Available online at www.elixirpublishers.com (Elixir International Journal)

Civil Engineering

Elixir Civil Engg. 98 (2016) 42696-42700

ISSN: 2229-712X

Social Sustainability of Green Building Research: A Review

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ARTICLE INFO

Article history:
Received: 12 August 2016;
Received in revised form:
13 September 2016;
Accepted: 23 September 2016;

Keywords
Green Building,
SGBR,
Green Construction.

ABSTRACT
Green building research and construction is getting day by day a place in construction industry worldwide. With augmenting issues of environment and growing concern over climate change, a social sustainable green building research is getting importance. However, construction of green buildings still encounters impediments, as there is a lack of proper framework and research. The present study aims to identify common barriers encountered and social factors which are important for the sustainability of green building research. The findings from this review reveal that, although project cost is the paramount barrier among others, there is no paucity in sustainable knowledge in construction industry. Furthermore, a sustainable green building research (SGBR) framework for green building construction should be developed to overcome the barriers.

Introduction

For the last few decades, the built environment became a focus of attention within the environmental movement. Research revealed that buildings consume 40% of the world's materials, use 55% of the wood cut for nonfuel use, use 12.2% of the total water consumed, consume 40% of the world's energy and 71% of electricity. "Green building" is a term encompassing strategies, techniques, and construction materials that are less resource-intensive or pollution-producing than the regular construction. In some cases, this involves merely doing without extra space, finishes, or appliances. In others, it substitutes a less polluting by product for more polluting ones like low-volatile organic compound paints. More integrated strategies reconfigure a space to take advantage of unique site attributes (e.g., facing glass toward the sun path to use natural or passive solar heat energy gain instead of using natural gas or electricity for the space light etc.) or reconfigure design parameters to take advantage of building system synergies (e.g., downsizing the boiler after extra insulation has been added to the exterior shell). Buildings in many developed countries are consuming significant portions of their nations' energy resources. According to Perez-Lombard et al. (2008), both commercial and residential buildings together are responsible for between 20 and 40% of the world's energy consumption and these values are rising steadily every year. Not only are buildings expending large amounts of energy, they are also the culprits behind substantial carbon dioxide emissions, which can be detrimental to the environment and play a huge role in the world's climate change (Yudelson, 2008). In addition, building construction generates many other environmental issues such as atmospheric and water pollution (Pasquire, 1999), which arise from the use of toxic materials and many other harmful processes involved. Evidently, the building construction industry may be a consequential environmental burden.

Green Building and Sustainable Construction

There are various definitions of the term 'green building' and many varied perspectives of what constitutes a green building.

According to Glavinich (2008), the term green building is defined in the American Society of Testing and Materials (ASTM) as a building that provides the specified building performance requirements while minimizing disturbance and improving the functioning of local, regional and global ecosystems both during and after its construction and specified service life. In general globally, a building is considered green if it has met the concept such as, the building to be both energy and water efficient, be environmentally sustainable, have a minimum indoor environment quality and possess green features (BCA, 2009). Despite having multiple definitions, a green building essentially means a building that is energy and resource efficient and has minimal disruptions to the environment. Green building is often mentioned together with sustainable construction, and sometimes these two terms are used interchangeably. According to Kibert (2008), sustainable construction focuses on the ecological, social and economic issues of a building in the context of its community. Therefore, green building can be a subset of sustainable construction and is a stepping stone to sustainable development, which has been defined as being able to meet present needs without the expense of the needs of future generations (CIRIA, 2001).

Social Sustainability

Public opinion polls on environmentally responsible behavior often face weaknesses in responses due to positive illusions. People want to project and present an aspiration of their virtue rather than a reality of their lifestyle. Consumers may hold to a self-image of being environmentally responsible, whereas their behavior does not match that projection. For example, despite growing interest and support for environmental issues worldwide in last few years, but the recycling rates have declined from well over 60% to 50% in this time period (Hoffman, 2006).

Wade-Benzoni, Li, Thompson, and Bazerman (2007) argued that people can more easily maintain positive images of themselves on general, ambiguous issues than on specific, observable behaviors. This results from general items providing more cognitive room for self-enhancement in comparison to the specific items for which people have direct

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evidence of their behavior on a regular basis. In addition, Wade-Benzoni et al. found that people were much more likely to deny harming the environment than to claim that they were helping the environment—despite that the only difference was the way in which the information was presented. These kind of results imply that most people do not do more for the environment because they see themselves as environmentally benign. Renowned associations can play themselves out on a more practical level as well. Neuman (2006) reported that market often worry that, "A building that promoted itself as an environmental paragon might give short shrift to basic functional considerations, like water pressure." Others recognize an association between green buildings and smaller space, lower comfort, or unappealing aesthetics. Such presumed associations led Whirlpool to consider removing the Energy Star label from their washers in the 1990s while still retaining the official Energy Star qualification and higher efficiency of less water and energy use. Internal market investigations showed that consumers associated high efficiency with poor performance thinking that less water meant less cleaning (Hoffman, 2006). Kempton, Boster, and Hartley (1995) found that people regularly underestimate the effects of small global temperature changes. To the people surveyed, a global average temperature change of 3°F to 9°F wasn't much at all, whereas climatologists project significant global disruption as low as a 2°F change. This lack of literacy makes the link between energy conservation and climate change more difficult for people to understand and creates a reduced sense of urgency or motivation for addressing environmental issues, much less to develop green building practices. There are numbers of important factors which are desired for the social sustainability of green building research. The following sections described the important factors.

Reward

Rewards take the form of both formal and informal signals, at times being ambiguous or conflicting. Many companies have hoped to foster improved environmental performance through the establishment of highly publicized environmental programs endorsed by top-level speeches, only to watch them fail because they did not align the reward structures properly. In one example, a refinery manager quipped that his responsibilities were to protect the environment, maintain safety, and increase process yield. But when it came time for promotions, they "skipped the first two and went straight to the third" (Hoffman, 2001). As a result, reward systems and not corporate policy guided his behavior.

Time

Time is as precious a resource as money. Green technologies and products require more information processing and an understanding of the technology's life cycle. Developing an expertise in green building is often overshadowed by more pressing concerns of managing existing workloads. Understanding new terminology and performance parameters of LED lighting, for example, can take hours of research and compilation that steals time from either other projects or someone personal time. New technologies must be identified, integrated, and tested as research as the technologies themselves evolve and improve. Howard-Grenville (2006) described the Moore's Law time pressure in microchip manufacturing, which demands process innovation every few years. This pressure thwarts full investigation and solving of environmental issues in production.

Similarly, owners looking to sell or lease a building quickly pressure the design and construction teams to use the known processes and technologies to prevent delay or lead-time extensions.

Education

Members of the building industry are highly influenced by the norms, rules and regulations inculcated in their early training experience. Therefore, one way to overcome social barriers is to integrate environmental literacy within existing training systems of the building sector. This includes architecture and engineering curriculum in the university, apprenticeships in the building trades, and even business education of owners and managers (Building Technology Incorporated, 2005). It can be a growing number of green construction courses emerging around the country in programs related to architecture, engineering, management, urban planning, and environmental affairs. Unfortunately, many remain in disciplinary departments and do not foster the cross-disciplinary collaboration necessary for this issue. The environmental impact of buildings cannot be seen as simply other factor to be added to the standard operating practice. But rather than viewing existing models as obsolete, to be discarded and replaced by a new set of ideas and theories, they must instead be adapted, bringing them closer to a realistic understanding of the behavior of the firm. This adaptation will manifest itself in a holistic approach to understanding the relationship between the built environment and the natural environment (Egri & Pinfield, 1996). Arizona State University recently created a new School of Sustainability, where traditional theory-based research gives way to problem-based research. This approach integrates theories from multiple disciplinary sources to both understand environmental problems and teach students to design viable solutions. Few universities offer a green construction course that is aimed toward and attracts business, natural resource, architecture, and engineering students. Students work in multidisciplinary teams and report surprising success in learning the basic assumptions and cultures of other disciplines.

Personal Touch

On the personal level, homeowners need to understand the connections between their lifestyle choices and the energy use that results. They can then begin to see their monthly energy bill as something they can manage rather than merely accept. To accomplish this task, companies are developing energy monitors that track energy use and provide real time displays of its volume. Ohio University includes water savings in the dormitory competitions. Recycle Mania is a 10-week competition that includes over 400 colleges and universities, calculating the percentage of recycled to total waste per capita, and include internal per-department and per-building challenges (RecycleMania, 2008).

Economy

Economic Benefits Green buildings have many economic advantages that traditional buildings do not possess. According to Gluch et al. (2009), organizations can improve their business performance by focusing on three predictors of green business advantage: acquisition (routines to identify demands, initial reviews), assimilation (measurable goals, plans of action, LCA) and transformation (audits, environmental declarations). More specific examples are energy and water savings, reduced waste, enhanced productivity of occupants and decrease in maintenance and operation costs (USGBC, 2003). In addition, with prices of oil and natural gas skyrocketing in recent years, having energy

savings in green building every year increases the building value, as occupants are able to recoup their investment in the building within a shorter period of time. constructing green buildings also entitles developers to different types of incentive. for instance, in the united states, states such as oregon and new york offer green buildings with tax credit, depending on the building size and leed certification level (yudelson, 2008).

Better Risk Management

According to usgbc (2003), adoption of proper green construction practices has many risk management advantages. for instance, adoption of sustainable construction practices, such as reusing building elements, can help reduce the risks of environmental liability with relation to construction waste disposal, shielding the developer from future lawsuits concerned with non-compliance of sustainability related legislations. another example of these advantages is the mitigation of occupational risks for construction workers due to the reduction in new construction works required when building elements are reused. furthermore, green properties are now generating faster sales and leasing as compared with conventional building units as, in light of environmental issues such as global warming, the public at large are being educated of their numerous benefits (yudelson, 2008).

Delivery Systems: Conventional Versus Green Building

A majority of today's construction projects are still carried out in accordance with traditional methods and norms, where short-term solutions are favored over long-term ones, with material, technical solutions and managerial approaches that can seldom be classed as innovative green technology and practice (demaid and quintas, 2006; gluch, 2009). In particular, in terms of delivery systems, design–bid–build, construction management-at-risk and design–build are commonly adopted for conventional construction projects and each method has pros and cons. For green construction projects the design–build delivery system is the most appropriate as effective communication is necessary between project team members (kibert, 2008). In addition, with both the architect and the contractor working together, the contractor can provide valuable advice on the feasibility of green building design features. Expertise inputs by the contractor can help avoid changes in design and reworks in later stages of the project, which can cause major delay in project schedule and incur extra cost. Moreover, this delivery system ensures that the end product is consistent with the design, which is especially important for green building construction where various specifications have to be met before it can be certified as green building. A green building project also requires team building at the start of the project, which should include all important personnel involved in the project. Specialists with expertise in green building, such as building energy performance and green building certification, should also be engaged. This is because these people have deeper comprehension of the concept of green building and are familiar with the standards and requirements of green certification.

Sustainable approach for green building construction

During green building construction procurement, special attention has to be placed on green requirements, which are typically found in the specifications of contractual document (glavinich, 2008). Such kind of requirements usually specifies the types of material and equipment to be used and ensure that they satisfy the minimum standard in the context of environment sustainability.

Other than this, sustainable construction's practices and measures are another type of green specification addressed in project specifications. These sustainable construction practices and measures can be found in the leed green building rating system for new construction, which includes measures such as construction activity pollution prevention and conservation of existing natural areas (usgbc, 2009). Such detailed specifications may not be needed in a conventional construction contract. Before contracting with contractors and other professionals such as project managers and consultants, the developer selects those who are experienced in the field of green building and sustainable construction (ciria, 2001).

Green Building Design

Green building design can be more complicated that what is typically required for conventional buildings, considering that evaluation of alternative materials and systems by the design team is commonly necessary (glavinich, 2008). In conventional building projects, schematic designs that consist of simplified and general concepts of what the buildings will be like are used at the beginning of the project process (sbe, 2005). However, in green building projects, a holistic and integrated design process is being used right at the start of the project as green buildings have many unique design features not typically found in conventional building and require deep integration (kibert, 2008). The cardinal green building design features are divided into three broad categories – namely indoor lighting, building materials and layout (yudelson, 2008). In a green building, the lighting design integrates low-energy lighting fixtures with natural lighting through strategic window installation and usage of energy efficient fluorescent lighting. Environmentally friendly building materials, such as recyclable bamboo flooring, as well as toxic-free materials, such as formaldehyde-free cabinets and non-toxic paint, are used in green buildings to ensure that they are sustainable. Building layout plays a significant role in ameliorating energy efficiency of the building. Green buildings also take advantage of natural ventilation through the building's orientation.

Construction of Green Projects

Other than conventional construction procedures, green building projects have to implement sustainable construction practices, which are usually listed in green building rating systems such as LEED. One example of such practices is a waste management plan (CIRIA, 2001) to minimize waste generation on the construction site (Kibert, 2008). A green building construction also has to adopt sustainable practices such as using recycled aggregates for concrete work and using timber which is from renewable sources (CIRIA, 2001). In addition, the main contractor and project manager have to ensure that pollution from the construction is kept to a minimum by controlling soil erosion, waterway sedimentation and airborne dust generation (USGBC, 2009b). Furthermore, the natural habitat should be conserved through prudent sitting of the building to minimize the disturbance to the existing natural environment. These considerations are often neglected in traditional construction.

Overcoming Barriers to Green Construction

High Cost Premium

It costs more to construct green buildings as compared with conventional buildings (Yudelson, 2008), as green materials cost significantly more than ordinary materials (Kibert, 2008). For example, compressed wheat board which is a green substitute for plywood, it costs about 10 times more than ordinary plywood. Other factors leading to the high cost premium of green buildings are the cost incurred in the search

for green alternatives and in the certification of buildings (Yudelson, 2008). Teo (unpublished undergraduate dissertation) discovered that using green techniques on site results in additional cost, which deterred adoption of such methods. Therefore, when managing green building projects, it is difficult to keep within the project budget.

Unequal Distribution of Benefits

It is difficult to convince the developer to build green when there is unequal distribution of advantages amongst the builder and tenants (Yudelson, 2008). Developers have to fork out the high cost premium for green buildings while the tenants accrue most of the benefits generated from the green building, such as better indoor environment quality and cost savings in energy and water. In addition, the extra cost incurred by the green building cannot be passed to the tenants readily (Architecture Week, 2001).

Lack of Green Product Information

There is still inadequate information regarding green products and sustainable building systems that can be implemented in a green building (Architecture Week, 2001). Hence, developers are being forced to engage consultants who are specialized in green products and building systems at a fee. Without adequate information, the developer can also risk losing green certification or incur additional cost to correct products or systems that do not meet specified green standards.

Complex Legislation

Green building codes and regulations are becoming more complicated, causing difficulties for developers when evaluating the cost involved in the compliance of such codes (Architecture Week, 2001). Often, developers fail to see convincing benefits behind green building and thus do not feel inclined to 'go green'.

Lack of Awareness

Traditional perception of how a building should be constructed still prevails and many developers resist building green due to the perceived risks (Kibert, 2008). It has been found that there is a lack of awareness and readiness in the adoption of environmental auditing, which is a useful sustainable construction practice. Another study proves the lack of awareness for green building worldwide by showing that local contractors manage and use materials without giving much thought about sustainability and the surrounding environment. There is a lack of awareness in the public regarding the benefits of green buildings due to insufficient research, especially on issues such as the effects of indoor environmental quality of green buildings on productivity and health (Kibert, 2008).

Summary

In green construction, we must think differently about both the form and purpose of our buildings and the process by which they are built. Changing our thinking requires that we challenge social and physiological routines that we have developed and that have worked well in the past. Such change is not easy and will invite resistance. Consider the consumer who is able to navigate the hundreds of familiar offerings in the cereal aisle of a standard grocery store. The first time that consumer faces hundreds of unfamiliar offerings in the cereal aisle of an organic food store he becomes crippled at the analysis now necessary in what was previously an automatic decision. These decisions become even more challenging when new choice parameters are introduced. Which is better for the environment—linoleum or cork flooring, concrete or steel structure, paper or plastic packaging? Research has shown that consumers are happiest when they have a limited amount of information on which to make decisions (Tugend, 2008). Calling it the "blissful ignorance effect," Mishra, Shiv, and Nayakankuppam, (2008) found that people who have more ambiguous information about a product expect to be happier with what they have bought than those who have more specific details. Consumers can be thought of as cognitive misers, (Fiske, 1992; Fiske & Taylor, 1991) preferring to do as little thinking and research as possible when making purchasing decisions. One study shows that though people stated a preference for green electricity, their actual selections were based on the least effort by accepting the default offering, whether it was green or gray (nonrenewable) (Pichert & Katsikopoulos, 2008). In short, we recognize that people are bounded rational. Social and psychological barriers for organizational purposes, but they are very much interconnected. Individual decisions influence organizational behaviors; individual and organizational behaviors affect what becomes institutionalized, and vice versa. Though many social barriers can be changed through new structures and education, individual bias, underlying beliefs of organizational culture and cognitive institutions constitute more difficult barriers. In the face of this recognition, strategies for overcoming the social and psychological obstacles to the adoption of green buildings can fall into two categories: (a) treat these obstacles as an entrepreneurial opportunity or (b) treat them as an obstacle to be overcome. In both cases, strategies cannot be targeted strictly at the individual, organization, or institutional levels. Successful strategies create change across all three levels of analysis.

Conclusion

Many believe that the goal of green building is to become obsolete. In other words, green building should become so much of a standard practice that LEED and other rating systems are no longer necessary green building will have become so important. As we have pointed out here, this will require more than just a development of green technologies and lower costs for these technologies. We insist that by identifying social and psychological barriers, we can influence changes in social structures, rewards, and incentives. Incremental changes like those proposed here can bring green building practices into the mainstream of business such that they are taken into consideration within every decision in the building process. This review highlighted a number of ways in which our psychological and social structures bias our view on green construction and create barriers to its full adoption, often without our knowledge. It is useful to notice that we rarely highlight evil entities. Rather, seemingly benign individuals, organizations, and institutions create harm without realizing their impact. We attempt to clarify the mechanisms behind their negative influence.

It has also demonstrated how existing cognitions, procedures, and routines have surprising consequence. Finally, we have attempted to use this knowledge to outline the changes that are needed behaviorally to create meaningful change. Conventional projects typically adopt least-cost delivery, such as design–bid–build, where communication between the design and construction teams is not prioritized. In addition, succinct schematic design is usually adequate at the planning stage of conventional projects. On the other hand, green projects require superlative communication, which can only be achieved through delivery systems such as design–build, where building design and construction is carried out as a single entity.

Furthermore, a detailed integrated design process is employed at the start of the project as, unlike conventional building design, green design features are unique and require deep integration with every building aspect.

There are limitations to this study, one of which is the reluctance to provide detailed information regarding project management of green building construction.

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