International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Key Criteria Influencing Sustainability Assessment of Building Projects

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Abstract - *A building project can be regarded as sustainable only when all the various dimensions of sustainability such as environmental, economic, social and technical are considered. Any building level assessment method is complex and involves contradictory aspects. The purpose of sustainability assessments is to gather and report information for decision-making during different phases of the construction, design, and use of a building. This paper aims to find out the key factors influencing the sustainability of the building. The sustainability of different phases of construction such as planning phase, construction phase and operation phase is considered separately in the study. Data collections were carried out by conducting questionnaire survey and key factors were determined separately for environmental, economical, social and technical dimensions of sustainability. Software Package for Social Science was used for ranking of variables.*

Key Words: sustainability, key factors, construction, environmental, economical, social, technical

1. INTRODUCTION

Over recent years, construction projects are rapidly increasing. The developing structures should be healthy for the human comfort as well as environment. Sustainability is the key to create a healthy, happy and thriving economic climate in communities around the world. It is important to our future success and plays a critical role in creating and enhancing development. Sustainable development is often defined as, "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". A building project can be regarded as sustainable only when the various dimensions of sustainability such as environmental, economic, social, and technical sustainability are dealt with. The various sustainability issues are interwoven, and the interaction of a building with its surroundings is also important. The following goals can be found in several building sustainability assessment methods: optimization of site potential, minimization of energy consumption, protection and conservation of water resources, use of environmentally friendly materials and products.

The sustainability of a building is determined in terms of its life cycle . During the life cycle of a building, there are four main aspects of sustainable development that needs to be considered in decision making to achieve the aim of a sustainable building. These are as follows:

- Environmental Aspect: The environmental aspect covers the energy efficiency, resource efficiency, pollution features etc., throughout the life cycle of the building.
- Economic Aspect: The economic aspect deals with the cost effectiveness, use of recyclable and reusable material, conservation of energy etc. throughout the life cycle of the building.
- Social Aspect: Social aspect deals with the health of the users and their productivity, facilities for the disadvantaged people etc.
- Technical aspect: From a technical standpoint, sustainability requires that current technical aspect not disproportionately burden future generations.

1.1 Objectives of the Study

The following are the main objectives of this study :

- To identify the criteria which affects the sustainable construction and study the effect and relative importance of these criteria on sustainable construction using Questionnaire survey.
- To identify the key criteria among the identified criteria.

2. DATA COLLECTION

Two forms of data collection has been used in this study-questionnaire survey and personal interview of the various officials of construction firm like project managers, site engineers, structural engineer, designers, architects etc. Questionnaire has been used as the main method of data collection for this study to allow for feedback from a large number of respondents, where it is impractical to collect feedback using other more resource intensive methods. Questionnaire survey was conducted at 40 different construction companies. Questionnaire was distributed to various officials in construction field such as project manager, site engineer , design engineer etc to investigate the factors influencing sustainable construction in India and to make full use of the information obtained from the results to identify the dominating criteria to be observed in a sustainable construction. The scale used for the measurement is Likert scale. It is used by the respondents to express their opinions or views towards the importance of the criteria. Therefore a five-point Likert scale is used for recording the perceptions of respondents. The main advantage of Likert scale lies in its simplicity and versatility. The criteria are quantified with the help of numerical values assigned. The table showing Likert scale value and indication is shown in Table 1.

Table -1: Likert scale

Linkert value	Indication
1	Not at all important
2	Slightly important
3	Moderately important
4	Very important
5	Extremely important

3. ANALYSIS

SPSS statistical package is one of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions.

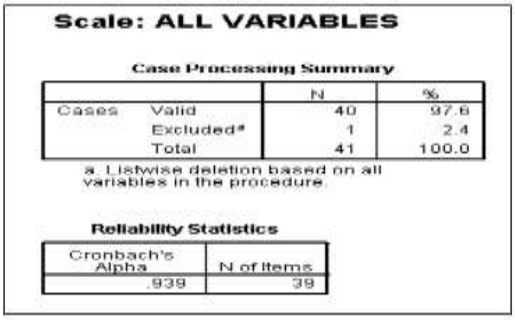
3.1 Reliability check

Cronbach's alpha is the most common measure of internal consistency ("reliability"). It is most commonly used when you have multiple Likert questions in a survey/questionnaire that form a scale and you wish to determine if the scale and the questionnaire is reliable. High degree of reliability is obtained if the value of Cronbach's alpha is obtained as shown in Table 2.

Table -2: Cronbach's alpha values

Cronbach's alpha	Reliability
>0.9	Very high reliability
0.7-0.9	High reliability
0.5-0.7	Reliability is quite high
<0.5	Low reliability

The responses obtained from all the questionnaires were analyzed for their reliability using SPSS software. The result obtained from the software is shown in Fig 1.



Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	40	97.6
	Excluded[a]	1	2.4
	Total	41	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.939	39

Fig -1: Reliability Statistics Since the value obtained is greater than 0.9, the questionnaire response is highly reliable.

3.1 Relative Ranking Index Analysis

The data were analyzed on the basis Relative Rank Index (RRI) technique. The RRI technique is used for comparison between the importance level of variables and derived from the Likert scales which represent the level of importance of variables chosen by respondents which need to be transformed into a Relative Rank Index that has a value of one or less. The RRI can be calculated using the following equation:

$$RRI= \frac{1}{nN}\left(\sum_{i=1}^{n} li\ xi\right)$$

Where,

RRI refers to Relative Rank Index, n- Maximum Likert scale value (here 5)

N-Total number of responses, i- 1,2.....n

li =Likert scale (*l*1 is the least important and *l*n is the most important)

xi=the frequency of the i^{th} response.

As many as 40 respondents' views were collected regarding the building sustainability criteria preferences who are having enough experience in the construction industry. Considering the lengthy procedure of manual analysis and availability of time, the key criteria were selected from the analysis using SPSS software. The key criteria were as follows:

Table-3: Key Criteria for environmental aspect

Environmental
Impact on biodiversity
Effect on land pollution
Green innovation and product
Influence on public health
Land use and water
Waste generation

Table-4: Key Criteria for social aspect

Social
Effect on local development
Occupational health and safety
Employment opportunities
Public sanitation
Project function
Land use and its influence on public

Table-5: Key Criteria for economical aspect

Economical
Productivity
Corporate strategy
Payback period
Project investment planning
Life cycle benefit

Table-6: Key Criteria for technical aspect

Technical
Application of latest technology
Durability
Government policy
Quality of service
Training programs
Skilled labours

4. CONCLUSIONS

The purpose of sustainability assessments is to gather and report information for decision-making during different phases of the construction, design, and use of a building. Every construction should be environmentally, economically and socially sustainable. The review of various literatures regarding sustainability assessment were carried out which helped in identifying different criteria for sustainability analysis. Questionnaire survey was conducted at 40 different construction companies. Questionnaire was distributed to various officials in construction field such as project manager, site engineer , design engineer etc to investigate the factors influencing sustainable construction in India and to make full use of the information obtained from the results to identify the dominating criteria to be observed in a sustainable construction. The key criteria under four dimensions of sustainability namely environmental, economical, social and technical were obtained and these were grouped under different phases of construction namely planning phase, construction phase and operation phase.

In future studies various other dimensions of sustainability can be studied to have a more detailed study on aspects of sustainability. Also an assessment tool for sustainability can be developed with the key criteria obtained from the study which could overcome the limitations of the existing assessment tool.

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