

Barriers in the Green Building Practices Adoption: A Stakeholder's Perception

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Abstract

India has become the world's fourth largest market for Green building construction. The reasons for this demand are obvious: these structures are designed to save energy, waste, emissions, and water while also prioritizing occupant health and wellness through the use of eco-friendly construction materials and improved air movement. People are becoming more conscious of the importance of utilizing green solutions that do not hurt the environment, and the building industry is heading the same way. The research focuses on numerous literatures and attempts to assess the Green building adoption or implementation barriers in the residential construction. The goal is to find and assess obstacles by questionnaire survey using ranking based on individual stakeholder's perception from developing countries like India. The findings revealed that there is a need for a shift in stakeholder perceptions and attitudes toward green building development. This article will assist construction professionals in their decision-making and raise awareness about the advantages of using green buildings.

Keywords: Green buildings, Awareness, Adoption, Barriers, Stakeholders perception, ANOVA.

1. Introduction

The Construction industry has been a major contributor to the country's economic growth for the past decades. According to the International Finance Corporation (IFC), the construction sector consumes over 40% of the country's total energy and grows at an annual rate of 8%. Buildings would account for nearly 70% of emissions by 2050 if current inefficient building techniques continue, posing a huge challenge to India's green objectives [1]. India has the world's third highest rate of green building growth and has pledged to lower emissions intensity by 33–35 percent by 2030 compared to 2005 levels [2].

As per Indian Green Building Council's report from November 3rd, 2021, a total built-up area of 7.97 billion square feet was registered for more than 7,002 GBPs, with 2,344 projects certified and fully operational. The tremendous rise in green or sustainable buildings is one of the most significant trends that can be seen today. Telangana is one of the top cities in the country for supporting sustainable infrastructure and construction development, with 428 projects certified as green buildings. Green building encompasses a total of 280 million square feet of built-up area in the state. Tamil Nadu, Uttar Pradesh, Karnataka, and Maharashtra are the other four states. Government, Residential, Banks, Airports, Institutions, and other types of buildings are all going green today [2]. The urge for implementation of green techniques in the construction sectors are achieved and rapidly developing over the past two decades, yet the research is limited [3]. Since adoption or implementation is associated with quality, capital

and time, the phenomenon of adoption has been a matter of concern for construction professionals as well as a topic of study. Some researchers [4], [5], [6] have studied the barriers influencing the adoption and others studied the effects of each roadblock in the green building adoption.

2. Idea of Green

A Green Building is a structure that uses less water, conserves natural resources, and provides better quality of life for its occupants. It can also reduce or eliminates negative impacts on the environment [2]. Green construction awareness has exploded in the country in recent years [3]. The destructive nature of the construction sector is rising and having an influence on the environment; nevertheless, the growth of GBP's is significantly less than that of traditional structures. All construction projects are fraught with unknowns and challenges, and GBPs must balance standard construction aims with additional objectives such as GB rating system certification. GBPs are expected to embrace creative ways and materials to fulfil these sustainability goals, posing unknown and unanticipated dangers [7]. In comparison to conventional construction, risk drivers are determined by factors like energy savings, reduced disruption to the surrounding ecology, regional climate, and local material availability [8].

A framework is required to comprehend the factors (as shown in Fig.1) that influence implementation and to analyze the results in order to provide a better solution to reduce long-term consequences [9]. To gain a better understanding of how stakeholders feel about the deployment of GBPs. Despite the benefits and importance of GB development, green practices are rarely used [9]. Because there is a scarcity of qualified engineers and laborers who deal with green materials and processes, the green techniques used by GBPs in one location may not be appropriate in another [8]. Since several green building committees have been founded in many nations, green building has become increasingly popular. Green building problems, such as building certification, are the focus of these councils. A building's status as a green building is determined by an assessment procedure that employs green building rating systems (GBRT) [4]. With the development of the green economy, several green evaluating systems have been established to help the environment, they are of two types: LCA and criteria-based tools like LEED, GRIHA, IGBC, EDGE, and BREEAM [10]. New green techniques and approaches are being developed, but more assistance is needed for the building industry to thrive.

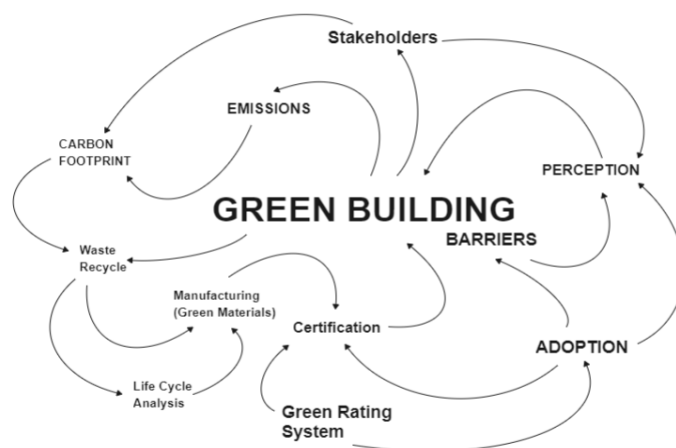


Figure 1. Causal loop diagram on Green Building

The literature review provides in-depth knowledge that serves as a solid foundation for identifying impediments to GBP implementation [3]. The findings revealed that throughout implementation, more attention should be paid to daily routine procedures. The findings imply that both financial and time overruns are caused by the slow rate of growth, as well as hard acceptance and neglect in modern site management procedures. Setting standards, measuring performance, skill development, and research projects in project management are all necessary steps in reducing time overruns on GBPs [11].

Despite the benefits of green building practices and federal policy drivers, what is preventing a greater adoption of green construction practices? As a result, the quest for hurdles to GB has persisted, as has the search for answers to those drawbacks. Only country-specific research (e.g., [11],[12]) have attempted to answer, and have discovered that they concern about costs of green practices, time constraints, codes, regulations, level of knowledge, and insufficiency in information. The current goal of the study was to gather and compare the perspectives of GB specialists in order to establish a common set of barriers (Table.1) and methods for encouraging GB adoption through an online survey. In this work, the results of the obstacles are presented. The findings of this research are expected to benefit industry practitioners and stakeholders, particularly developers, in developing appropriate methods to overcome the identified constraints. Researchers may find the report valuable in formulate future extensive studies on hurdles to GB implementation in various circumstances [5]. The previous research studies were chosen based on the literature evaluation exploring variety of issues depending on the region, phase and type of construction project. There are many different sorts of green construction projects, including industry, infrastructure, high-rise buildings, residential, and so on. The regions such as India [6], [13], China [12], [14], [15], [16], South Africa [17], Malaysia [18], Sri Lanka [19], Singapore [17], [19], [20], [21], [22], Pakistan [23], Vietnam [24], [25], United states [26], UAE [27], Nigeria [28], and Ghana [12].

Table 1. Identified barriers with their description

Code	Barriers	Description
B01	Unfamiliarity with green concept	Involves lack of data, information, knowledge and awareness about green materials and techniques.
B02	Economic issues	Involves the high cost of the green materials, charges, taxes, inflations, etc.
B03	Market limitations	Unavailability of materials, machinery and adequate workers, etc.
B04	Stakeholders' attitude	Resistance and unsupportiveness towards the adoption of green building materials and techniques.
B05	Risk due to complexity in green techniques	Risk of cost, time or quality overruns due to difficulty to perform, analyze, and understand the process or green techniques.
B06	Lack of administration support	Low incentives, norms and regulations, establishing evaluation standards, promotion and support, etc.

3. Methodology

The methodology process takes a semi quantitative and qualitative approach for data gathering which includes identification, analysis, allocation, and mitigation as shown in Fig 2. The systematic review process (T/A/K) was adopted in this paper to gather data focusing on the barriers in green building construction by reviewing various research papers, articles, and journals relating to the construction sector. A total number of 6 barriers in adoption of green construction projects were identified. These barriers are: Unfamiliarity with green concept, Economic issues, Market limitations, Stakeholders attitude, Risk due to complexity in techniques and Lack of administration support.

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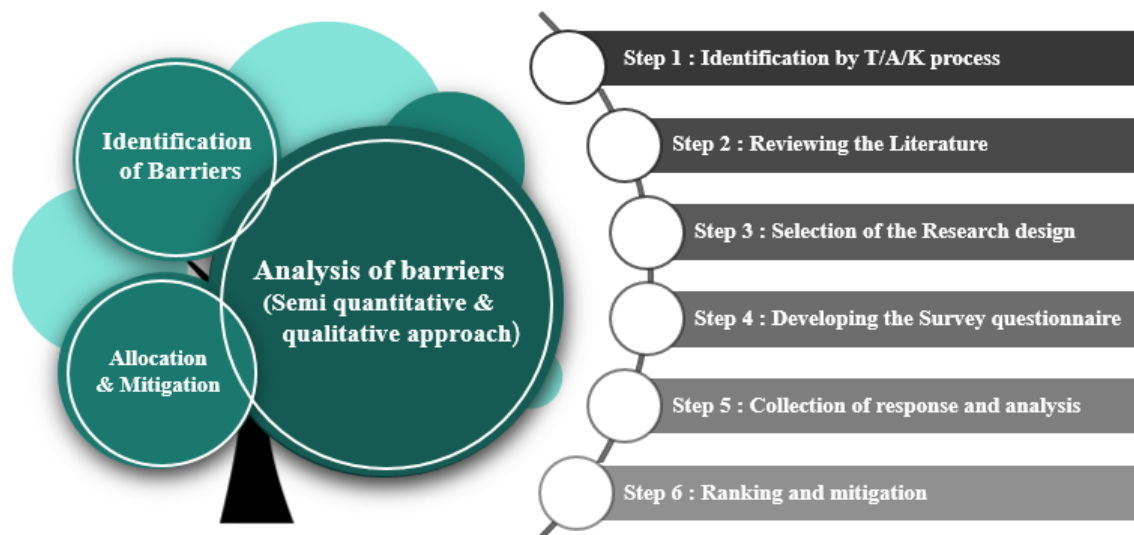


Figure 2. Framework of methodology

3.1. Questionnaire Design

The survey was conducted online using Google forms, emails, and other methods to determine the likelihood of each obstacle occurring and its impact. The questionnaire was split into two parts: (1) Stakeholder's profile (see Fig 3), and (2) an assessment of the barriers to GBP adoption (Rating from 1 relatively low to 5 high) in terms of importance (see Table 3.). Sampling was used to choose the respondents, and the survey's target audience was construction industry professionals. Contractors, consultants, architects, engineers, developers, and other construction professionals were issued questionnaires and a total of 82 valid responses were collected.

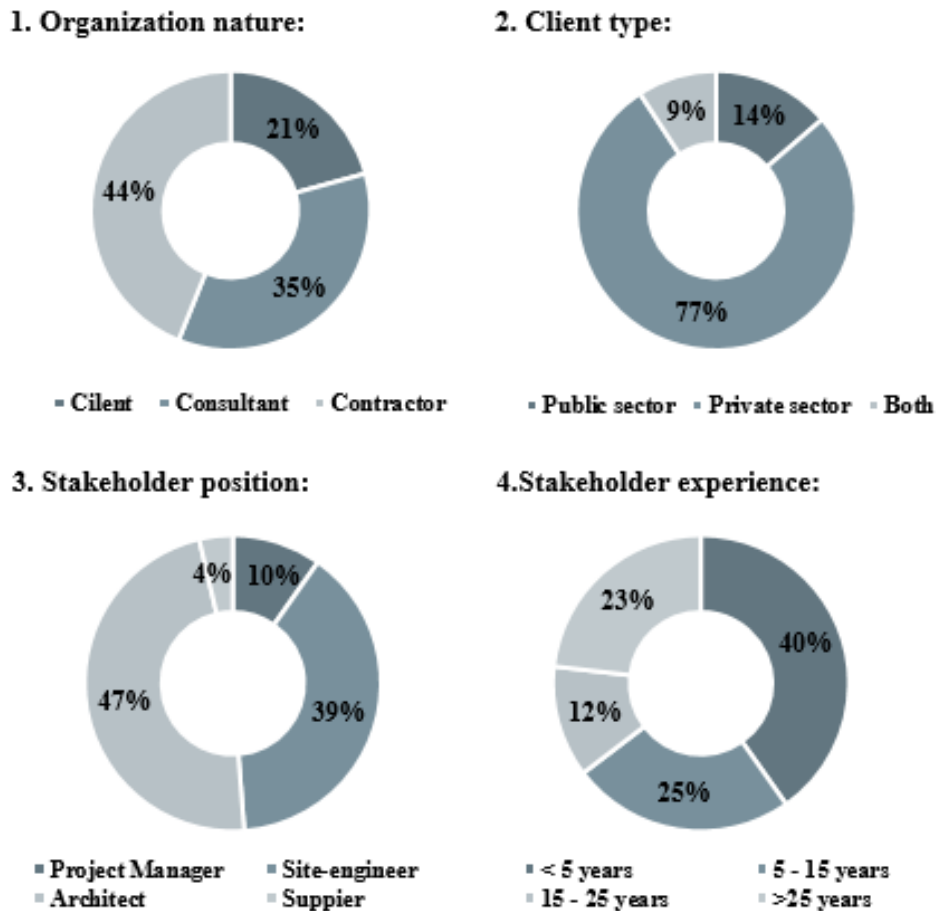


Figure 3. Representation of Stakeholder's profile

3.2. Cronbach's alpha & ANOVA test

Using Xlstat software, a reliability coefficient was computed to test the reliability of a survey. The procedure used a numerical model to evaluate the reliability of the survey. Because the coefficient values were greater than 0.7, the data acquired was considered reliable for further analysis. [29]

Table 2. Analysis of variance (ANOVA)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	104.4797	5	20.89593	16.42689	0.008	2.2325
Within Groups	618.2195	486	1.272057			
Total	722.6992	491				

Addition, ANOVA test out seemed to always be employed to check out if there are considerable distinctions or brouille in stakeholders' awareness on the score of individual limitations. As proven in Table 2, P-value is less as compared to 0.05, which in turn indicates there is definitely difference in notion of construction professionals [5].

Table 3. Analysis of the Implementation Barriers

Code	Barriers	Overall		Client		Consultant		Contractor	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
B02	Economic issues	4.05	1	3.82	3	3.86	2	4.14	1
B01	Unfamiliarity with green concept	3.98	2	3.88	2	4.24	1	3.97	3
B06	Lack of administration support	3.72	3	4.00	1	3.76	3	3.97	3
B04	Stakeholders' attitude	2.99	4	3.18	5	2.79	6	3.00	6
B05	Risk due to complexity in green techniques	2.96	5	3.35	4	3.55	4	4.03	2
B03	Market limitations	2.95	6	2.41	6	3.03	5	3.17	5

4. Summary and Discussion

The results showed (in Table 3.) that the main barrier is considered to be economic issues (B02), and typically the initial cost. This is because, in most cases, green components are more expensive compared to traditional counterparts [17]. Previously, the cost of green constructions was 15-18% more, but it is now comparable to the cost of conventional structures. Because of the increased demand for green construction, 60-70 percent of eco-friendly materials are now produced domestically. The Council anticipates that around 90% of such materials will be manufactured within the country in the next few years, considerably lowering construction costs [2]. Unfamiliarity with green concept (B01) was ranked next highest with mean value of 3.98. Information can be described as an "indicator for GB assessment" [30] and a lack of valid GB research can result in insufficient information, misinformation can obstruct awareness, and scope inaccuracy, along with many other things [5]. In order to improve the uptake of green building concepts in the built environment, an appropriate legal framework should be established. This should be strengthened through increased enforcement and education [36].

The stakeholder's attitude (B03), behavior, lifestyle, and culture can influence their perspective of the GB market. It is essential that construction technologies are optimized to improve their efficiency and effectiveness in order to create a sustainable built environment. Assessment of existing construction activities is often arduous and requires various studies to be conducted, for example, clients and customers rating also have a huge impact [5]. The Green techniques adoption and practices is believed to be impossible due to a lack of client desire [21]. Some can be skeptical about the performance, quality, and etc. of technology due to deeply ingrained traditional views among the stakeholders and inadequate data of most green techniques [20]. By the stakeholders' cooperation in the green building movement, the growth and perception of GB adoption can be changed.

Technology, Material & Market related Barriers (B05, B06): To attain GB project results, modern GB technologies must be used. Limitation of standards is a serious barrier to the development of GB. There are various categories such as: evaluation methods, restricted professional users, and evaluation objects [37]. Green technologies can wreak havoc on the construction process at times. To properly drive the intricacies and related green issues included in the GBPs, all project participants must be qualified and technically trained [5]. Lack of technical expertise could be a major impediment to green technology adoption [20]. The barrier can be segregated by employing IGBC greenpro products and processes, as well as receiving proper training and adhering to all applicable codes and laws.

Administration related Barriers (B04): The developing countries have made significant progress in developing GB regulations and laws. These regulations and laws are aligned with each other, which provides a level playing field for GBPs [37]. To promote in India, the IGBC collaborates closely with a number of federal and state government entities. Some state government agencies have recognized the IGBC's Green Rating Systems and are providing clearance in fast track bases for GBPs that are Pre/ Provisionally Certified, as well as a free incentive of 5 to 25% FAR. [2] The government's involvement in providing incentives, developing GB norms and regulations, and establishing evaluation standards, as well as serving as an advocate or promoter can be helpful [31].

5. Conclusion

People are becoming more conscious of the importance of utilizing green solutions that do not hurt the environment, but there is a lack of awareness. Through a comprehensive review of many review and research articles, blogs, and other sources, the article has identified and summarized the impediments to green building adoption in Indian construction. Based on research, survey was developed and conducted using Google Forms, emails, and other methods. Construction professionals such as contractors, engineers, architects, and developers, rated the barriers based on importance in the response. The information received from the questionnaire was analyzed using a likert scale for measuring the mean ranking of the barriers. Based on results, it's clear that barriers and their consequences in construction projects clearly differ based on an individual's viewpoint and attitude toward green adoption. Such as the client rated lack of administration support and Unfamiliarity with green concept as main barriers whereas the contractors rated Economic issues and Risk due to complexity in green techniques. As a result, the current article will aid construction professionals in making decisions and develop knowledge about the benefits of employing green buildings.

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