

Accelerating the Green Movement: Major Barriers to Sustainable Construction

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Despite the growing trend of adopting more sustainable practices in construction, the paradigm-shift of “becoming green” still has to respond to serious challenges for further improvement. From the industry professionals’ viewpoint, many of the sustainability methods suggested by the research, are not smoothly applicable to the real world of the construction. This paper is a result of a study in which eight major barriers to applying green practices were identified through a pilot survey and the findings of the similar studies. In a second survey, the industry professionals were surveyed, and the relative importance index method was used to rank the barriers based on their criticality. The results show that the investors’ unwillingness to pay the additional initial costs of the green buildings is the primary barrier. The seven other barriers are ranked and discussed. The research indicates that for increasing the willingness of the industry to the green movement, the additional initial costs and the extra efforts required for sustainable construction must be handled and compensated through other incentives. The findings of the research are expected to contribute to sustainable construction by reflecting what needs to be done to create more practical and applicable practices which are more likely to be adopted in the real world of the construction industry.

Key Words: sustainable construction, barriers, building green

Introduction

Although the necessity of moving towards a more sustainable construction industry has made promising improvements in the recent years (Robichaud and Anantamula, 2010), the achievements are not sufficient to reverse the negative environmental impacts of the built environment (Robichaud et al., 2010). Identifying the barriers to sustainability in construction, specifically from the viewpoint of private owners is essential to accelerate the pace towards sustainable construction (Sourani, 2011). When challenges are clearly understood, the construction industry decision makers should collaborate to develop practical solutions to overcome these challenges (Koonts, 2006).

Despite the fact that significant research has been conducted suggesting different practices and techniques to enhance the sustainability of construction, in practice, the construction industry seems to be unwilling to apply most of these methods. Considering the quantity of the research focused on this topic, and the efforts and investments to conduct it, plus its potential in evolving the sustainability in construction, it should be investigated why the owners and developers do not seem to be interested enough to apply the outputs of the research in their projects. This could be attributed to some barriers in the industry that limit the application of the new sustainability guidelines. As an example, cost constraints are the dominant factor while making decisions in the construction industry. Some of the major barriers to sustainable construction in the literature are the following:

1. Green construction is commonly considered more expensive than conventional construction (Kats et al., 2003).
2. Applying green policies requires knowledge and expertise (Tafazzoli, 2017).
3. Applying green policies will add multiple standards and constraints in projects design, construction, maintenance, rehabilitation, and demolition (Van Bueren and Priemus, 2002).

The purpose of this study is to investigate and reflect the construction industry professionals’ concerns and limitations in implementing the sustainable construction practices and methods that are advised by the research. The study explains how the research should evolve to reflect the real world’s limitations to offer methods and recommendations that can be more smoothly applied. Based on this, the paper has the following purposes:

1. Investigating the barriers to the green construction in the viewpoint of the construction industry professionals
2. Prioritizing the challenges based on their criticality by reflecting the construction professionals’ concerns
3. Providing recommendations to overcome the major challenges of the sustainable construction

Background

A considerable amount of research has focused on highlighting the dominant role of the construction industry in sustainability. It is known that the construction industry, in a global scale, has significant negative impacts on 1) the depletion of natural resources (Alfsen et al., 2007), 2) air and water pollution (Pasquire, 1999), 3) generation of solid waste (Gavilan and Bernold 1994), 4) deforestation (Geist et al., 2002), 5) generation of toxic wastes (Peng et al., 1997), and 6) global warming (Augenbroe et al., 1998). Based on the report published by the United Nations, (UNEP 2007), the built environment has the main role in exacerbating environmental issues. This can be explained by considering the share of the built environment in major environmental concerns as shown in Figure 1.

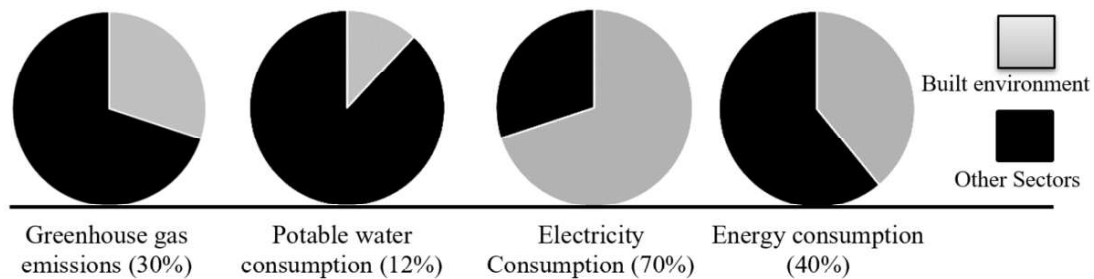


Figure 1: The share of the built environment in four environmental concerns (Tafazzoli, 2017)

The necessity of switching to more sustainable practices in the construction industry has been focused on by numerous studies (Tafazzoli, 2016; Goleman, 2010). Thanks to the raising of public awareness about the essentiality of sustainable development, attempts for mitigating the negative impacts of the construction on the built environment has been taken more seriously in the recent decades (Holmes et al., 2000; Robichaud and Anantamula, 2010). In addition to people and policymakers, building professionals' interests have also risen to make more sustainable buildings (Rees, 1999). The research with regard to sustainable construction has evolved from explaining the negative impacts of the construction on the environment (Gangoellis, et al., 2009) to introducing and explaining the concept of sustainable construction (Hill and Bowen 1997) and then to developing or expanding different practices that can contribute to the green movement (Ding, 2008).

The problem with the outputs of different studies that suggest new sustainable construction methods is that in the real world, the industry is not welcoming to adopt them for various reasons (Van Bueren and Priemus, 2002). There is limited research conducted to investigate the barriers to more sustainable construction. Some of the studies that have focused on this topic and their findings are listed in table 1.

Table 1

Major barriers to thriving of sustainability practices in the literature

Author	Study Area	Year published	Major barriers
Van Bueren and Priemus	Netherland	2002	Institutional factors
Studer et al.	Hong Kong	2005	lack of a legal requirement to report sustainability, poor support from senior management, no demand from shareholders for sustainability reporting
Williams et al.	England	2007	Sustainability measure is not considered by stakeholders
Pitt et al.	England	2009	Low affordability
Pinkse and Domnisse	Netherland	2009	Costs for the contractors
Sourani	England	2011	lack of funding, restrictions on expenditure and reluctance to incur higher capital cost when needed

Research Methodology

This study is focused on finding the barriers to accelerating the green movement in the real world of the construction industry. For this purpose, the four following steps were taken:

Step 1: Investigating the Sustainable Construction Potential Barriers

The first step to find the potential reasons why the construction industry professionals find many of the recommendations and practices suggested by the research unaccommodating was to investigate the possible hindrances in the professional construction environment. This was done in two steps:

- 1) *Reflecting the findings of the existing research.* A comprehensive review of the studies discussing sustainable construction was performed. The major barriers that were mentioned in the research were listed.
- 2) *Interviewing the Construction industry professionals.* A Sample of twelve construction professionals including general contractors and construction managers and highly experienced field engineers were interviewed and were asked about their concerns, challenges, hindrances and any reason that can make them unwilling to adopt the sustainable construction methods and practices. The pilot survey was based on the assumption that the experts are informed about the suggested practices and methods and yet they prefer not to adopt them in their projects because if not being aware of these practices is the reason, then the results cannot reflect the real causes of the unwillingness of the construction firms to apply the sustainable methods.

Step 2: Conducting a Survey for Criticality Ranking of the Barriers

A survey was developed to assess the criticality of the barriers to sustainable construction in the viewpoint of the industry professionals. An online questionnaire was designed, in addition, hard copies of the survey were distributed. Invitations to complete the survey were sent to almost 1300 different construction industry professionals in different states. Respondents were asked about the major type of their involvement in construction projects (designer or contractor) and years of experience in the industry. They were also asked to rate each potential sustainability barrier with a number between '1' to '5', where '1' indicated the lowest and '5' indicated the highest level of criticality. None of the questions were forced responses in order to maintain the quality of responses; therefore, a different number of responses have been collected for different questions. In addition, this survey tool made it possible to check how much time the respondent spent in answering the survey; this allowed the administrator to eliminate the responses that were generated in less than one minute.

Step 3: Analyzing the Data and Interpreting the Results

The results of the survey were analyzed using the Relative Importance Index (RII) method. RII is a method that aids in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables (Tafazzoli and Shrestha, 2017). The equation 1 was used.

$$RII = \frac{\sum W}{A \times N} \quad (0 \leq RII \leq 1) \quad (1)$$

where:

W = the weight given to each factor by respondents and ranges between 1 and 5

A = the highest weight (i.e. 5 in this case) and;

N = the total number of respondents

Step 4: Analyzing the Data and Interpreting the Results

Based on the results, some policy recommendations to handle the barriers were provided. Some of the recommended policies reflect the facts about the sustainable construction that can help to handle the barriers caused by the construction professionals' inaccurate judgments about the challenges of applying the sustainable practices. Other recommendations reflect some required approaches and changes to break through the barriers.

Results

In the first step, the barriers to sustainable construction were investigated through reflecting the findings of the similar studies and combining it with the outputs of the pilot survey. Based on this, the barriers in the viewpoint of the owners and developers are listed and explained in the eight following categories.

1. *Unwillingness to Pay the Additional Initial Costs of the Green Buildings.* While the idea of following sustainability measures is appealing to most people, in practice, many owners are not willing to accept the additional expenses for contributing to the environmental and social aspects of sustainability and monetary factors seem to be the main incentive to them. This is also supported by the findings of research; McGraw-Hill Construction conducted a research in 2006, between 400,000 architects, engineers, and contractors to investigate the top incentives for them to choose green construction. The results revealed that financial concerns were more than twice as important for the contractors (54%) compared with their environmental concerns (24%). The unwillingness of the owners will direct the developers to less expensive options which may be not sustainable choices.
2. *Decelerated Construction Speed to Fulfill the Added Sustainability Requirements.* In the viewpoint of the constructors, quick delivery of projects has the high priority. Many of the suggested sustainable methods require extra time for procurement, installation, inspection, and if acquiring a green building certificate is pursued, the fulfillment of the requirements has to be recorded and documented. This is in contrast with the desire of the owners to finish the project in the minimum possible time.
3. *Inadequate Increased Market Value of Sustainable Buildings to Cover the Extra Initial Costs.* The price difference of a building for being sustainable, in many cases, is not sufficient to compensate the extra costs of implementing the green practices. This is because green buildings' additional initial costs are expected to be paid off through their life-cycle. However, the buyers' unwillingness to pay extra for more sustainable buildings discourages builders to invest in green buildings as they know the marketability of these buildings is not high enough to cover the expenses and the extra efforts it requires to design and construct them.
4. *The Sustainable Building Beneficiary Being Different from those who Pay for the Sustainable Construction.* The construction investors, in many cases, are not the individuals who benefit from the savings which occur during the life-cycle of the project (Yudelson, 2008). What makes the additional initial costs economically sense is the return of the additional investment mainly through cost reduction of energy and water because of consumption reduction and efficiency increase; however, investors are seeking short-term interests and they will not benefit from the less expensive power and water bills. Additionally, based on the findings of the previous research, reducing the initial costs is more important than reducing operational costs for most investors (Robichaud and Anantatmula, 2010).
5. *Difficulty of Providing Special Expertise for Sustainable Construction.* Certain sustainable construction measures need the expertise that conventional construction team may not have. Examples are the installation of a green roof or construction of a net zero building. The need to hire more experts to implement some of the sustainability standards is a constraint for the builders as it forces extra expenses to the project and depends on the availability of the experts which can make the construction schedule more complicated.
6. *Difficulty of Providing Special Materials for Sustainable Construction (Cost, Availability, Maintenance).* Sustainable measures with regard to construction material encompass comprehensive methods of extraction of the raw materials, processing, delivery, installation, maintenance, and restoration. In each section, certain standards must be met. In the viewpoint of the builders, these standards limit their freedom in procurement and use of materials. Additionally, sustainable construction materials are commonly more expensive, and in certain areas, they are less available and require to be delivered from other regions. While builders have access to less expensive and more easily available conventional (and not necessarily sustainable) materials, encouraging them to make more sustainable choices about materials will not be easy.

7. *Lack of Effective and Sufficient Governmental Support.* Since there is no significant monetary interest in building and selling green buildings, the developers need additional incentives that can encourage them to be willing to accept the additional initial costs and efforts of pursuing sustainable construction. The governmental support seems to be a powerful solution. However, in the viewpoint of the builders, this support is insufficient while there are potentials in it to be improved and act as an effective incentive.
8. *Plentiful, Impractical, and Inconsistent Methods, Standards, and Guidelines.* Considering the fact that construction industry is connected to numerous industries, materials, and experts, there are various sustainable construction approaches, methods, practices, tools, and guidelines which have been developed by the research and they are still expanding, and evolving. Private owners are commonly looking for the policies with maximum effect and minimum costs that can be smoothly applied in their projects. In the viewpoint of the industry professionals, the abundance and inconsistency of these methods in addition to a limited realistic understanding of the industry constraints to apply them is a barrier to adopting new sustainability methods and will cause the builders to prefer conventional methods which are well-established and easier to follow.

As it was explained in the methodology, in step two, the construction professionals were surveyed to rank the criticality of the barriers. The survey was responded by 67 experts. The respondents were professionals in different types of construction companies in the United States with an average experience of 23 years in the industry. The responses were inserted into the SPSS software and using the RII method the eight aforementioned barriers to sustainable construction were ranked based on their criticality. The data analysis of the survey reveals that *Unwillingness to Pay the Additional Initial Costs of the Green Buildings* is the primary barrier to implementing the sustainable construction practices. Figure 2 shows the criticality ranking of the eight barriers.

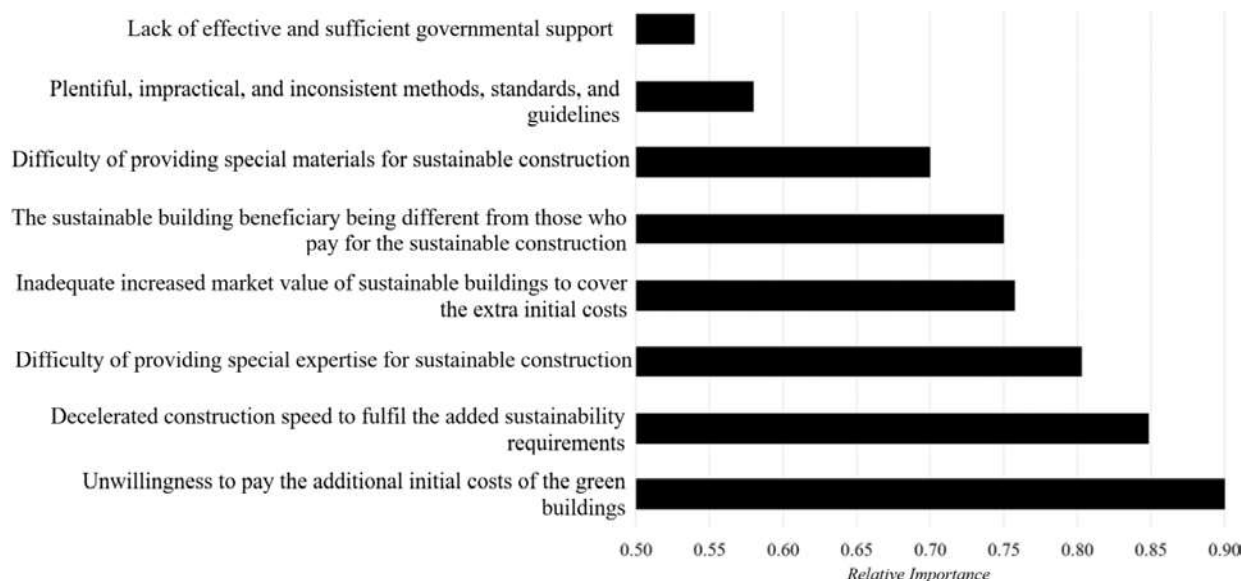


Figure 2: Relative importance index for the barriers to the sustainable construction

Analyzing the Data and Interpreting the Results

In the following, some policy recommendations to handle the major barriers are discussed. The recommendations are explained in three categories; 1) Handling initial additional costs, 2) Handling reduced speed of construction, and 3) Handling the need for special expertise.

Handling Initial Additional Costs.

Preparing Cost-saving Reports for the Owners. While it is known that implementing some of the sustainable construction measures creates additional initial costs to the project, many builders seem to have

overestimated judgments and assume the costs to be much higher than they actually are. A 2007 public opinion survey conducted by the World Business Council for Sustainable Development found that respondents believed, on average, that green features add 17% to the cost of a building, whereas a study of 146 green buildings found an actual average marginal cost of less than 2% as shown in figure 3 (data from USGBC). On the other hand, many of construction industry owners might not be adequately informed about the economic benefits of implementing the green practices. The cost-saving report is an effective solution that can provide more detailed information about the costs and benefits of implementing different green measures and for making comparisons between different possible scenarios. One recommended strategy is preparing different scenarios with different levels of sustainability and an estimation of expected savings resulting from implementing each scenario. Since monetary incentives act stronger, the owners are more likely to be willing to accept the additional initial costs if they know that besides multiple environmental and social benefits, their investments will make economic sense.

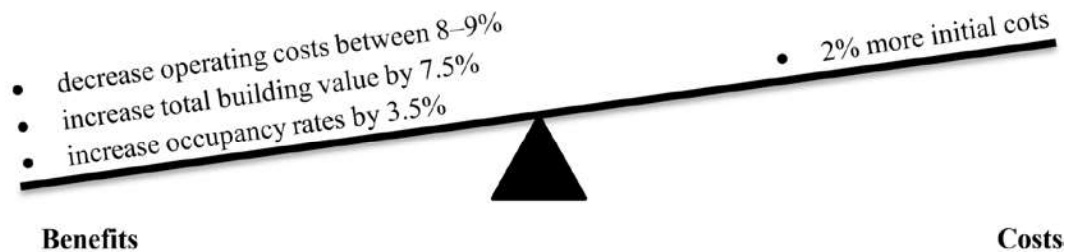


Figure 3: The costs and benefits of sustainable buildings

Taking Advantage of Inexpensive Solutions. Not all the practices of sustainable construction require an extra budget. If the project manager is familiar with the methods of increasing sustainability during construction, the project can be built more sustainably with marginal additional costs. Some examples of sustainable methods that do not require additional costs are 1) dust and noise control during construction through effective scheduling (avoiding noisy tasks at certain hours), 2) specifying priority parking for green vehicles, and 3) utilizing natural light.

Handling Reduced Speed of Construction

Integrated Project Delivery. The additional time which is required to implement sustainability measures in the project can be controlled through Integrated Project Delivery (IPD). IPD is a collaborative approach in which all parties get involved, share the risks, and attempt for common goals of the project. One of the most effective approaches for implementing IPD is the lean construction. Lean construction focuses on minimization of wastes and maximizes collaboration between project team members. Implementing lean construction is appropriately aligned with the sustainability goals and has been shown to increase the speed of the project delivery compared with the conventional methods (Alarcón, 1997).

Handling the Need for Special Expertise

Hiring a Field Construction Manager with Expertise in Sustainable Construction. The construction manager (CM) has a significant role in lowering the costs of the additional expertise that is required for sustainable construction. By having the knowledge and experience of being involved in green construction projects, certain sustainability guidelines can be provided by the CM to the team and the need to hire special laborers will be reduced.

Pursuing Green Building Certificates. Another suggested policy for facilitating the implementation of green construction and making more sustainable choices in the project is pursuing the green certificates. To acquire these certificates, the project has to follow a detailed process from pre-design to demolition. While having a sustainability expert on the team is helpful, depending on the level of certification, many of the required measures in these rating systems are explained in details and can be performed by the team without the need to special expertise.

Summary and Discussion

This research studied the barriers to implementation of green construction methods by the industry. The root causes were investigated and through a survey, the major barriers were ranked based on their criticality. The results revealed that cost constraints are the major challenge in becoming green. This explains that for motivating the industry to move towards more sustainable practices, these practices should lead to reducing the costs. While it is widely known that *life-cycle* costs of green buildings are less, which make them more economical than the conventional buildings, due to the importance of initial costs for the owners, and the fact that those who benefit from the operational costs are commonly different from the investors, the savings that occur throughout the life of the building fail to perform as strong incentives for the project investors. Therefore, to become adopted in the industry, the practices have to make minimal changes on the initial costs.

On the other hand, besides the economic goals, sustainability triggers the environmental conservation and social well-being. Therefore, relying on economic incentives alone is not aligned with the sustainability paradigm. Therefore, it is required to continue working on raising the awareness of developers and owners about the necessity of becoming green even if economic incentives are not the central goal. This is not practical unless there are certain regulations for the developers that enforce the implementation of major sustainability measures throughout the construction process. This highlights the necessity of establishing and reinforcing the regulatory incentives.

Promotional incentives from the government should be increased to encourage adopting the sustainable methods and to compensate the possible challenges of implementing green practices. Different types of tax reduction for green buildings to help in reducing their initial costs can be offered from the governmental agencies. Considering the fact that the green buildings will contribute to the community in different aspects, their partial exemption from certain taxes would make sense. Another promotional incentive would be expedited permit processing for the green buildings. Such incentives seem to have the potential to act as effective tools in encouraging the construction industry in becoming green.

Finally, for enhancing the willingness of the industry professionals to the sustainable construction, the new practices suggested by the research, should have a realistic understanding of the limitations and concerns of the real world industry. According to this logic, the new practices should land on conventional methods and be based on making practical, and preferably gradual changes that are in the meantime, economically viable and take the owners' limitations, expectations, and concerns into consideration.

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