SUSTAINABILITY ASSESSMENT OF INFRASTRUCTURE PROJECTS

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ABSTRACT

Sustainability of an Infrastructure project is governed by a wide range of parameters and indicators .These indicators should represent the overall sustainability of the infrastructure projects. Hence there is a need to identify the sustainability indicators .The approaches available so far focus mainly on some aspects of the sustainability of the project .This paper defines and identified the essential indicators which can be grouped under the Economic, Environment and Technical heads of sustainability. The paper is based on a wide literature survey of the previous research work done in the field. A set of key assessment indicators were identified for assessing the overall sustainability of infrastructure projects.

Keywords: Environment, Indicators, Infrastructure, Sustainability.

I. INTRODUCTION

Sustainable development or the concept of sustainability is fundamental to almost all kinds of human activities .Human development is synonymous with infrastructure development .The term infrastructure include a wide range of services like power, telecommunication ,water supply ,sanitation and solid waste disposal and collection, roads ,dams ,railways ,urban transportation, ports, airports[1].During the past five decades more than 30% of the world bank's investments were in developing countries for infrastructure projects. Hence assessing and forecasting of sustainability of infrastructure projects is of great consequence in decision making for sustainable development.[2],[3].The sustainability assessment of infrastructure projects requires a combined approach of environmental ,economic and technical services. Several researchers have analyzed infrastructure sustainability from different perspectives .among the available sustainability assessment methods the sustainability assessment indicators approach has proved to be most transparent ,consistent and useful method in decision making process [4].No method adopts the dimensions of sustainability .This has been a motivation for the study to arrive at a list of key assessment indicators that incorporated all the elements of sustainability and sustainable performance of infrastructure projects.

II.LITERATURE REVIEW

Several researchers address models/frameworks for defining sustainability.Venegas proposed that sustainability is comprised of inter related systems i.e. financial, environmental and ecological [5]. Some researchers have grouped the sustainability parameters into three key categories: Economical, social and environmental. By using

the key assessment indicators the sustainability of an infrastructure project can be assessed by giving a sustainability score. This could help decision makers find an optimal solution among the available alternatives which could give a maximum sustainability score [6]. Indicators are becoming increasingly recognized as an important tool in understanding infrastructure sustainability .The Indicators can help in decision making process based on measurable conditions and results. Indicators approach of assessing an infrastructure project is not a substitute for exercising judgment in infrastructure decision making but an effective tool in decision making[7].The sustainability assessment methods are a planning tool. Indicators should have appropriate parameters that should make assessment possible. Every project may be evaluated in terms of environmental and technical aspects of sustainability where integration and optimal balance of all the three dimensions and objectives is needed for overall sustainability.

Mehmet A.Boz et al. had developed three innovative system based bench marks to assess civil infrastructure projects; namely work ,nature and flow. They proposed a three step methodology compromising of survey development, data collection and analysis [8].

The research conducted by Melissa M.Bilec et al , says that though much of the assessment attention lies on the environmental effects some methods focus on aspects like energy use hazardous material indoor climate and sick building syndrome [9].

III.BACKGROUND

3.1 Construction Industry

It is one of the clusters of consumption of mankind that places the maximum burden on the environment. In order to understand the construction process from an environmental perspective the effects of built environment on natural environment have to be studied. The construction process should also be evaluated with a multi disciplinary frame work which would lead to sustainable development.

3.2 Sustainability

The word sustainable development was first introduced in the report of the World Commission on Environment and Development in 1987[10].Sustainable development has three basic dimensions (1) Economic (2) Environmental (3) social ([11].Initially the concept of sustainability was only restricted to the environmental aspect. As the concept gained momentum the other dimensions like social, cultural and economic sustainability gained attention. These interdependent dimensions of sustainability are what constitute the overall sustainable development.

The most evident effect of urbanization and infrastructure development are the division of the land into smaller units, the pattern of land use and the intensity of the land use. Hence the concept of sustainable development finds its place in order to improve the social structure, economic development and higher standard of living for all people. For rough understanding of sustainability the following four aspects can be defined.

3.2.1. Technical Sustainability: It refers to the design, scientific research and technology, ease and efficiency of durable construction, safe operation, material selection ,reduction, recovery, reuse of construction material.

3.2.2. Environmental sustainability: Focuses on the effect of the engineering process, the structures and the material on the environment.

3.2.3. Economic sustainability: This refers to the profit making policies. Economic health of communities. The impact of the structures on the economic health, employment and the standard of living.

3.3 Sustainability Assessment

Several researchers have studied Infrastructure Sustainability from different perspectives. Rackwitz et al , proposed a maintenance strategy for improvement of the effectiveness of a project based on cost benefit analysis[12].Assa Amiril et al, proposed a relationship between sustainability factors and performance for Malaysia Railway infrastructure projects[13].Paolo Bocchini et al, developed a unified approach of Resilience and sustainability[14]. Liyen Shen et al, provided an alternative solution for assessing sustainability by introducing Key Assessment Indicators using Fuzzy set theory[15].

IV. ASSESSMENT INDICATORS

4.1 Economic

It is the statistics about an economic activity. Economic indicators allow analysis of economic performance and predictions of future performance.

4.1.1 Capital Cost: Capital costs are fixed, one-time expenses incurred on the purchase of land, construction equipment, and cost of construction of an Infrastructure Project. It is the total cost needed to bring a project to a commercially operable status.

4.1.2 Life cycle cost: Sum of all the recurring and onetime costs over the full life span of the structure or the project.

4.1.3 Financial returns: The gain or loss of a security in a particular period. The return consists of the income and the capital gains relative on an investment. It is usually quoted as a percentage.

4.1.4 Improvement of regional economy: The way in which the proposed Infrastructure project would affect the economy of the region.

4.1.5 Affordability: This parameter indicates the feasibility of the project in terms of the available finances

4.1.6 Payback period: Payback period in capital budgeting refers to the period of time required to recoup the funds expended in an investment, or to reach the break-even point. The time value of money is not taken into account.

4.2 Technical Sustainability

Refers to the ability to keep the project running with minimum down time.

4.2.1 Performance: This indicator refers to the performance of the project in terms structural designs, whether the project is suitable for its intended purpose.

4.2.2 Reliability: Refers to the extent to which the project is reliable in serving its intended purpose.

4.2.3 Durability: Refers to the ability of the structure to last for the predetermined period without deterioration.

4.2.4 Vulnerability to failure: Refers to the extent to which the structure is susceptible to failure and damage

4.3 Environmental

4.3.1 Air pollution: Refers to the pollution the proposed project could cause to the air during the construction and operation phase of the project

4.3.2 Water pollution: Refers to the pollution the proposed project could cause to the water bodies and the ground water of the area during the construction and operation phase of the project.

4.3.3 Noise pollution: Refers to the pollution the proposed project could cause to the Noise levels of the surroundings during the construction and operation phase of the project

4.3.4 Waste generation: Refers to the waste generated during the construction phase and the methods of waste disposal

4.3.5 Visual impact: Refers to the aesthetic impact the structure would have on the surroundings

4.3.6 Ecological impacts: Refers to the impact the structure would have on the various ecosystems present in the surrounding areas.

4.3.7 Energy Savings: Refers to the reduction in the consumption of energy from various renewable and non renewable sources and thereby reducing the impact on the environment.

4.3.8 Natural resource utilization: Refers to the extent to which natural resources in the area were utilized without causing negative impact to the environment.

ASSESSMENT INDICATORS

S.No	Group	Indicators
1	Economic	Capital Cost
2		Life Cycle Cost
3		Financial Returns
4		Improvement of Regional Economy
5		Affordability
6		Payback Period
7	Technical	Performance
8		Reliability
9		Durability
10		Vulnerability to Failure
11	Environmental	Air Pollution
12		Water Pollution
13		Noise Pollution
14		Waste Generation
15		Visual Impact
16		Ecological Impacts

17		Energy Savings
18		Natural Resource Utilization

V. APPLICATION

The assessment indicators mentioned above in the table can be circulated among professionals, experts and officials dealing with infrastructure projects to arrive at a score for each of the indicators based on level of significance. The data so obtained can be checked for reliability by calculating the Cronbach's Alfa[6]. A Fuzzy set theory can be proposed to give the sustainability score to the proposed infrastructure project. This can help the decision makers to choose the alternative plans for the proposed Infrastructure project.

VI. CONCLUSION

Infrastructure projects play a major role in Economic, Social and Environmental activities of any country. Therefore before implementation their sustainability performance has to be properly assessed. This study therefore introduces a set of indicators which help in assessing the overall sustainability of a project. The Indicators mentioned above can be used to assess a project by weighed sustainability score .The application of assessment indicators can help decision makers to choose an optimum solution from available alternatives based on the sustainability score

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