

ANALYSIS OF GREEN BUILDING TECHNIQUE PERCEPTION AND IDENTIFICATION OF ITS IMPENDIMENTS

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Abstract— Inventory In construction industries there is a vital role of building sector which contribute the larger amount of co2 (climate change) with its high energy footprint. Green building plays and important role towards the potential of building sector and reducing the greenhouse gases at low cost and gives environmentally friendly or healthy buildings. In addition the green building give the sustainable advantages towards green building or climate changes like reduction in electricity and water consumption, reduction in waste generation , use of green and less energy-thoroughgoing materials in construction and preservation of greenery. Although the economic advantage is also offered by green building. The objective of this paper is to quantitatively identify, rank and prioritize the barriers to the adoption of green building using the RII method . Results from RII method of 70 questionnaire survey responses from GB experts around the Surat city are presented. The study identifies 27 specific barriers which are classified in five categories- (1) Attitude and Market Barriers; (AMB) (2) Financial and Economic Barriers (FEB) (3) Information, knowledge and Education Barriers,(IKEB)(4) Management and government Barriers (MGB) (5) Technology and training.(TTB). Three group of stakeholder were taken part architects, contractor & project engineer took part in the ranking and prioritization of barriers. Calculation of local and global weight reveals that (IKA) barriers are ranked high and MG comes second where FE and TT where get lag much behind with lower global weights among the top 10 specific barrier unfamiliarity with gb technologies, lack of knowledge and awareness of gb technologies and their benefits, limited experience with the use of non traditional procurement methods, lack of reliable gb technologies research and education etc . From the perspective of gb experts, this study contributes to the body of knowledge about GB barriers.

Keywords— Green building, stakeholder perception, Green building; Barriers, Construction industry, Sustainable development.

INTRODUCTION

The term The construction sector's owing to the significantly increase in weather condition and global temperature extremely and 33% of high energy-related emission which is expected that the energy emitted between 11-15.6 billion metric tonnes by 2030 according to the intergovernmental panel for climate change (IPCC 2007). After agriculture construction is the 2nd largest economic activity in India. The construction sector has the largest resources footprint. Accounting 30% of electricity consumption, 23.6% green house emission gas & 10% of total electricity consumption. In construction sector there are two segment infrastructure & real estate where real estate contribute 24% of value addition to the construction industrial (NSDC 2009).The construction industries consume a fairly larger amount of global energy which majorly contributor to carbon dioxide emission.

In India the building sector is one of the larger construction sector which is growing 10% annually. Green building offer potential opportunities for minimizing the environmental impacts of building to achieve sustainable development. Through substitution of raw material, use of energy efficient technologies, optimization of building orientation & configuration waste treatment, energy conservation , passive solar & low emission which adopt to climate change at least cost (IPCC 2007). Residential & commercial sector of green building in which commercial sector gives a major ongoing efforts to reduce and adopt to climate change.

In different part of world various building rating system has been adopted for the inception of sustainable development movements including the building research establishment environmental assessment method (BREEAM), Canada's building performance assessment criteria (BEPAC), The european union's energy performance of building directive (EPBD), green building tool (GBTOOL), Leadership in energy & environment design (LEED) etc.

In india two major green building rating system at presently publicize the adoption of energy efficient sustainable building-LEED is being develop by Indian green building council (IGBC), and green rating for integrated habitat assessment (GHIRA) by the energy research institute (TERI) LEED India ratings are provisioned for new construction as well as Core and Shell, Green Factory Building, Green SEZ (Special Economic Zone) and Green Cities. GRIHA is an indigenous rating system for new construction based on nationally accepted energy and environmental practices. GRIHA rating guidelines keep in view the Indian agro-climatic conditions and in particular the preponderance of non-air-conditioned buildings.

Now a days there is a wider role of green building in different countries & it is being constructed currently, so where we adoption of green building there is a adoption of barrier may aries. The barrier are rises due to the priorities involving

multiple stakeholder in different building sector & it also depend upon the perception of different users like adoption of risk in green practice. For successful adoption, an integrated approach across all stakeholders is required and the building sector should take into consideration the expectations and endeavours to meet their needs (Bal et al. 2013). A green building project can only happen when constant communication and idea exchange is assured between the stakeholders. While the relative literature on barriers to energy efficiency is pretty rich, there is a dearth of India- specific studies on barriers to green building. However, barriers to the adoption of green buildings must be identified and studied systematically, as not much has been done in the Indian context.

LITERATURE REVIEW

Haripriya Gundimeda et al have done a survey by explorative questionnaire to the respondents involved in daily activities of construction firms in various regions in the Gujarat region of India. This paper represents the analysis of the factors affecting the adoption towards green building with the most affecting factors based on survey. Base on ranking, most important causes for barrier affecting green building by the Analytic Hierarchy Process (AHP) were: (1) Misunderstanding lack of expertise in the application of life cycle costing of material and energy efficient technique in building sector [AHP=0.6975]; (2)Weak enforcement of buildings codes.[AHP=0.130].

Albert P. C. Chan; et al have applied statistical analysis to find out the most critical barrier. Research shows that the most critical barrier which surely will help in reduction and adoption of green building in surat a) resistance to change from use of traditional technologies, b) higher cost of green technologies, c)lack of green building database and information.

According to Bon-Gang Hwang et al. In This paper it aims to identify the critical factors affecting the productivity of green building construction projects by assessing the likelihood, impact, and criticality of the factors with comparisons against traditional projects & it also says that Training in green building practices should therefore be introduced in institutions of higher learning and trade schools. The professionals felt that the introduction of green building practices in the building bye laws will institutionalize these practices.

Julker Nine et al describes a study in which the purpose was to identify the use of green building techniques that reflect with low carbon emission towards nature. Surveys, finds the ways and challenges of the construction of low carbon building are pointed out, which are new energy develop, clean technique use, green planning, green building and low carbon life style. And The following suggested techniques during different stages of building's life cycle, lower carbon emissions from buildings could be achieved, which will help in development of more sustainable, ecofriendly environments.

METHODOLOGY

Tangible and intangible qualitative value judgments is being involve for prioritizing the barriers with multiple criteria rather than a single criterion. We use Relative Importance Index (RII) to rank and identify the most significant barriers. Before seeking the views of selected stakeholders, the following steps were taken: 1) identified the potential barriers from the literature and focus group discussions with experts working in Green Building Rating Systems; 2) used a questionnaire survey to elicit the qualitative and quantitative responses of various stakeholders The approach was to conduct both structured and unstructured interviews within focus groups to identify the main barrier categories and the indicators to be incorporated into the questionnaire for further analysis. Opinions and judgments were sought from the experts who are knowledgeable about the working of the construction sector. The professionals working in green building rating mechanisms like LEED and IGBC participated in focus group discussions to give significant insights into the linkages among different stakeholders and the functioning of the building sector. Based on the focus group discussions with the member of IGBC, twenty seven specific barriers and five barrier categories hindering the widespread adoption of green buildings were identified and three groups of stakeholders were identified to be part of the survey. Three groups of stakeholders had a significant role and potential in influencing the enactment of green building measures were identified for the study based on the literature review and focus group discussions with experts in the building sector. The three stakeholder groups chosen are: 1) architects and designers, 2) engineers, project managers 3) contractors and sub-contractors, 4) government authorities. This categorization is based on the performance objectives, shared challenges and disincentives they face in the adoption of green practices stakeholders in the status-quo situation. Table 1 highlights how the indicators of performance/measurement, the challenges and incentive structure vary across the stakeholders.

Table-1 The indicators of performance and challenges of stakeholders.

Stakeholder	Performance Measures	Challenges in the adoption of green practices	Disincentive faced for promotion of green building
Architects, Landscape Architects, Interior designers	Aesthetics, visual & space planning	Safety motives, data shortage discourages optimal sizing, design is changed as per convenience	Fee structure disincentivizes green innovation in design, concerns about potential liability is met by over-sizing at the expense of clients.
Engineers (Civil, Water, Structure, mechanical, electrical)	Watt/sq m, kW/ton	Joins at a later stage and not part of conceptualization, working on multiple projects at a time, lack of interaction between different departments	Engineering fees have been customarily based on a percentage of the capital cost of the project, process like installation of equipment rewards over-sizing
Contractor & subcontractor	Budget & schedule, profit margin	No long-term contract on efficient functioning, liability is there for under sizing not for creative initiatives, familiarity and punctuality of suppliers is important	Absence of relational contracting, presence of short-term partnering
Project Managers	Critical path and drawing adherence	Between owner and designer, time, price and familiarity works. Not responsible for operating budgets. Needs to change the design as per convenience and availability of materials, adoption of green measures incur more work.	
Government Authorities	Implementation of building codes and compliance with other laws and regulations	Data shortage, lengthy process for commissioning	

DATA COLLECTION

Respondents were asked to express their professional opinions on the criticality of 27 barriers to GB technologies adoption using a four-point Likert scale from 1 (not important) to 4 (very important).

Data were gathered through a survey and analysed by using Relative Importance Index (RII) technique. RII technique: The procedure used in analysing the results was aimed at establishing the relative importance of the various factors responsible for selection of Barriers towards green building by giving rank to the factors. The questionnaire gave each respondent an opportunity to identify the factor by giving the response “Not important, Very important.....etc.

” The primary data collected from the first part of the questionnaire was analysed from the perspective of contractors, engineers and architects. Total 70 numbers of respondents comprises of 25 engineers, 15 contractors and 30 architects who participated in this field survey. The responses of them were taken for this analysis. Each individual factor perceived by all respondents was computed for overall analysis by RII.

The relative importance index is computed for each factor to identify the most significant factor that affects selection of Green building technique. The factors are ranked by the RII method by input data in the excel software for analysis. In which rank is given to all the factors and the four point scale ranged from 4(strongly agree) to 1 (strongly disagree) is adopted for data analysis by RII.

The formula to calculate RII given below:

Where,

W = Weighting given to each factor by the respondents

(ranging from 1 to 4),

A = Highest weight (i.e. 4 in this case),

N = Total Number of respondents.

$$RII = \sum W / (A * N)$$

The questionnaire consisted of two parts: 1) Related to general information of respondent, 2) Includes the list of the factors affecting decision making of green building barrier & users perception in construction project. The participants were asked to rank these barriers based on their perceptions and the questionnaire has been semi-structured with more space for listing additional perspectives. The representative profiles and percentage distribution of the stakeholders who have participated in the questionnaire are given in Table below

SR NO.	Respondent	Questionnaire Distributed	Response Returned	% of Response	% of Respondent
1	Architect	50	30	60%	42.85%
2	Site engineer, project manager	50	25	50%	35.71%
3	Contractor, sub-contractor	30	15	50%	21.42%
4	Total	130	70	53.84%	100%

ANALYSIS

A. Top 10 ranking for specific barrier by different stakeholders.

Table-2 Ranking of each barrier

SR NO. RANK	ARCHITECT		ENGINEER		CONTRACTOR	
	BARRIER	RII	BARRIER	RII	BARRIER	RII
1	C2	0.8750	D2	0.8100	E2	0.5000
2	C5	0.8667	B6	0.8000	C2	0.8167
3	C3	0.8417	E2	0.7800	A2	0.5667
4	C4	0.8167	B5	0.7600	B2	0.4000
5	B1	0.8000	E5	0.7500	C4	0.5333
6	D4	0.7917	B2	0.7400	B7	0.6167
7	B4	0.7750	C1	0.7200	E1	0.8000
8	C1	0.7667	A5	0.7100	E4	0.4500
9	B2	0.7083	D1	0.7000	D2	0.6333
10	E4	0.6917	E4	0.6900	B4	0.4667

B. Top 10 combine barriers by RII method

Table-3 Combine barrier

SR NO.	BARRIER	RII	RANK
1	B6	1.5600	1
2	D2	1.3100	2
3	E5	1.4400	3
4	E2	1.4300	4
5	B5	1.4200	5
6	E3	1.4100	6
7	B2	1.3900	7
8	B3	1.3800	8
9	B1	1.3600	9
10	B7	1.3400	10

Table-4 Identify the top 3 reasons for using green building.

SR NO.	RANK	ARCHITECT		ENGINEER		CONTRACTOR	
		RGB	RII	RGB	RII	RGB	RII
1	1	B	0.8333	C	0.7500	A	0.9167
2	2	A	0.7917	A	0.6500	G	0.6667
3	3	C	0.7083	K	0.6000	C	0.4167

Table-5 Identify the top 3 perception of users.

SR NO.	RANK	ARCHITECT		ENGINEER		CONTRACTOR	
		PGB	RII	PGB	RII	PGB	RII
1	1	I	0.7500	F	0.8000	I	0.8333
2	2	E	0.5417	E	0.5100	E	0.5933
3	3	B	0.4583	I	0.5000	C	0.5833

Table shows the ranking of specific barriers according to the global weights. Among specific barriers, C2 (lack of knowledge and awareness of gb technologies and their benefits) emerged as the most important barrier. Contractors, and project managers also rated C2 as most intense barrier they face while considering investments in green building. The second and third barriers in architect, C5 (limited experience with the use of non-traditional procurement methods) and C3 (lack of reliable gb technologies research and education) weigh 0.86 and 0.84, respectively, belong to the IKE category. Contractors rated E2 as their top priority barrier, while Engineer rated D2 as their first important barrier. While C2, C4 for architect, E2, B5 for engineer, A2, B2 for contractor were ranked less important in their stakeholders with weights less than 0.87. These are the top four barriers which need urgent attention when any kind of action is sought in favour of green building. It must be noted that five of the top ten barriers are internal in nature, that two of them belong to the TTE barrier category and one belongs to the MGB barrier category. Other two belong to the AMB barrier.

The most common top ten critical barriers from 27 barriers which need attention when there is any kind of action is sought in favour of green building are B6 lack of tested and reliable gb technologies, d2 lack of interest and market demand, e5 complexity and rigid requirements involved in adopting gb technologies, e2 difficulties in providing gb technological training and project staff, b5 lack of available and reliable green technologies suppliers, e3 lack of technical standard procedures for green construction, b2 lack of interest and market demand, b3 high degree of distrust about gb technologies, b1 resistance to change from the use of traditional technologies, b7 lack of availability of demonstration projects. These are the top ten barriers towards green building which resist against the green building.

The top common reasons for using green building by stakeholders are (A) REDUCING TRASH, POLLUTION AND DEGRADATION OF ENVIRONMENT, (C) PROTECTING OCCUPANT HEALTH AND IMPROVING PRODUCTIVITY. These are the reasons for using green building amongst the 12 reasons.

The common perception of users of green building are (E) HEALTY INDOOR AIR, (I) WATER EFFICIENCY. These are the major perception of users.

CONCLUSION

The building sector has a very important role to play in reducing energy consumption and carbon emissions. However, several barriers hinder the effective adoption and diffusion of buildings with superior environmental performance. This study identified some of the significant barriers that should be prioritized in the Indian context.

Lack of knowledge and awareness of gb technologies and their benefits is a barrier which gets priority. Labelling as a market mechanism decreases search costs, experience costs and reduces credence costs without resorting to a command and control mechanism. It neither imposes the producer to produce his/her goods in a particular way nor the customer to buy a particular product. Rather, it provides information on the production of good and leaves it to the market forces of demand and supply. Labelling, in this case, provides market information about production attributes and can be used as a mechanism revealing consumer valuation of environmental attributes which brings long-term economic advantages through market instruments. This can solve the problem of 'missing market' in the case of green buildings.

For the awareness of green building the social constructivist approach tells that technology and change have to be seen from a dual perspective. There is a social shaping of technology and the technical shaping of society. The increasing power of persuasion through media and images has an important role in popularizing the technology and translating it into ideas that fit into the society. Besides the technical prescription, there needs to be increased awareness to capture the societal imagination of 'why going green' is important. This can be tackled through demonstration programs, training of professionals, labelling, or popularization of green building certification. Compulsory energy audits in buildings will create a clear notion of the importance of energy efficiency. The benchmarking and identification of best practices will serve positively in increasing the visibility of the green building movement in India and can also help the building sector to become resource-conscious.

This study clearly shows that the barriers are many and so a single policy may not be effective in facilitating the shift to green buildings in India. There is a clear need for government regulation including setting this as part of the national agenda and the implementation of command and control, as well as market-based instruments to enable the shift. A judicious mix of various instruments like regulation, taxes, green subsidies for consumers, preferential housing loans to buy green buildings, information disclosures, etc. are required. Financial incentives in the form of Additional Floor Area Ratio (FAR), reduced stamp duty, and soft loans are suggested as part of the low carbon strategy by Indian Planning Commission. Some of the most significant policies require reducing information provision to ensure the market penetration of green buildings. The results of the study also show that there is the need for eco-labelling of green buildings so that the users and potential adopters know what they get for their investment. The idea of 'Green Leases' for green rated buildings can fetch higher rent and can also increase the resale value of the property.

A unified view of both the builders, as well as users, is that green buildings do incur substantial costs and thus there is an urgent need to adopt lifecycle perspective to compute the cost savings that the green buildings provide.

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