Factors Influencing the Growth of Energy Efficient Building in Construction Projects

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Abstract—**This research paper aims at examining the concept of green building with the objective of identifying the key factors that affect the growth of green building in the construction industry. A comprehensive literature review was undertaken to provide an overview of the factors limiting the growth of green building globally. A quantitative approach was adopted and data was collected via a questionnaire survey of randomly selected construction professionals in the Gwalior construction industry. This paper is aim to analyze the factors which are mostly responsible for factors limiting the growth of green building. In order to do so a literature survey is conducted that gives the desired factors which leads to limiting the growth of green building construction. The factors are derived by a detailed literature survey. In the end, an investigation is completed by using the process Important Index (IMPI) which gives the relative importance of these factors which help in ranking those factors according to their IMPI The paper will add value to construction industry stakeholders who have limited information regarding factors limiting the growth of green building.**

Index Terms— **Green building, Energy efficient, Growth, Construction industry, IMPI**

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I. INTRODUCTION

The construction industry is important because of the outputs and outcomes of its activities. It contributes to national socio-economic development by providing the buildings, which are used in the production of all goods and services in the economy (Ofori, 2012). However, how a building is designed, the way and manner it is constructed, and where it is located clearly affects the users of the building, the community, and the environment (Choi, 2009). Thus it can be implied that the construction industry can influence the competitiveness of enterprises within the economy. Construction can also affect the ability of the nation to attract foreign investment. For these reasons, efforts should be made to ensure the continuous improvement of the industry especially in this era of globalization since all nations are competing nations in order to attract foreign investment. Notably, the construction industry performs poorly with regards to environmental considerations (Ofori, 2012). Construction activities in developing countries may involve excessive resource consumption, and cause land degradation, loss of habitats, air and water pollution, and involve high energy usage and produce approximately 23-40% of the world's greenhouse gas emissions (Ofori, 2012; Gunnell, 2009).

The substantial negative environmental impacts of buildings have led to the emerging concept of 'green buildings' (Gunnell, 2009). According to Gunnell (2009), green buildings are designed to be energy and water efficient, use non-hazardous materials and provide healthy productive environments. Green building is defined "as a construction project that is either certified under any recognized global green rating system or built to qualify for certification" (Bernstein & Mandyck, 2013:5).Green building is a practice of creating structures to provide a healthy, applicable and effective environment, and at the same time to conserve resources (energy, land, water and materials), protect the environment and reduce pollution as much as possible and thus to remain harmonious with nature throughout its life cycle.(Liu, 2011) With these environmental friendly characteristics, green building is considered to be an effective method to achieve low energy and environment consumption of construction industry and promote its sustainable development.

Against this backdrop, this paper was developed to identify the major factors that inhibit the growth of green building in the construction industry and to determine whether there is a significant difference between the participants' perceptions and the factors inhibiting the growth of this sector.

II. AIM & OBJECTIVE

- The main aim of this paper is to find out responsible factors limiting the growth of Green Building.
- To find out the relative importance of the factors limiting the growth of Green Building.
- To rank the factors as per their relative importance.

III. FACTORS LIMITING THE GROWTH OF GREEN BUILDING

For finding out the factor responsible for limiting the growth of Green Building in the construction projects, a literature survey is conducted in which several works of the researchers have been analyzed and the critical factors are taken which was common in most of the papers.

Total 27 numbers of factors are identified by literature study which are shown in Table 3.1

Table 3.1: List of factors responsible for these causes

S.NO.	FACTORS RESPONSIBLE FOR LIMITING THE GROWTH OF GREEN BUILDING
1	Asymmetric distribution between different stakeholders regarding costs and benefits
2	Higher cost of green buildings compared with traditional ones
3	Insufficiency in consumer's demand for green building
4	Technical difficulty in design
5	Failure to bring greater economic benefits for stakeholders
6	Delays in obtaining certification and permits for green buildings
7	Deficiency of green building related technology.
8	Lack of relevant experience of green building projects
9	Limited Accessibility to Relevant Information
10	Lack of incentives for promoting green building
11	Cultural and social resistance
12	Limited range of green products and materials
13	Insufficiency of stuff who are familiar with green techniques
14	Capacity barriers
15	Technical difficulty during the construction process
16	Inadequate information regarding the financial and economic benefits and opportunities of green buildings
17	Perception that Materials are of Low Status
18	Incompletion of corresponding laws and regulations
19	Unreliability of Suppliers
20	Lack of communication and collaboration between different stakeholders
21	Incompletion of green building's relevant supporting materials procurement market
22	Higher Maintenance
23	Lack of the atmosphere to pursue green building in construction industry
24	Society's inadequate understanding regarding green building
25	Insufficient support for green building from the government
26	Lack of Familiarity with Techniques
27	Inadequate cost data for green buildings

The Table 3.1 will be used for analyzing the data to find out the relative importance of the factors by IMPI.

IV. RESEARCH METHODOLOGY

For reaching out the goal of this paper important index (IMPI) is used to find out the relative importance of all the factors responsible for limiting the growth of Green Building in construction projects.

4.1 IMPORTANCE INDEX TECHNIQUE

The information gathered to decide the most influential factors is done through a survey by explorative questionnaires to the respondent required in daily activities of construction firms in Gwalior region of India. The research methodology for study contains two phases. The first phase included a literature search and interviews. The writing audit was led through books, meeting procedures, articles, web and worldwide project administration diaries. As the result of this stage, 27 factors limiting the growth of green building is find out. The second stage incorporates arrangement of survey in light of various approach utilized for offering positioning to factors limiting the growth of green building in construction projects. In this method Importance Index (IMPI) is figured as a part of frequency and severity.

In this method, Importance Index is computed as an element of frequency and severity lists. Here, both frequency of event and severity were classified on a four-point scale with the qualities 4 to 1. Frequency of event is sorted as usual, frequently, at times and once in a while (on 4 to 1-point scale). So also, level of severity was classified as extreme, great, moderate and little (on 4 to 1-point scale).

4.1.1 FREQUENCY INDEX

To rank the factors limiting the growth of green building in construction projects based on frequency of occurrence as identified by the members, the following equation is utilized:

Frequency Index (F.I) (%) = $\Sigma a(n/N) \times 100/4$

Where, a = the constant expressing weighting given to each response (ranges from 4 for always up to 1 for rarely)
n = the frequency of the responses
N = total number of responses.

4.1.2 SEVERITY INDEX

A formula is used to rank the factors limiting the growth of green building in construction projects based on severity as indicated by the members, the following equation is utilized:

Severity Index (S.I) (%) = $\Sigma a (n/N) * 100/4$

Where, a = the constant expressing weighting given to each response (ranges from 4 for always up to 1 for rarely)
n = the frequency of the responses

N = total number of responses.

4.1.3 IMPORTANCE INDEX

The significance list of every cause is computed as a component of both frequency and severity files as takes after:

IMPORTANCE INDEX (IMP.I) (%) = [F.I. (%) * S.I. (%)]/100

V. DATA ANALYSIS

Importance index (IMPI) process is used to find the relative importance index and ranking them. The Overall ranking and index is giving below in Table 5.1

Table 5.1: Ranking of responsible factors

S.NO.	TOTAL FACTORS	WEIGHT (%)	RANK
1	Asymmetric distribution between different stakeholders regarding costs and benefits	33.9934	16
2	Higher cost of green buildings compared with traditional ones	72.2565	1
3	Insufficiency in consumer's demand for green building	52.4691	4
4	Technical difficulty in design	38.8888	12
5	Failure to bring greater economic benefits for stakeholders	21.2962	23
6	Delays in obtaining certification and permits for green buildings	24.4341	22
7	Deficiency of green building related technology.	64.8148	2
8	Lack of relevant experience of green building projects	62.8600	3
9	Limited Accessibility to Relevant Information	30.6498	18
10	Lack of incentives for promoting green building	44.8045	7
11	Cultural and social resistance	20.8333	24
12	Limited range of green products and materials	37.2942	13
13	Insufficiency of stuff who are familiar with green techniques	40.8950	9
14	Capacity barriers	41.9327	8
15	Technical difficulty during the construction process	35.6485	15
16	Inadequate information regarding the financial and economic benefits and opportunities of green buildings	36.0082	14
17	Perception that Materials are of Low Status	39.5661	11
18	Incompletion of corresponding laws and regulations	19.4984	25
19	Unreliability of Suppliers	27.2545	19
20	Lack of communication and collaboration between different stakeholders	24.9717	21
21	Incompletion of green building's relevant supporting materials procurement market	39.7508	10
22	Higher Maintenance	46.6901	6
23	Lack of the atmosphere to pursue green building in construction industry	32.7906	17
24	Society's inadequate understanding regarding green building	18.6258	26
25	Insufficient support for green building from the government	16.6990	27
26	Lack of Familiarity with Techniques	49.2592	5
27	Inadequate cost data for green buildings	26.8864	20

The Relative importance & overall ranking of all the factors is shown in Table 5.1.

VI. CONCLUSION

Through the studies, it is necessary to adopt the energy efficient concept for saving the environment depilation. Energy efficient buildings reduce consumption of energy over its lifetime by numerous ways.. by the use of energy efficient method are introduce to deal with the problem of environment and energy loss that will able to creating and maintaining the structures without undergoing any loss and give benefit of making building energy efficient. It is clear that by working with several smart technologies like site selection, heating and cooling system, waste reduction, water savings and material used while working with renewable energy, natural resources and using concept like solar water may lead to tremendous advancement in environment and health, value for money, water and energy conservation and waste management issue, shows It is cost effective as shows quick access money repayment and resource saving application. Helps to reduce the carbon elements and hygienic residual in nature, thus contribute towards healthy environment.

The important conclusion withdrawn from the data analysis is that the top ten factors which are concluded by data analysis are: Higher cost of green buildings compared with traditional ones(%), Deficiency of green building related technology(%), Lack of relevant experience of green building projects(%), Insufficiency in consumer's demand for green building(%), Lack of Familiarity with Techniques(%),Higher Maintenance(%),Limited Accessibility to Relevant Information(%),Capacity barriers(%), Insufficiency of stuff who are familiar with green techniques(%),Incompletion of green building's relevant supporting materials procurement market(%).

Thus, this study concludes that the government needs to initiate a strategy by establishing various incentives schemes that will serve as a catalyst to enhance the growth of green building. The green building sector could be incentivized either through monetary or non-monetary incentives. There is a need to create a coordinated knowledge hub to document and provide the existing and emerging information on the true cost of going green, the benefits and performance of green building, market and environmental trends, as well as monitoring and evaluation data. This can significantly build up the industry confidence in expanding the market for green development.

REFERENCES

[1] Akshay B. Mokal, Allaudin I. Shaikh Shamashree S. Raundal, Sushma J. Prajapati, and Uday J. Phatak International Journal of Application or Innovation in Engineering & Management (IJAIEM), 4(4), 2015, 244-249

[2] Vinutha Bai N, DR.R.Ravindra, ENERGY EFFICIENT AND GREEN TECHNOLOGY CONCEPT, IJRET: International Journal of Research in Engineering and Technology, 253-258

[3] Dr. Siba A. Awawdeh, Buildings' Energy Efficiency and Buildings' Energy Codes: a Literature Review, International Journal of Applied Science and Technology 4(2); March 2014, 37-46.

[4] Windapo, A. (2014). Examination of Green Building Drivers in the South African Construction Industry: Economics versus Ecology. Sustainability, 6(12), 6088-6106. doi:10.3390/su6096088.

[5] Hwang, B., Zhu, L., & Ming, J. T. (2017). Factors Affecting Productivity in Green Building Construction Projects: The Case of Singapore. Journal of Management in Engineering, 33(3), 04016052. doi:10.1061/(asce)me.1943-5479.0000499.