

SUSTAINABLE CONSTRUCTION THROUGH PROCUREMENT IN CONSTRUCTION PROJECTS

Kavipriya A1 ,Renuka SM2, Umarani C3

1M E Student, Department of Civil Engineering, College of engineering, Anna University, Chennai

2Assistant Professor, Dept of Civil Engineering, College of Engineering, Anna University, Chennai

3Professor, Dept of Civil Engineering, College of Engineering, Anna University, Chennai

kavidomik@gmail.com

Abstract—Sustainable construction through procurement is the, “Construction and the way they construct have a fundamental impact on the environment, consume large quantities of resources, involve large numbers of workers, and represent a large proportion of economic activity, so decisions made during all stages of the construction procurement process”. There is a lack of understanding and application of the concept in the construction industry. Hence the aim of this project is achieving SC through procurement in construction industry. 7 factors that helpful in attaining sustainable construction, 6 factors in social aspects, 4 factors in economic factors, 7 factors in environmental aspects and 9 factors of roles & responsibilities of procuring body in attaining sustainable construction were listed from literature. Based on the factors two parts of questionnaire were prepared. Five point likert scales was used. The relative importance index was calculated for the collected data. Based on the RII, the factors were ranked and it shows the importance of the factors. It results that seeing user needs and satisfaction, considering whole life costing and value for money, considering sustainability as a primary aim of project, waste minimization & management and Integrating sustainability issues in procurement decision making are dominant factors in each criteria. Recommendations provided for the advancement of SC throughout the procurement process.

Keywords— sustainable construction, sustainable construction through procurement, sustainable procurement, sustainability in construction, sustainability factors

I. INTRODUCTION

Like never before, the later part of the 20th century has witnessed urgent calls towards sustainable development. This issue relates to social, economic and environmental sustainability and has become one of the topmost agenda on government's policies over the world. Since 1987 the World Commission on Environment and Development has been at the forefront calling for the development of new methods to measure and assess the advancement toward sustainable development.

The concept of sustainable development, defined as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Significant efforts have been made by corporations, academia, non-governmental organizations, communities, nations, and international organization towards the attainment of sustainability goals. Current development models being implemented across the globe is

unsustainable, so it is believed that Sustainability is emerged. Sustainable approach will result in long term benefits.

Sustainable construction, concentrate on achieving simultaneously the three goals of sustainability,

- Economic prosperity
- Social inclusion
- Environmental sustainability

II.TOWARDS A SUSTAINABLE CONSTRUCTION

There have been conscious efforts by stakeholders in the construction industry to pursue sustainable development in the recent years. There have been advances in the sector through planning and programming. And in some cases even more intricate and comprehensive legislation in the areas of social, economic and environmental sustainability. The main objectives of sustainable construction are, Effective environment protection, Judicious use of natural resources, in social criteria that recognizes the needs of everyone and maintenance of high and stable levels of economic growth for a long term.

The demand and desire for sustainability interventions within the construction sector now make a contribution towards sustainable development. Social sustainability like the labour-intensive and the opportunities it presents for poverty alleviation. Social sustainability also means contributing to a higher social assimilation and to the continuous development of society in a gradual manner. The sector is also making significant contributions in the creation of small, medium and micro enterprises whose contribution to the economy. The construction activities alone produce more amount of waste. This sector also consumes more than one-sixth of fresh water globally and consumes more amount of global energy. Because of the activities the negative impacts like the loss of biological diversity, pollution of air, water and land dereliction.

III. Sustainable construction procurement

Sustainable construction procurement is the, "Construction and the way they construct have a fundamental impact on the environment, consume large quantities of resources, involve large numbers of workers, and represent a large proportion of economic activity, so decisions made during all stages of the construction procurement process are vital for maximising sustainability.

IV. OBJECTIVES OF THE STUDY

The objective of this study is follow as

To achieve sustainable construction (minimizing time, cost and waste) through procurement

a) To determine the sustainability factors in the procurement process that helpful in achieving sustainable construction.

b) To define criteria for assessing sustainable construction in the procurement process.

c) To identify the role of procuring entities in achieving sustainable construction

V. REVIEW OF LITERATURE

Loosemore (2015) was addressed that numerous changes to existing procurement practices are needed to encourage the engagement of more social enterprises in construction projects. Clients have a critical leadership role in bringing about these changes. No one is expecting a social procurement revolution and social enterprises will never completely replace the multitude of traditional suppliers and subcontractors that supply products and services to the construction industry. Ruparathna and Hewage (2015) concluded by three results. First, project owners should incorporate more sustainability requirements when procuring

for construction. Second, contractors should considering acquiring more experience related to sustainable construction to successfully deliver the mentioned sustainability requirements. Finally, construction industry institutions should promote benefits of sustainable procurement to create an interest within the construction industry. Since procurement starts at the pre-construction stage, many parameters are unknown at the time of procurement. Tadelis (2012) stated that expectations are that ex post haggling and frictions might occur when changes are needed. Second, due to strategic reasons there will be a lack of input by qualified and knowledgeable contractors at the design stage. Third, the need to proceed quickly without the ability to complete detailed plans and specifications will also cause contractual incompleteness and a need for ex post renegotiation. It's been observed that the construction sector generates waste on a grand scale in comparison with other industrial sectors (Ebohonet al., 2002). Research has shown that, about 10 to 30 percent of waste disposed of globally in landfills emanates from construction and demolition activities (Fishbein, 1998) resulting in grave environmental problems in many large cities (Begum et al., 2006; Chen et al., 2002; Teo and Loosemore, 2001). Life cycle costing (also referred to as whole life costing) is a popular theme that runs through the concept of sustainable construction. It refers to the cost of an asset throughout its life and takes into account planning, design, acquisition, operation, maintenance and disposal, less any residual value (Berry and McCarthy, 2011). Life cycle costing is considered a necessity due to the long service life of construction assets (COM, 2011). Life cycle costing according to Subramanian, (2007) plays a vital role in the development of sustainable construction.

VI. FACTORS INFLUENCING IN SUSTAINABLE CONSTRUCTION PROCUREMENT

D) Factors that helpful in attaining sustainable construction

Contractors knowledge and experience(F1), integrating sustainability requirements into contract document(F2), considering sustainability as a primary aim of the project(F3), encouragement for the contractor (or) supply side(F4), assuring the sustainability requirements are delivered and it is clearly assessed & measured(F5), the undertaking of sustainability risk assessment of project and provision of sustainability achievement records(F6), provision of a separate sustainability act for construction sector(F7).

II) CRITERIA FOR ASSESSING SUSTAINABLE CONSTRUCTION

A) Estimated factors in social criteria

Co-operation of stakeholders (A1), generating employment opportunities & social inclusion (A2), seeking intergenerational equity by considering cost for future generation (A3), training and improvement of workforce (A4), increasing health & safety performance and working environment (A5), consideration of user needs and satisfaction, constructing a positive impact on the local environment (A6)

B) Estimated factors in economic criteria

Clear installation of need and evaluation of alternative options (B1), consideration of whole life costing and value for money (B2), financial affordability for intended beneficiaries (B3), supporting the regional/local economy (B4)

C) Estimated factors in environmental criteria

Selection suitable material and its usage (C1), waste minimization and management (C2), minimization of pollution like air, noise, land water and etc (C3), reducing the consumption of energy, reusing the existing resources (C4), use of renewable resources (C5), protecting and enhancing biodiversity (C6)

III) Role of procuring body in attaining sustainable construction

Relationship, communication and knowledge within the organizational body (R1), training on sustainability factors and issues (R2), valuation of alternative procurement routes (R3), assuring the consideration of a complete range of options to attain organizations infrastructural needs (R4), integrating sustainability issues in procurement decision making (R5), sustainability estimation at various stages of construction procurement (R6), policies and guidelines of organization (R7), report to monitor the delivery of sustainability requirements throughout the project lifecycle (R8), initiation of sustainability requirements before tendering process (R9)

VII METHODOLOGY

The factors which need attention during implementation and which affects the procurement process were identified from literature. Based on the factors two parts of questionnaires were prepared. Data was collected from the all fields of construction entities and also from the procuring entities to get the correct result. Some questionnaire

were sent through email and many of the responses were contacted and collected directly. Relative importance index was calculated for the collected data and factors were ranked by RII. Based on the result, recommendations will be suggested for the construction industry.

VIII RELATIVE IMPORTANCE INDEX

The data received in the questionnaire was analysed by Relative Importance Index (RII) method. RII is used to determine the relative importance of

- The important factors in the projects
- critical success factors

$$RII = \frac{\text{Sum of weights (W1 + W2 + W3 + \dots + Wn)}}{A \times N}$$

where

W = weights given to each factor by the respondents and will ranges from 1 to 5 where '1' is less significant and '5' is extremely significant. A = highest weight (i.e. 5 in this case), and N = total number of respondents

IX RESULTS AND DISCUSSION

I) Ranking for factors that helpful in attaining sustainable construction

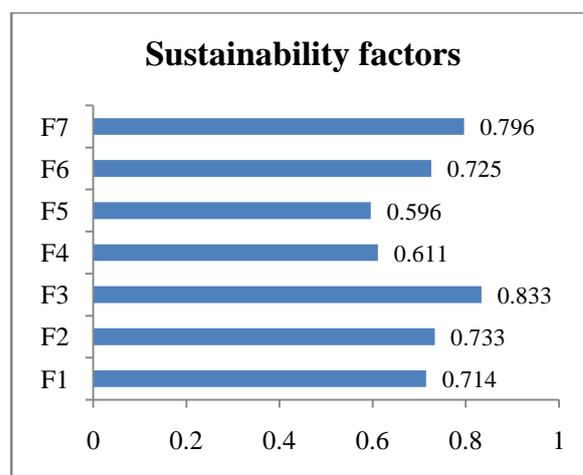


Fig. 1 Sustainability factors

The above graph plotted based on the RII value all the factors are ranked. Here the important factors are,

- considering sustainability as a primary aim of the project
- provision of a separate sustainability act for construction sector

Sustainability will be achieved, if we considering it as the primary aim of the project and provide separate act for sustainability. If it is implemented in the project sustainability will be achieved easily.

II) Criteria for assessing sustainable construction

A) Estimated factors in social criteria

From the below graph important factors in social criteria were listed below to attain sustainability

- Seeing user needs and satisfaction” among all factors.
- increasing health & safety performance and working environment

Social sustainability is important consideration. In that we need to concentrate user needs and satisfaction, safety performances. In that the assessment is prepared after construction process is completed. Because it is need to concentrate on human life and safety environment for the workers.

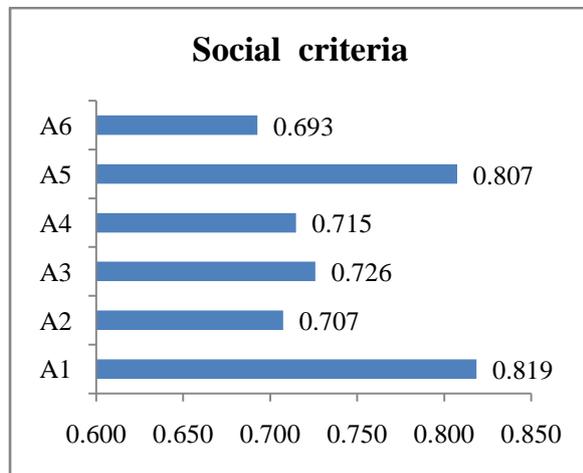


Fig. 2 Social criteria

B) Ranking for the estimated factors in economic criteria

From fig. 3 economic sustainability in construction industry can be attained if the following factors should be considered firstly:

- Consideration of whole life costing and value for money
- financial affordability for intended beneficiaries

From this observation these two factors play a great role in economic sustainability. Because in economic criteria a life-cycle cost assessment should be estimated and used to appraise all procurement decisions to attain life time costing in construction industries.

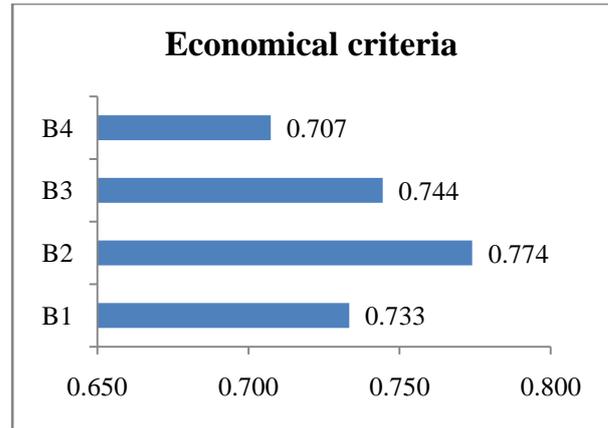


Fig. 3 Economic criteria

C) Ranking for the estimated factors in environmental criteria

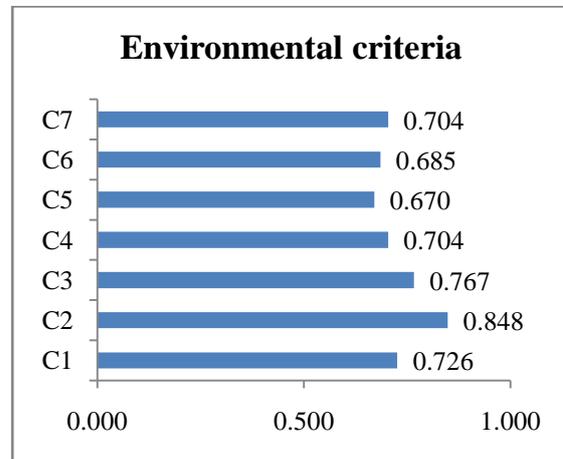


Fig. 4 Environment criteria

From the above graph the following factors concentrated more to attain environmental sustainability

- Waste minimization and management
- minimization of pollution like air, noise, land water and etc

Construction industry produces large amount of waste. So the waste minimisation and pollution minimisation need to be concentrated to attain environment sustainability and to maintain ecological system.

III) Ranking for the role of procuring body in attaining sustainable construction

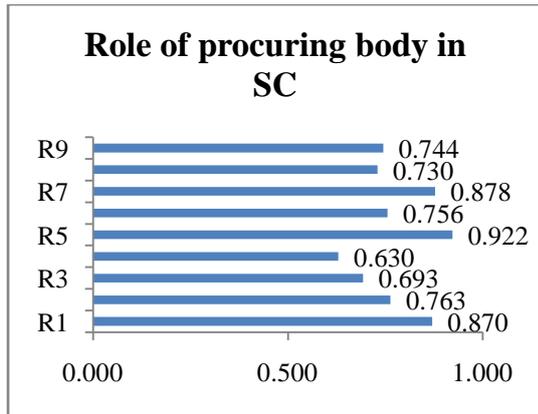


Fig. 5 Role of procuring body

Based on the above graph to attain sustainability in construction industry the following factors should be considered:

- Integrating sustainability issues in procurement decision making
- policies and guidelines of organization

If we integrate sustainability in all decisions, policies and guidelines, the attainment of sustainability becomes easier and because of this the roles and responsibilities also cleared among the working entities in construction industry.

IV) Ranking for sustainability factors based on various sections

A) Based on gender classification

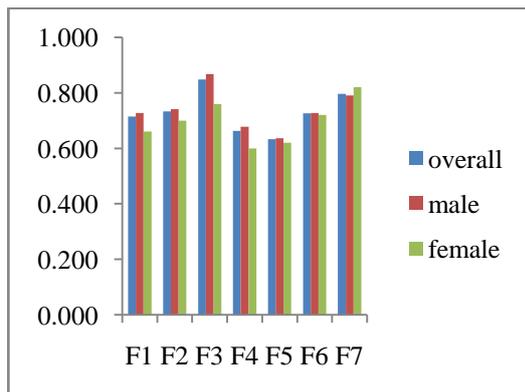


Fig. 6 Based on gender classification

The above graph is plotted for the overall, male & female RII values. Female gender concentrates on provision of a separate sustainability act for construction sector. And male gender dominates on considering sustainability as a primary aim of the project. These two factors were concentrated in overall RII. And the separate RII values have slight

changes from the overall value. And based on the gender graph was plotted for each criteria.

B) Based on Designation

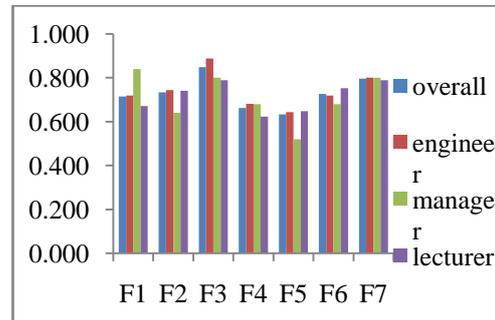


Fig.7 Based on designation

The above graph was plotted based on designation the sustainability factors were ranked. Here different designations like engineer, manager and lecturer were received and RII were calculated. Here also small deviations in each designation from overall. And frequency of engineer is high. They concentrate on considering sustainability as a primary aim of the project. Managers view varies from engineers because they concentrate on Contractors knowledge and experience.

C) Based on Experience

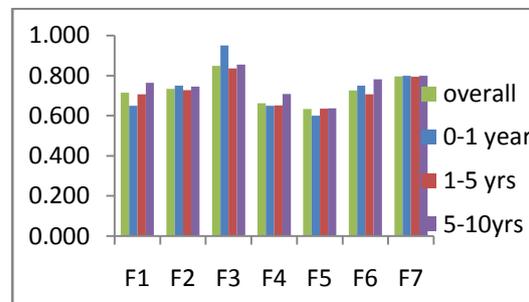


Fig. 7 Based on experience

The graph was plotted based on the respondents experience and compared with overall value. Frequency is higher for 0 to 1 year. They concentrate on considering sustainability as a primary aim of the project.

X. CONCLUSION

From the above study it can be concluded to attain sustainability in projects we need to concentrate on

- considering sustainability as a primary aim of the project

- provision of a separate sustainability act for construction sector

To attain social sustainability in construction industry we look into

- Seeing user needs and satisfaction
- increasing health & safety performance and working environment

To attain economic sustainability the following factors need additional attention

- Consideration of whole life costing and value for money
- financial affordability for intended beneficiaries

In environment sustainability it needs some attention for the following factors

- Waste minimization and management
- minimization of pollution like air, noise, land water and etc

In construction industry the role of procuring body should be concentrated on

- Integrating sustainability issues in procurement decision making
- policies and guidelines of organization

Training on sustainability issues, Emphasise sustainability at all stages in the procurement process, Implementation and monitoring and evaluating sustainable construction are recommended for the construction industries.

REFERENCES

1. Araújo M, Alencar L, Mota C., 2017. Project procurement management: A structured literature review. *International Journal of Project Management* 35 (2017) 353–377
2. Chen J, Dada M and Hu Q., 2017. Flexible procurement contracts for competing retailers. *European Journal of Operational Research* 259(2017) 130–142
3. He B, Huang H and Yuan K., 2015. The comparison of two procurement strategies in the presence of supply disruption. *Computers & Industrial Engineering* 85(2015) 296–305
4. Loosemore M., 2015. Social procurement in UK construction projects. *International Journal of Project Management* 34(2016) 133–144

5. Naouma Sand Egbua C., 2015. Critical review of procurement method research in construction journals. *Procedia Economics and Finance* 21(2015) 6–13

6. Pal R., Wang P, Liang X., 2017. The critical factors in managing relationships in international engineering, procurement, and construction (IEPC) projects of Chinese organizations. *International Journal of Project Management* 35 (2017) 1225–1237

7. Ruparathna R, Hewage K., 2015. Sustainable procurement in the Canadian construction industry: current practices, drivers and opportunities. *Journal of Cleaner Production* 109(2015) 305e314

8. Tadelis S., 2012. Public procurement design: Lessons from the private sector. *International Journal of Industrial Organization* 30(2012) 297–302.