



Exploratory Analysis of Success Factors in Green Building Research: a Survey

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ARTICLE INFO

Article history:

Received: 10 November 2016;

Received in revised form:

29 October 2016;

Accepted: 6 December 2016;

Keywords

Green Building,
Productivity,
Thermal Comfort,
Sustainable construction.

ABSTRACT

The present study offers an exploration of the success factor used in green building construction in the Bhopal area. The specific objective includes assessment of the factors relation and its impact. How these factors will play the role and awareness among public as well as in builders of Bhopal region. In total 54 builders is interviewed face to face with the help of semi structured questionnaire. Responses are tabulated and descriptive analysis is performed. Correlation analysis is done for the received data on success factors. It is being found that most of the success factors are related and having impact in the success of green building research.

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Introduction

Green building has now become a trade mark and brand of sustainable development in this century that takes the responsibility for balancing the long-term economic, environmental and social health. It offers an opportunity to create environmentally efficient buildings by using an integrated approach of design so that the negative impact of building on the environment and occupants is too much reduced. Green design does not only make a positive impact on public health and the environment, it also reduces operating costs, enhances building and organizational marketability, increases occupant productivity, and helps to create a sustainable and eco friendly society.

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). Evidently, the building construction technique may be a help to protect our environment.

However, there is a lack of proper project management framework for green projects. Based on survey and interview results from 54 construction industry experts, this study aims to identify common success factors considered and its significance during management of green construction projects. The findings from this study reveal that, although green building cost is the paramount barrier among others in green building construction management, there is no paucity in sustainable knowledge in construction industry. To deal with the cost related problem, the coverage of government incentives should be widened to include the usage of green products and technologies. Furthermore, a project management framework for green building construction

should be developed to promote the adoption of sustainable green construction in future projects.

Green Building

Green building is an utmost important area where builders and society can implement sustainability objectives to keep their benefits and environment in the mind. Green buildings are designed to reduce negative impacts on the environment while increasing the occupant health, by addressing these five categories: Sustainable site planning, Safeguarding water and water efficiency, Energy efficiency, renewable energy and lower greenhouse gas emissions, conservation and the reuse of materials and resources, and improved health and indoor environmental quality.

The environmental impact of buildings is often underestimated, while the perceived costs of green buildings are overestimated. Kats *et al.* (2003) comprehensively examined the costs and benefits of green buildings for the state of California in the United State. According to Kats, the average cost premium over just building to code is less than 2%. The Kats report finds that "minimal increases in upfront costs of about 2% to support green design would, on average, result in life cycle savings of 20% of total construction costs more than ten times the initial investment". The majority of savings from green building are in the maintenance part and utility costs (CEA, 2011). Since, Green building construction is earning a place everywhere in construction industry and, with augmenting cognizance of environmental issues and growing concern over climate change, sustainable construction is gradually being put forth globally.

Success Factors in Green Building Construction

Assessing the nature of success factors through literature reveals both strengths and weaknesses in real sectors. This exploration provides evidence of the robust nature of this sector in the Bhopal region. Factors are identified by interviewees included and previous research nationwide. Better Bricks, and the Builders Owners and Managers

Association of India also provide good clue about success factors. The presence success factors of leading green building consulting firms are as follows;

High premium cost green building (SF1): To overcome the cost issue associated with green buildings, it is recommended that the government continues to support the adoption of sustainable construction until an adequate market demand for green buildings is being achieved. The scope of support in terms of incentives should be expanded from developers, building owners, architects and consultants to cover the usage of green products and technology such as solar panels, which are still very expensive now. Doing so helps to keep the cost of building green within reasonable and acceptable budget, which could effectively remove deterrence and facilitate the adoption of green designs and practices.

Lack of Awareness (SF2): 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, in construction industry. Also, 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).

Required expertise (SF3): Green building construction require the expertise to understand the need of customer along with keeping in mind the policy of government, comfort as well as the climatic environmental condition.

Green construction practice (SF4): in many of the places there is only a good practice of green construction. The available material is totally eco friendly and the policy of government is strictly to have the follow of green building construction.

Market demand (SF5): research indicates that the demand of green construction is not that much only because of high construction cost of building.

Government support (SF6): Globally it has been observed that for green building government support is very much required. Without government support either in tax relaxation or policy helps the customer as well as the builders.

Sustainable construction (SF7): An assessment done by the researcher, Sustainable Development on import substitution is helping to provide information about areas where economic development opportunities could be expanded through the development of green building products and services that are currently not available in the region.

Training provided on green building (SF8): research indicates that most of the public has demand of green building and also builders are interested but have not that much training. Training provides the way to understand the need of customer. Training relates the need and climate along with the environment.

Interest about green building (SF9): Interest of green building indicates the awareness about the environment and human comfort. Previous research indicates that Public has interest but the greatest barrier is the cost. Many of the government have made rule for the same.

Eco-friendly environment (SF10): Green building usually possesses very much natural policy and natural way of the comfort of human being that also eco friendly.

Health and productivity (SF11): Studies of the health benefits of sustainable design focus primarily on indoor

environmental quality, especially air quality. Health effects result from environmental stimuli interacting with the body's physical systems, especially respiratory, skin, neural, and visual pathways.

Thermal comfort (SF12): A better thermal comfort increases the productivity of human being. Further the natural light and temperature enhance the longevity of life and reduces the physical sickness. In case of green building construction there should not be very much dependency on air conditioning system. Wall conduction and thermal radiation should be proper as per the climate and comfort of the human body.

Research Objectives

There have been extensive researches on various aspects of green buildings in different contexts. However there is lack of systematic review of existing body of knowledge. Such systematic review and survey plays a critical role to not only identify the common success factors but also highlight the future research trends. This research aims to critically correlate the success factors for the green building related studies in a bid to highlight the state of art and future needs in this field.

Research Methodology

For this study, literature reviews on the various success factors in green and sustainable building construction, were carried out first. The aim of the reviews is to identify few important success factors as shown in table 1, encountered in green building construction.

Table 1. Identified Success Factors.

S. No.	Name of Factors	Notation
1	High premium cost green building	SF1
2	Lack of Awareness	SF2
3	Required expertise	SF3
4	Green construction practice	SF4
5	Market demand	SF5
6	Government support	SF6
7	Sustainable construction	SF7
8	Training provided on green building	SF8
9	Interest about green building	SF9
10	Eco-friendly environment	SF10
11	Health and productivity	SF11
12	Thermal comfort	SF12

Then, a survey questionnaire was developed to capture the views and agreement encountered in the success factors of green building. The factors of green building and their respective solutions provided in the survey questionnaire were based on the findings derived from the face to face interview. The structure of this survey questionnaire consists of a section that asks about the details of respondents. The next section carries questions regarding the profile of green building construction projects undertaken by the respondents. The third section asks the respondents about the success factors during management of green construction. The third section questions are based on 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). With the questionnaires, the author made face to face interview with 32 builders within the Bhopal itself and 22 nearby Bhopal. Hence population size of 54 were chosen as the target population as they have a strong foundation and knowledge of green building and have the professional capability to advise on designing of environmental friendly buildings. It is believed that with their experience in planning, tender and procurement, construction and commissioning of green buildings they are able to provide comprehensive accounts of the factors taken during the green construction.

Out of the questionnaires disseminated, all 54 completed copies were received. The survey results were analyzed using simple tabulation of percentages and are represented in graphical and tabular forms in the following sections. Figure 1 represents the percentage of respondents profile while the figure 2 represents the years of experience.

Percentage

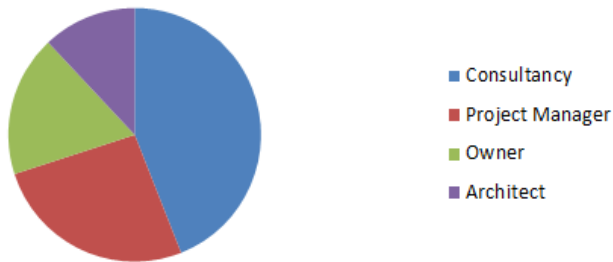


Figure 1. Percentage of Respondents Profile.

Percentage

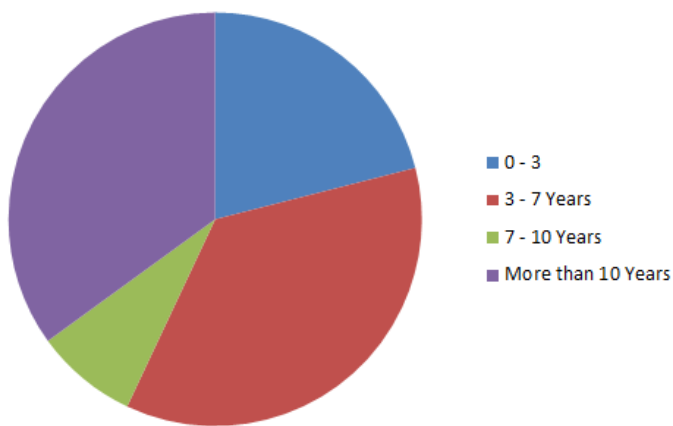


Figure 2. Years of Experience of Respondents.

Results and Discussion

Respondents Most of those interviewed indicated that local people are more financially conscious, although few customers are ready to accept green building at high premium cost because of environmental factors. Descriptive Analysis of as shown in Tables 3, there is statistically significant association between market demand and sustainable construction. Based on health and productivity, developers (Mean= 3.7) have more commitment to green building concept. Although, this commitment is slightly higher than moderate, it might be effective to stimulate consultants and contractors to be more obsessed with environment as they can ask consultants and contractors to practice eco friendly in their construction projects.

To explore which success factors to green building are the most important compared to other ones in construction industry, respondents were asked to rate their importance in different levels for each item. Data were analyzed based on the Mean and Median (Table 2). These measures of dispersion are used to assess the homogenous or heterogeneous nature of the collected data. According to the finding the current support made by government are not effective enough to encourage construction firms to enter green building development. Financial support and high premium cost are also not able to recoup the high upfront cost of green buildings and make it more affordable for construction companies. Public awareness about green building has been an important component that

led to high demand. Improving public awareness about green building leads to better informed consumers who will demand better products from companies and encourage more green building development. In addition, cost savings can potentially increase a consumer's willingness to pay extra. To achieve sustainable green home development and to make balance between green home owners' benefits and construction companies' profits are critical issues.

Table 2. Descriptive Analysis of all Success Factors.

	N	Minimum	Maximum	Mean	Std. Deviation
SF1	54	1.00	5.00	4.1667	.84116
SF2	54	2.00	5.00	3.7222	1.25016
SF3	54	1.00	5.00	2.1481	.95971
SF4	54	1.00	5.00	3.4815	1.32808
SF5	54	2.00	5.00	3.6667	1.25893
SF6	54	1.00	5.00	4.1852	.80269
SF7	54	2.00	5.00	3.6667	1.25893
SF8	53	1.00	5.00	2.1509	1.04507
SF9	54	1.00	5.00	3.5741	1.28271
SF10	54	2.00	5.00	3.7407	1.23143
SF11	54	1.00	5.00	4.1111	.90422
SF12	54	2.00	5.00	3.7037	1.28312
Valid N (list wise)	53				

Association of Success Factors

The building environment can have both negative and positive impacts on the occupants' quality of life. Negative impacts include illness, absenteeism, fatigue, discomfort, stress, and distractions resulting from poor indoor air quality, thermal conditioning, lighting, and specific aspects of interior space design (e.g., materials selections, furnishings, and personnel densities). Reducing these problems through sustainable design often improves health and performance. Improved indoor air quality and increased personal control of temperatures and ventilation have strong positive effects. In addition to reducing risks and discomforts, buildings should also contain features and attributes that create positive psychological and social experiences. Although less research has been done on health-promoting environments, emerging evidence shows that certain sustainable building features, including increased personal control over indoor environmental conditions, access to daylight and views, and connection to nature, are likely to generate positive states of well-being and health. Table 3, indicates that most of the success factors are positively associated with the cost of projects. However few of the factors are negatively associated, it might be the view of the interviewer. The previous research indicates that all factors should work in consequence and association but here the thinking of interviewer that means builders have not very much either interested or demand has enforced to ignore the particular factors.

Tables 3 show the relationship between factors and their levels. This result (Pearson correlation: 0.859, sig: 0.000) indicates that by increasing the awareness level green building demand rises. Further, raising the training among the experts will lead to increasing construction companies' interest in the green building market. It also helps them practice more environmentally friendly methods in their future projects as part of their responsibility to the society.

Table 3. Correlations Analysis of Success Factors.

	SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9	SF10	SF11	SF12
SF1	1	.117	-.709**	-.225	.428**	.233	-.018	-.246	-.230	.370**	.099	.221
SF2	.117	1	-.390**	-.520**	-.480**	.052	.515**	-.377**	-.440**	-.060	.295*	.559**
SF3	-.709**	-.390**	1	.476**	-.318*	-.355**	-.068	.357**	.282*	-.286*	-.128	-.270*
SF4	-.225	-.520**	.476**	1	-.365**	-.227	-.128	.324*	.621**	-.372**	-.093	-.324*
SF5	.428**	-.480**	-.318*	-.365**	1	.156	-.417**	.080	-.113	.491**	-.232	-.214
SF6	.233	.052	-.355**	-.227	.156	1	.081	-.625**	-.545**	.259	.647**	.146
SF7	-.018	.515**	-.068	-.128	-.417**	.081	1	-.602**	-.522**	-.276*	.232	.230
SF8	-.246	-.377**	.357**	.324*	.080	-.625**	-.602**	1	.799**	-.398**	-.382**	-.279*
SF9	-.230	-.440**	.282*	.621**	-.113	-.545**	-.522**	.799**	1	-.453**	-.333*	-.365**
SF10	.370**	-.060	-.286*	-.372**	.491**	.259	-.276*	-.398**	-.453**	1	-.109	.106
SF11	.099	.295*	-.128	-.093	-.232	.647**	.232	-.382**	-.333*	-.109	1	.289*
SF12	.221	.559**	-.270*	-.324*	-.214	.146	.230	-.279*	-.365**	.106	.289*	1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

By applying this strategy, level of green features applied by professionals in the buildings will increase dramatically due to high concern on projects' environmental impacts. This aim can be achieved by establishing training courses and periodical seminars for experts in order to promote their knowledge of green building.

In Indian construction context, government plays a significant role to promote green building. Government is the key player in term of promoting green building in the construction industry. Government can affect the construction industry by a variety of instruments. Regulatory instruments and incentive instruments are the main tools for governments to develop green building. A combination of legislations to enforce companies and market to sustainable construction development and incentive package for construction firms that practice sustainability in their projects is the best approach that can be applied by governments. Contractors as next major players undoubtedly can promote sustainability and minimize environmental impacts in construction field by using new technologies and environmentally friendly products, and applying awareness, training and expertise in construction stage.

Conclusions

This paper provides a useful reference for both industry practitioners and academics that are interested in green building developments. This paper reports the results of a questionnaire survey conducted in Bhopal on the success factors of the green building development. The level of green building development from builder's point of view has been investigated and the most important factors have been analyzed. The findings suggest that government roles, cost and lack of awareness are the significant drives for the success of green building.

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