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Sustainability in PPPs: Bid selection model for highways using ANP

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Abstract

Sustainability is one of the most critical agendas of the modern governments and this concept has been applied in various fields including infrastructure development projects. However, this concept is yet to be extended to infrastructure projects normally developed through public private partnership route. One of the effective approach for integrating sustainability concept in PPP projects is to include sustainability aspects in the procurement process as this will compel the private sector to devise project proposals that are sustainable. In this study, a multi-criteria decision-making model to evaluate the bid proposal has been proposed. This MCDM model is developed using Analytical Network Process with the indicators based on the four pillars of sustainability, namely, the economic sustainability, social sustainability, environmental sustainability, and institutional sustainability. The application of the model is then demonstrated by applying in a PPP highway project case study. Developed methodological framework will enhance the sustainability of public private partnerships. This will ease and help in the decision making process of the host government to achieve the goals of sustainable development and to meet the demand of infrastructure through PPPs, in most sustainable way by selecting best and sustainable bid.

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Keywords: public private partnership; bid selection; sustainability; analytical network process;

1. Introduction

Brundtland commission (United Nations) (WCED, 1987) defined sustainable development as the *"development that meets the needs of the present without compromising the ability of the future generations to meet their own needs"*. This concept of sustainable development has close relationship with development of infrastructure projects. These projects consume natural resources, leaving massive and alarming impact on the environment and ecology of habitants.

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In addition to it, infrastructure development also demands huge capital investment and procurement of such projects involves wide range of stakeholders.

Budgetary constraints faced by the governments have forced them to find innovative ways to bridge the demand-supply gap in provision of infrastructure. Public Private Partnerships (PPPs) have become one of the most innovative ways for the government for meeting the infrastructure demand. Procurement process of infrastructure projects through PPPs, especially in India, though has significantly stabilized with experience over time, but there are many facets of sustainability which are yet to be incorporated and implemented. This could be attributed to the notion that sustainability has been traditionally viewed in terms of limiting the damage that economic activities impose on the environment and remedying these damages as much as possible (Planning Commission, 2011). Thus, the focus of appraisal of infrastructure projects has concentrated on some of the dimensions of sustainability such as economic analysis, cost benefit analysis, and environmental impact assessment studies (Morrissey et al., 2011). However, this approach needs to be expanded to include assessment of social and environmental sustainability of the projects which are claimed to be economically sustainable. Colverson and Perera (2012) affirmed that sustainability practices are present within PPPs, but sustainable development principles are largely absent from the theory and frameworks that underpin and direct PPP action. Ryan (2004) also concluded that PPP programmes are yet to include sustainability as one of the key aspects of the programmes. In view of this, a study was undertaken to answer the research question - *How to achieve sustainable infrastructure development through public private partnerships in India?* In order to answer the research question, three key objectives were formulated for the study inquiry.

This paper argues that sustainable development in PPP infrastructure can be enhanced when the private sector is inspired for sustainability in the bid selection stage. The paper is structured into five sections. Second section explicates the perspectives of sustainability, the inherent challenges in PPPs and their procurement as evidenced in literature. Also, usage of indicators is argued to be a possible solution to sustainability integration into bidding due to limitations in the past bid evaluation models. Third section presents the indicators' development employed in the current study. Fourth section presents the development of bid evaluation model using ANP through the developed indicators. The usage of this model is subsequently illustrated by a case study of PPP highway infrastructure project and closes with conclusions and implications of the study.

2. Theoretical Points of Departure

2.1. Definitions of sustainability

Sadler (1988) defined sustainable development as "a commonwealth of values lying at the intersection of environmental, economic and social goals to give conservation of equity, environment-economy integration and community economics as if people mattered". According to New Oxford American Dictionary (2010), development means "process of developing or being developed" and sustainable means "able to be maintained at a certain rate or level". To sum it up, sustainable development implies a process of developing and maintaining whatsoever in a certain rate or level, for instance resources especially natural such that the future generation will also access the same resources that exist now. The current human activity in the name of development is threatening the availability and opportunities for the generations yet to come. Forum for the Future (2006) distinguishes between sustainability and sustainable development – sustainable means something has the 'capacity for continuance' and sustainability is therefore a 'quality'. Thus, sustainable development is the process over time by which sustainability is achieved. Hodge (1997) described the concept of sustainability as "a parallel care and respect for the ecosystem and people within –not one or the other, not one more that the other but both together as one".

Gibson et al. (2005) argued that sustainability is one of the most defined concepts, where hundreds of definitions and thousands of variations have been applied in various areas of application. As a result, there is a need to fix the boundary of sustainable development in the field of application, and develop notions based on the early principles established by the past researchers. This would also need defining the concept of sustainability relevant to the field of application in order to bring uniformity and acceptance of the application. Adopting such an approach will make

sustainable development assessment practices relevant and such mechanism will help in developing a transparent decision-making process for development through inclusion of diverse social, economic and environmental dimensions in the process.

2.2. Dimensions of sustainability

The evolution of the concept of sustainable development has resulted in various schema for characterizing the dimensions of sustainability development, which defines or characterizes the sustainability envelope. Broadly, two significant models used by researchers are the non-concentric adjacent circles of environment, society and economy and triple bottom line approach of sustainable development (as in Okon et al., 2010). The non-concentric adjacent circles model has been based on the interrelationships it reflects amongst environment, society, and economy and this is based on the popular three-pillar version first proposed by Sadler (1988). In three pillars version, sustainability is looked from society, environment and economy perspectives. All the pillars are explicit and at the same time interdependent (Hodge, 1997). For example, economy, it is not competent with environment and people's needs are not competent with environment in which the habitants live. Consequently, a project is considered sustainable when the project fulfills all the three sustainable development dimensions, i.e. environmental aspect, social integration and social economy, and economic aspect of maintaining cost, time, quality and performance (Fernández-Sánchez and Rodríguez-López, 2010).

2.3. Sustainability indicators research

Sustainable indicators are recognized as a useful tool for assessment of sustainability to policy maker and decision makers. The ISO 21929-1(2006) defines sustainability indicators as *"Indicators are figures or other measures, which enable information on a complex phenomenon like environmental impact to be simplified into a form that is relatively easy to use and understand. The three main functions of indicators are quantification, simplification and communication"*.

The main feature of indicator is its ability to summarize, focus and condense the enormous complexity of the present day dynamic environment to manageable and meaningful information. The indicator should also be able to assist the policy/decision makers to determine whether the action will lead to sustainable development of the society, providing an opportunity for evaluation of global social systems in short and long-term perspectives. Moreover, Indicators measure can be qualitative, quantitative, benchmarking, and framework setting (Boyko et al., 2012). According to Joumard and Nicolas (2010), indicators can be divided into three categories based on their objectives: (i) to help in the understanding the functioning of the system, (ii) to provide data for managing this system (evaluation, performance, control), or finally, (iii) to aid decision-making by ranking possible options.

Approaches for developing or selecting a sustainable development indicator could be broadly categorized into either adopting the framework defined by researchers and experts or development of indicators with the involvement of different stakeholders in the design of the framework. Singh et al. (2009) had carried out a review of various sustainable indicators and they have concluded that only few indicators have the characteristics of integrating the basic dimensions of environmental, economic and social. In the similar lines, Malkina-Pykh (2002) further suggested integration of specific sustainability indicators into framework as a tool to facilitate integration of social, economic and environmental domains. Adinyira et al. (2007) further pointed out the wide gap existing between assessment theories and practices. Hence, the design of sustainability indicators or indices is one of the possibilities to translate sustainable development into operation in specific fields such as infrastructure development.

2.4. PPPs and sustainability

The rationale of PPP projects is to provide value for money (vfm), deliver high-quality outcomes, and complete projects within time and budget (Cheung et al., 2010). In PPP mode, it is assumed that private sector has higher techno-managerial competency and they are better equipped to deliver innovative and quality solutions. However,

extant literature has been very critical on the performance of PPP projects from sustainability perspective (Colverson and Perera, 2012; El-Gohary et al., 2006; Patil and Laishram, 2016). In fact, the evaluation of proposals from private sector and selection of bid focuses purely on financial and technical aspects only. PPP procurement process is an important stage in PPP life cycle and this could become one of the points of intervention to compel private sector to take into consideration sustainability aspect in PPP projects. However, in the current PPP procurement process, the private sector responds to the expression of interest and then submit technical and financial proposal in response to the scope and objectives outlined by the client organization in order to secure the PPP project. A thorough overhauling of the procurement process should be done so as to include aspects of sustainability as part of the parameters based on which bids are to be evaluated.

Decision making based on the concept of multi criteria decision making models have been developed for making procurement decisions of infrastructure projects. For instance, Bana e Costa et al. (2002) presented a model based on MACBETH for bid evaluation considering social and technical aspects. Wang et al. (2007) used a fuzzy integral MCDM approach to facilitate bid price decisions for a bidder by calculating the project expected utility using the bid price distribution obtained from a simulation. Furthermore, Kumaraswamy and Zhang (2001) used multi-attribute utility analysis (MAUA) and Kepnoe Tregoe decision-making techniques for evaluation of BOT proposals using the criteria derived from critical success factors and distinctive winning elements.

Similarly, MCDM models have also been developed for assessment of sustainability of infrastructure projects. For instance, Ugwu et al. (2006) proposed an analytical decision model and a structured methodology for sustainability appraisal of infrastructure projects. Yigitcanlar and Dur (2010) developed an indexing model for urban sustainability assessment based on advanced geographic information and indicators which focuses on sustainability of land use, environment, transport systems and infrastructure. This model considered the concept of sustainability from the perspective of triple bottom line approach. Okon et al. (2010) considered the triple bottom line approach and developed a mathematical model using set theory called Sustainable Engineering model (SEI) to provide a platform for engineering community. But many studies using MCDM models for decision-making including sustainability assessment such as (Natividade-Jesus et al., 2007; Shen et al., 2011; Ugwu et al., 2006; Wang et al., 2007), assumed that all the criteria are independent in nature. However, the dependencies amongst the criteria limit the usage of MCDM models for decision-making relating to sustainable development.

Sustainability itself being a complex goal it is difficult to define the end of sustainable development for a project (Morrissey et al., 2011). The true challenge of achieving sustainability in design and construction of infrastructure projects is at micro level (Morrissey et al., 2011; Ugwu and Haupt, 2007). Most of the methods discussed above look at sustainability assessment from a macro level. In view of this, it is important to address these issues at the project specific levels. Furthermore, assessment of sustainability in the context of infrastructure projects has not been extended to PPP mode of procurement as the previous studies on sustainable assessment focused only on publicly funded infrastructure projects. This highlights the need for developing methods and techniques that could facilitate sustainable appraisal and decision making at micro level of PPP infrastructure projects. All the current sustainable initiatives, framework, and processes focus on wide national aspirations and strategic objectives and are weak in addressing the integrated decision making at micro level. Nevertheless, there exist gaps in holistic approach to decision support system. No past study attempted to develop a bid evaluation model encompassing all the dimensions of sustainability for decision-making. The peculiarity of indicators involved in infrastructure projects is their interdependency and the interdependencies amongst the indicators may led to either reinforcing or balancing feedbacks.

This paper submits that one possible way to integrate sustainability principles into PPP procurement process is to include indicators relating to sustainability in the bid selection of PPP proposals. This will stimulate private sector to adopt and develop suitable mechanisms to integrate sustainability from the early stages of PPP project development. This will facilitate to make binding commitment in concession agreement and support the realisation of sustainable projects.

3. Indicator Development for Indian PPP Infrastructure Projects

Sustainability assessment principles developed by Gibson et al. (2005) were regarded as prominent and relevant in translating towards sustainability. Using their principle based approach, Patil et al. (2016) have developed a set of 34 indicators for Indian PPP projects, shown in Figure 1. This framework is developed from extant literature by grounding on Gibson's sustainability assessment principles and validated though Indian stakeholders through a questionnaire survey. The indicators stood the tests of reliability and validity. The respondents varied from various stakeholder groups such as practitioners involved in development, and implementation of PPP projects such as transaction advisors, EIA consultants, officials from state and central governments, and researchers. The total number of respondents who had participated in the survey was 71, out of which 60 responses were complete in all respect and were taken for the analysis. In the sample, more than 70% of respondents have post graduate degree which meant that the respondents are well qualified. In addition, they can be regarded as experts in the field due to their experience and wide participation in PPP projects in their tenure. PPP advisors and consultants occupy a major share in the sample. Statistical tests revealed no significant differences in the perception of the importance of the indicators amongst the five respondent groups of the sample. Similar process for development of indicators through effective stakeholder participation has been stated to be a pre-requisite for developing sustainability assessment framework of developing countries (Ugwu and Haupt, 2007).

The 34 indicators that have been derived from survey with PPP project stakeholders are in line with the Sadler Tipple bottom line approach (Figure 1). For the current study, the triple bottom approach has been extended to include an additional fourth dimension on institutional sustainability. The fourth dimension is applicable to infrastructure because the existing three dimensions are not sufficient to envelop the whole concept of sustainability in case of infrastructure projects. The practice of extending it to include the institutional pillar is common strategy in conducting sustainability assessment techniques to various real-life applications in case the additional factors will lead to improvement in assessment (Gibson et al., 2005).

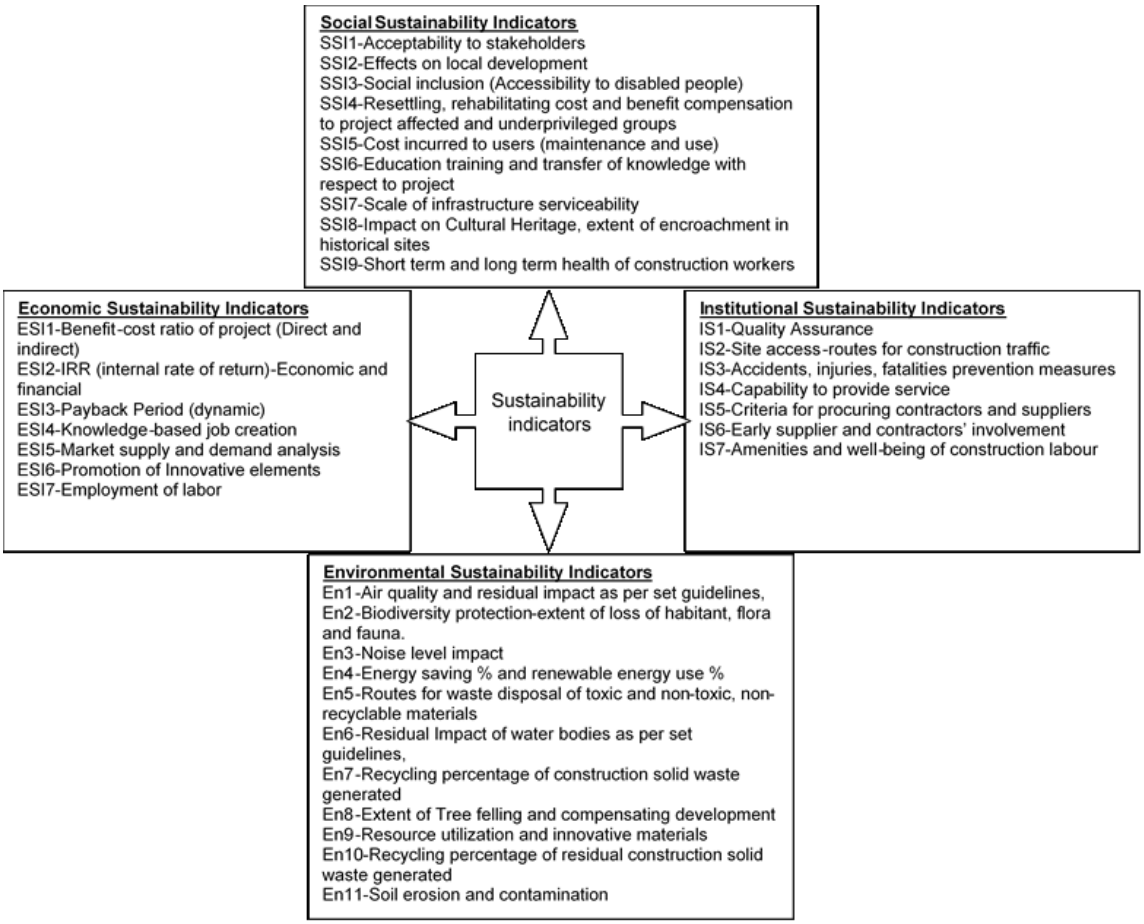

Figure 1 Sustainability indicators for PPP projects of India, Source: adopted with modification from Patil et al. (2016)

4. Bid selection model using ANP

4.1. Theory of ANP

Analytical Network Process (ANP) offers support in integrating sustainability indicators for bid evaluation. T.L Saaty first introduced ANP in 1980 and it is believed that ANP is a general tool, which helps in assisting the decision makers to organize its thoughts and experiences and to elicit judgments recorded in memory and quantify them in the form of priorities and allow for representing diverse opinions after discussion and debate (Saaty and Vargas, 2006). ANP is the advanced modelling technique, where, in addition to the relationships between the parent node and child nodes, interrelationships amongst the parent nodes, amongst the child nodes under the same parent node can be modeled as cluster thereby transforming the hierarchy into a network.

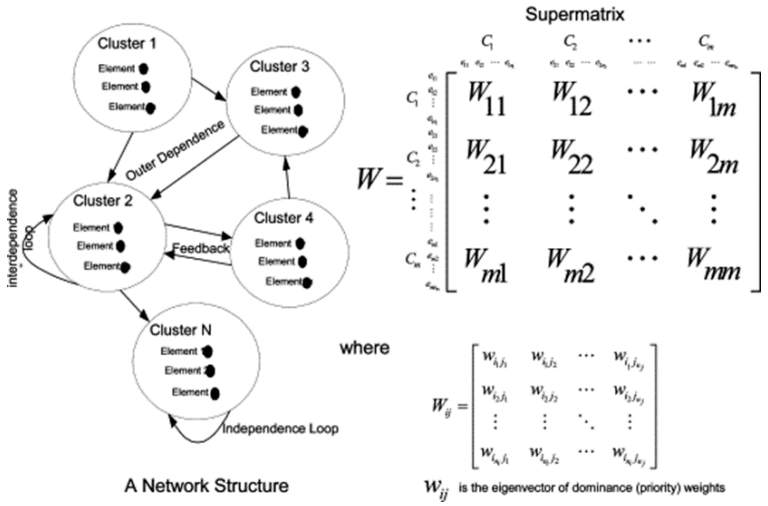

Figure 2 Structure of ANP Problem formulation [adopted from (Promentilla et al., 2006)]

Additionally, the influence of elements in the network on other elements is represented in the form of a comparison matrix where all the goal, influencing criteria, sub-criteria and alternatives are considered in a single matrix known as Super matrix (W). Figure 2 shows a generic form ANP problem formulation of network structure, Super matrix and block of Super matrix (W_{ij}). 'c' and 'e' in the above Super matrix represents the components and elements of a network, respectively. The objective is to derive limit priorities of importance from Super matrix. A typical entry W_{ij} is called a block (which is a Holon) of the super matrix (as show in Figure 2). It is known as Holon because of its nature that W_{ij} is also a matrix in which each column is a principal eigenvector of the elements in the i^{th} component of the network on an element in the j^{th} component. A comparison is carried among components according to their influence on each component of super matrix with respect to a higher order control criterion. The comparison is carried out to assess 'for a given criterion which of two criteria is more relevant (in this context) on that criterion with respect to the goal or with respect to a higher order controlling criterion?' and resulting matrix is Unweighted Super matrix. It is then transformed into a weighted Super matrix by multiplying all the elements of the first block of that column by first entry, second block of the column by second entry and so on. The weighted super matrix is stochastic in nature because each of column sums to unity (Saaty and Vargas, 2006).

The transmission of influence along all possible paths of the super matrix is accounted for by forming limit super matrix. All the possible influences of factors on each other and then the secondary factors and then on the tertiary factors and so on and thus have an infinite sequence of influence matrix by raising the limit matrix to power k denoted by W_k where k is an arbitrary number taken until the limit of the average of these powers converge to a finite sum known as Cesaro sum. The values of the column of limit matrix corresponding to the positions of alternatives are the final priorities. These final priorities are normalized, idealized and ranked to select the best alternative. Also, Analytical Hierarchy Process (AHP) is effective only in case of two options or alternatives exist unlike ANP which is capable to handle much more complexity (Sun et al., 2007).

4.2. Case Study Background

The central nodal agency for roads proposed to extend the road between two major cities A and B within the state to six-lane highway. The two cities are places of tourist attractions with widespread business activities ranging from textiles to automobile industries. The proposed alignment of the highway passes through an ecologically sensitive area. The government has proposed to develop the highway through DBFO model and have invited private sector to submit the bid, and sought proposal on how they propose to develop the project.

Private sector was invited to submit their request for qualification and request for proposal. The bid evaluation was mentioned beforehand that it will be based on scoring on each of the sustainability indicators. Three companies were into the final stage of bid submission and have submitted their details right from design to contract closure. Brief description on each of the proposals has been presented while discussing the evaluation of each bid with respect to the indicator dimensions.

4.3. Development of Bid evaluation model

The process of development of ANP model can be summarized as having seven steps. In the first step, the decision problem to select the most sustainable bid is described including the objective which is to be fulfilled by the factors that are involved (Patil et al., 2016) and which influences the decision and various alternative bids. In the second step, node connections are established between all nodes in all clusters. The developed ANP model is presented in Figure 3. However, it is not necessary to establish all but in this problem all the nodes are connected. In the third step, pair wise comparisons on all the connections are performed based on Saaty scale of rating Table.1. Similarly, with the help of same scale, comparison among indicators is also carried out. The option no comparisons is selected in cases where there is no relation of comparison possible between the nodes. The Super Decisions interface showing node comparisons is presented in Figure 4. This gives an idea on how the pairwise comparison was done. Un-weighted super matrix resulting from the pairwise comparisons, weighted super matrix and limit matrix are computed.

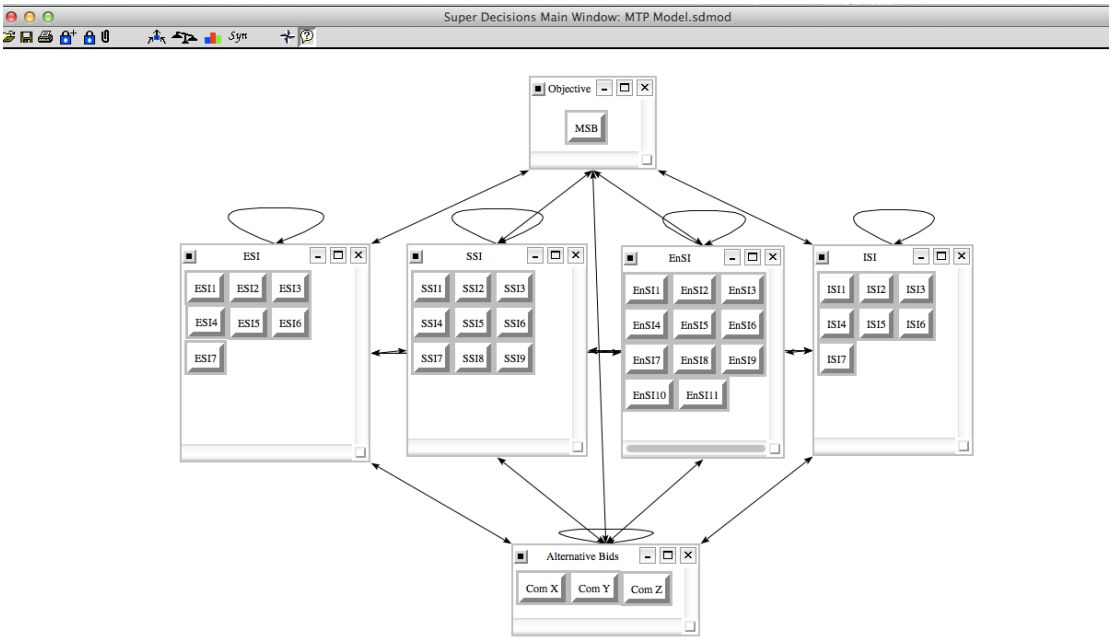

Figure 3 Developed ANP Model

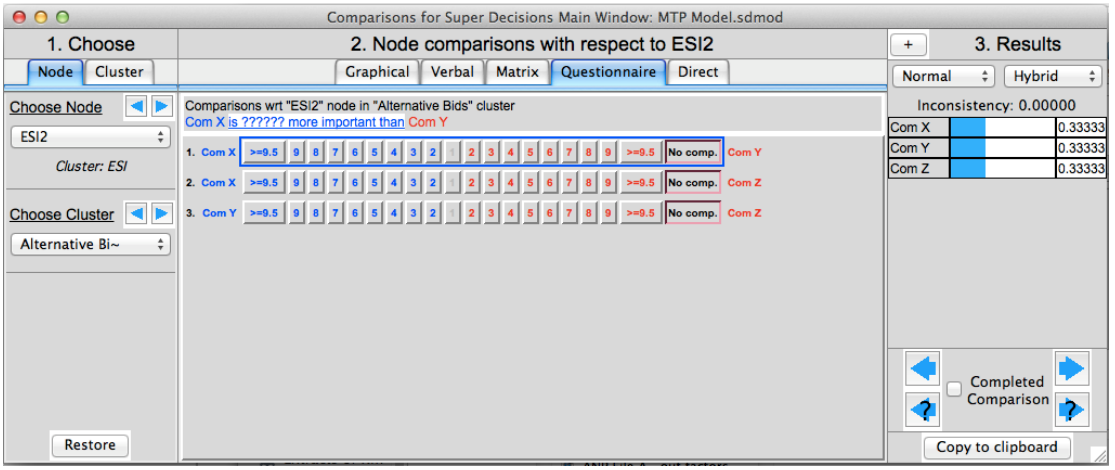

Figure 4 Pair Wise Comparisons of Alternative Bids in Super Decisions

Table.1 Rating Scale for Comparison of Bids Submitted Over a Sustainability Indicator & comparison of indicators in ANP Model

Scaled score	Definition	Explanation
1	Equal Importance	Two bids contribute equally to the objective
3	Moderate Importance	Subjective evidence and/or judgment slightly favour A over B.
5	Strong Importance	Subjective evidence and/or judgment strongly favour A over B.
7	Very Strong Importance	Subjective evidence and/or judgment very strongly favour A over B.
9	Extreme Importance	The subjective evidence and/or judgment favouring A over B is of the highest order of affirmation.
2,4,6,8	Intermediate Values	When compromise is needed in between

In order to select the most sustainable option for developing the project, these three proposals are evaluated to assess the extent to which these options contribute to sustainable development i.e. how these proposals have performed on economic, environmental, social, and institutional sustainability perspectives (as shown in Table.2). A brief of the bids of the three companies are: Company X has worked on innovation and they are proposing a new efficient technology and increased efficiency manifold to what is existing, whereas company Z came up with a unique solution which will increase the demand of the facility in terms of utility and plans to pitch good amount of foreign investment and plan to make it a good and cozy flagship infrastructure project. Company Y is carefully planning to perform consistently in all the indicators to the extent possible. With respect to social sustainability, Company X has very much focused on the acceptability of stakeholder and to gain the good will of public with respect to project, there by anticipating huge local developments. Company Y is promising the highest possible care on short and long term and short-term health of the construction worker by bringing in more advanced equipment which will have lesser impact on workers' health and enhance the safety aspects. Company Z has demonstrated a high serviceability and also proposed to initiate a relocation program and good amount of benefit compensation to effected people and underprivileged groups.

Evaluation of the proposals from environmental sustainability perspective is undertaken by assessing how these proposals have performed with respect to the various EnSI 's. Company X has given more emphasis on improving the air quality and has promised to achieve a substantially good air quality throughout the contract period right from construction with 'self-made' strict rules on infringement. They are also proposing to gain carbon credits. On the other hand, Company Y has proposed a safest possible disposal of all non-recyclable material by adopting best practices and also assured a great extent of compensating development along with minimum tree felling. Company Z has proposed to engage good usage of construction solid waste generated and also plan to achieve a good amount of recycling targets. With respect to institutional sustainability, Company X takes a detour to the construction site causing very little disturbance to public and traffic due to construction related traffic. They have also proposed a good management plan and put in place measures to prevent accident. Their past experience and their proposed actions focusing on prevention seem to be a good sign towards sustainability. Company Y adheres to best good quality control practices in construction and operation. Company Z has demonstrated to be a good contractor and practices earlier supplier involvement with the reputation of maintaining cordial relationships through good communication among the project team and also demonstrates a great concern on amenities and well-being aspects of construction labor with most commendable measures. The company's performance* on these indicators is shown in Table.2.

Table.2 Bids Performance on Sustainability indicators

Indicator	Company X	Company Y	Company Z
Benefit-cost ratio of project (Direct and indirect)	AA+	A+	AA
IRR (internal rate of return)-Economic and financial	AA	AA+	A+
Payback Period (dynamic)	A+	A+	AA
Knowledge-based job creation	A+	AA+	A
Market supply and demand analysis	A	A+	AAA
Promotion of Innovative elements	AAA	A	AA+
Employment of labor	A	AA+	AA
Acceptability to stakeholders	AAA	A	AA+
Effects on local development	AAA	A+	AA+
Social inclusion (Accessibility to disabled people)	AA+	A	AA+
Resettling, rehabilitating cost and benefit compensation to project affected and underprivileged groups	AA	A+	AAA
Cost incurred to users (maintenance and use)	A	AA+	AA+
Education training and transfer of knowledge with respect to project	AA+	A+	A
Scale of infrastructure serviceability	AA+	A+	AAA
Impact on Cultural Heritage, extent of encroachment in historical sites	A	A+	AA+
Short term and long term health of construction workers	AA	AAA	A
Air quality and residual impact as per set guidelines,	AAA	A	AA+
Biodiversity protection-extent of loss of habitant, flora and fauna.	AA+	A	AA+
Noise level impact	AA+	A+	A
Energy saving % and renewable energy use %	AA	A+	AA+
Routes for waste disposal of toxic and non-toxic, non-recyclable materials	A+	AAA	AA+
Residual Impact of water bodies as per set guidelines,	A	AA+	AA+
Recycling percentage of construction solid waste generated	AA+	A	A+
Extent of Tree felling and compensating development	AA+	AAA	AA
Resource utilization and innovative materials	A+	AA+	A

* It should be noted that the rating scale is a representation of the numerical values/measure.

Recycling percentage of residual construction solid waste generated	AA+	A+	AAA
Soil erosion and contamination	A	AA+	A+
Quality Assurance	AA+	AAA	A+
Site access-routes for construction traffic	AAA	A+	AA+
Accidents, injuries, fatalities prevention measures	AAA	AA+	A
Capability to provide service	A	A+	AA+
Criteria for procuring contractors and suppliers	AA+	A+	AAA
Early supplier and contractors involvement	A	AA+	A+
Amenities and wellbeing of construction labor	AA+	A	AAA

Legend:
AAA Extreme/Highest efficiency/performance /improvement
AA+ Very strong efficiency/performance /improvement
AA Good efficiency/performance /improvement
A+ Moderate efficiency/performance /improvement
A Minimum standard performance / No improvement or

4.4. Results

Pair wise comparison led to fourth step dealing with an un-weighted Super-matrix. This represents all the comparisons that are made. Next, weighted super matrix is computed which is the normalized form of un-weighted super matrix i.e. in weighted super matrix all columns sum is equal to 1. For the sake of brevity, the unweighted super matrix and weighted super matrix are not shown in this article. Sixth step deals with the limit super matrix which is the final version of the super matrix obtained by raising the weighted super matrix to powers. In the final, based on the limit super matrix, the final priorities or ranking of the alternatives has been computed. The rankings of the bids are based on the ideal score that has been derived from the normal score. The results of the computation are summarized in Table 3 and Figure 5.

Table 3 Final Rankings of Bids in ANP Model

Alternatives	Total	Normal	Ideal	Ranking
Com X	0.055	0.3206	0.8851	2
Com Y	0.0544	0.3171	0.8752	3
Com Z	0.0621	0.3623	1	1

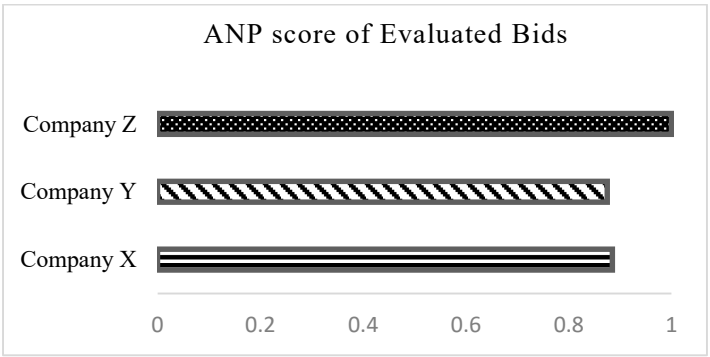

Figure 5 Graphical Representation of ANP Ideal Score of Bids

The results seem to be justified and valid because it can be observed that from the bids performance that Company Z is consistent in all indicators with significant advantage over other bids on many indicators. Also, when the bids appear to be competitive and performing equally, it is difficult to make a decision between the bids (just like Company X and Y) and the same can be observed from the normalized scores, which are very close (0.3206 and 0.3171). In such circumstances, ANP is thus equipped to differentiate the best alternative from a set of apparently equal alternatives.

5. Conclusions

The incorporation of all the sustainability principles is still a gap in the current PPP procurement process. The expertise and efficiency of the private sector is not utilized in facets of environmental and social sustainability. Aspects with respect to the improvisation of public good and betterment for environment health are absent in the current procurement process, which is inhibiting the increase in benchmark of the performance standards. Moreover, the criteria for evaluation and selection of a bid is purely based on financial and technical basis where scoring on these aspects is still used to compare the bids in India. There needs a structural change in the way PPPs are viewed and executed. As an initial stimulus for this change, this study employs 34 indicators which are found to be accepted by all stakeholders of PPPs and operationalizes them for enhancing the sustainability of PPP infrastructure project during procurement stage. In this process, this study adopts modified form of the Sadler Tipple bottom line approach where the fourth dimension is the Institutional sustainability. The applicability and suitability of MCDM is presented in this paper. A case study demonstrated the practical application of sustainability indicators in bid selection of PPP procurement. This methodological framework can provide the basis for promotion of sustainability in PPP projects through incorporation of the indicators as the evaluation criteria in the bid documents such as request for proposal and request for qualification so as to encourage private sector to achieve more sustainable deliverables. Further research can be carried with multiple case studies and develop sector specific indicators instead of the current generic set of indicators. Also, studies can be carried in other countries in order to validate and check whether any difference exist due to maturity of PPP market and geographical locations.

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