far is the best example of the sustainability in construction. According to (Kibert 2012), the sustainable construction techniques used in green building has not only an ethical and practical response to the issues of environmental impact and resources consumption, but also it has an economic sense on a life-cycle cost (LCC) basis. The life cycle of a sustainable building according to (Czarnecki and Kapron 2010) starts from the production of material for construction projects, then it goes to the construction and operation, at the end it goes to dismantling and recycling phase (figure2).

Furthermore, Kibert argued that although green building may be more expensive on a capital, or first cost basis, however, it will recoup their original investment within a relatively short time. In addition, specialists from (Ecoterra) - energy consultant company, based in US and considered as innovative company in sustainable solutions - has confirmed that life cycle costs of the

building in 30 years could reach up to four times of the initial cost of building construction (figure.3)

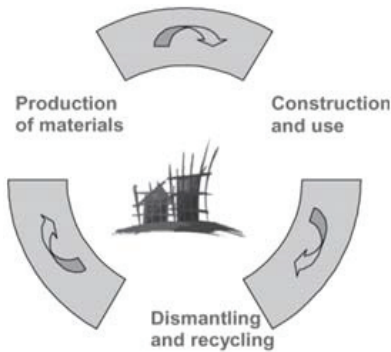


Figure 2. Building life cycle, adapted from(Czarnecki and Kapron 2010).

■ Initial costs ■ Oper. & Maint.

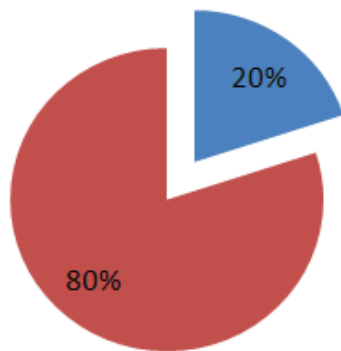


Figure 3. Lifecycle Building costs, adapted from (Eco Terra).

In addition, a report to California Sustainable Building Task Force states that an increment about 2% in green building investment would result in saving about 10 times of this initial increment but in the long life cycle of this building, which means that an increment of \$ 100,000 would result in \$ 1 million saving for a building in the life cycle in about 20 years (Kibert 2012). Furthermore, (Kats 2013)in his study for 170 U.S. buildings and 10 non-U.S. buildings mentioned that the majority of green premiums ranging from 0% to 4%, which means that the green building cost a little extra money comparing to the conventional one. This cost generally range from \$3/sf to \$9/sf, with the concept of the greener the building, the greater the cost premium.

For instance the following tables (T1) shows an analysis for typical green building, the total net present value (TNPV) over a period of 20 years for the green building ranges from 48\$ for LEED certified and silver, to 67 \$ for Gold and Platinum LEED, taking in consideration that the incremental construction cost ranges from about \$1.50p to \$9.5 per square foot for certified to platinum LEED. Furthermore, another study done by the U.S. National Renewable Energy Laboratory (NREL) shows that the sustainable building payback the extra cost of sustainable features almost in one year in some cases, which is quite significant (T2: the save mainly in one item).

Furthermore, another study done by (Morris and Matthiesen 2007) which compared 83 green building projects with 138 conventional building projects has confirmed that there is no significant difference in average costs for these project.

Table 1. TNPV analysis for typical green building over a period of 20 years, adapted from (Kibert 2012).

Category	TNPV (20 years)/ ft2
	\$
Energy Value	5.79
Emission Value	1.18
Water Value	0.51
Waste Value- Construction only, one year	0.03
Commissioning O&M Value	8.47
Productivity and Health Value (Certified and Silver)	36.89
Productivity and Health Value (Gold and Platinum)	55.33
Less Green Cost Premium	-4.00
Total 20 years NPV (Certified and Silver)	48.87
Total 20 years NPV (Gold and Platinum)	67.31

Table 2: Cost saving analysis for other sustainable building, adapted from (Kibert 2012).

Feature	Added costs	Annual Savings
Energy-efficiency measures	38,000	4,300
Commissioning	4,200	1,300
Natural landscaping, storm water management	5,600	3,600
Raised floors, movable walls	0	35,000
Waterless urinals	-590	330
Total	47,210	44,530

2.4 Aspects of sustainability in green buildings

2.4.1 Energy

Saving energy is considered the greatest challenge in sustainable construction. According to US energy information administration, building is responsible for consuming 41% of electricity consumption, while transportation following with percentage of 28% and 31% for the industry sector (EIA 2011). Furthermore, energy consumed by building is responsible for:

- 47% of U.S. sulfur dioxide emission;
- 22% of nitrogen oxide emission;
- 35% of carbon dioxide emission (Kibert 2012).

As a result from the energy efficient building (Wiley, Benefield et al. 2010) confirmed in their study that the return of efficient energy building will be more than the conventional one. Furthermore, using sustainable construction practices in energy sector could reduce its consumption to almost the half, for instance Kibert argued that today's green buildings typically reduce the consumption of commercial building from 100,000 BTU/ft2 per year (292 kWhr/sq meter/year) to less than 50,00 BTUs per square foot each year (146 kWhr/square meter/year)" which is almost the half. Furthermore, in order to maximize the benefit of sustainable practices in construction, passive design should be used, which mainly depends on the nature component such as day lighting, natural ventilation, solar water heating system, etc.

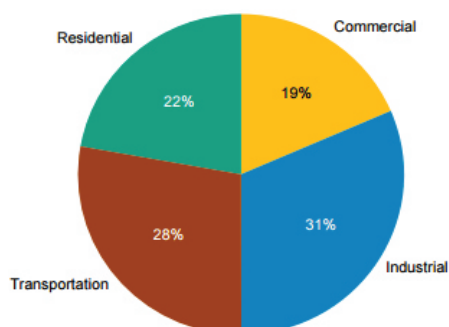


Figure 4. Electricity consumption per sector, adapted from (EIA 2011).

2.4.2 Water

In a survey done by (Issa, Rankin et al. 2010), the water conservation comes a second priority in green building area after the energy, unsurprisingly, this result reflecting the importance of water in our daily lives since it is a main source for keeping the life running on earth planet, it is the main content of human body about 97%, However, only 2.5 % of earth's water is freshwater, and of that, three-quarters is sequestered or locked up in glaciers and permanent snow cover or buried deep in the ground . Furthermore, waterborne diseases, including diarrhea, typhoid and cholera, are responsible for 80% on illnesses and death in developing countries (Kibert 2012).

Although direct consumption by building is not a large comparing to agriculture consumption which consume 80% of total water use in United states with a 60% of wastage due leaky canals, evaporation, and mismanagement; some area around the world suffer from insufficient supply of drinkable water. Furthermore, the main goal for implementing sustainable practices in water management is to help to minimize the water consumption to the level of 190 liters (outdoor), and 85 liters (indoor) per capita per day (Kibert 2012).

Other benefits from applying sustainable practices water resources management:

- energy saving;
- reduced wastewater production;
- lower facilities services investments;
- improved industrial process: through innovations in water application;
- higher worker productivity;
- reduced financial risk(Kibert 2012).

2.4.3 Material

"It is shown that the cost of green materials need not dictate the cost of green buildings, and that knowledgeable designers can utilize green materials, including some that ostensibly cost more, without increasing overall project costs" (Malin 2000).

In fact, the traditional way of construction is responsible for generating a huge percent of wasted material. Thus the role of the sustainable practices is to minimize this percent of waste in order to save the nature as well as the cost. The basic principles of the sustainable practices regarding to material focusing on the following points:

- Reuse existing structures;
- Reduce material use;
- Use materials created from renewable resources;
- Reuse building components;
- Use recyclable and recycled content material;
- Use locally produced materials(Kibert 2012).

2.4.4 Indoor environmental quality

In fact, there are strong correlation between the place where we reside and our health and productivity, in other words, the building design has indirect effects on the health and productivity of its occupants whether they are normal residents or worker, depending on it is function. According to (Nurul Diyana and Zainul Abidin 2013) there are several studies proven the positive effects of sustainable construction on the productivity of the occupant, for instance, a study by Fisk and Rosenfeld in 1998 shows that the annual cost of indoor air quality problems ranges from about 30 to 170 \$ billion (Fisk and Rosenfeld 1998), another study done by (Kats and Capital 2003) shows the value gains from less sickness ranges from 37 to 55 U.S. dollars per square foot.

3 DISCUSSION AND CONCLUSION

In fact, the sustainable application in construction industry has enormous advantages not only limited to the environment, but also to the economy and indirect cost saving such as indoor environmental quality. While most of the construction stakeholders are worried about the initial cost of the sustainable solutions, the earlier presented data shows that the premium cost due to sustainability in construction industry costs a slightly more by a maximum of 5%, and it has the ability to pay back the premium investment but in the life cycle of the building, not only that but it can save up to 10 times of the initial costs, furthermore, the application of sustainability in building can save a lot of money indirectly by improving the productivity and limits different costs associated with indoor environment quality problems such as sickness and medical treatments. This information gives clear answer for the construction stakeholders especially the governments and private investors clearing the doubt about the increase of the initial cost they pay and will encourage them to invest in this sustainable option.

Therefore, the future of the investment in sustainable construction is promising, serious steps have been taken by different construction stakeholders starting from governments and private sectors to move toward sustainable practices in the construction industry. Certainly this sustainable movement in return will enhance the construction market in particular and the whole economy in general during the current recession through bringing more investment in construction industry weather for new projects or retrofit of existing buildings.

Nevertheless, although the sustainable construction has an economical advantage besides the environmental, however, the effects of sustainable construction will be limited only to mitigating the effects of the current recession on the instruction industry, but to solve the economic crisis for sure. Furthermore, it could be more effective to use incentive to encourage the private investors or even imposing laws by the local government to insure the implementation of this kind of sustainable construction. In fact, the benefits of using sustainable construction is not limited on one party only, but it will be reflected on everybody living on this earth, so it should be responsibility of all to insure the implementation of this precaution measures in the construction industry in order to insure friendly environment not only for the time being, but also for generations to come.

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