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A Comprehensive Framework for Sustainability Assessment in Project Selection

Shamsiya Kudratova
Donlinks School of Economics and Management, University of Science and Technology Beijing, Beijing, China
Xiaoxia Huang
Donlinks School of Economics and Management, University of Science and Technology Beijing, Beijing, China
Shohrukh Qudratov
Department of Civil Engineering, Moscow Polytechnic University, Moscow, Russian Federation

Abstract

Lately, the concept of sustainability has been brought to investment project selection problems. In past years investors are facing fierce competition and strong global and governmental pressure to incorporate sustainability considerations into their project decision-making process. Investment project selection as one of the most important and largest sector with crucial importance to the economic development, having a huge impact on environment and society, needs to be taken into sustainable considerations. Taking that into account, this study undertakes investigation of new framework that integrates qualitative sustainability pillars into quantitative ones through significant criteria building, for sustainable project selection aims. In order to maintain competitive advantage, investors can employ proposed framework in their project selection practices, while enhancing sustainability concerns.

Keywords: Sustainability framework, environment, Integrated assessment, Project selection.

1. Introduction: Sustainable development has become strategic implementation of goal among nations worldwide. Over the last decades there have been considerable amount of research of project management aiming to set up an optimization model on how to boost the profit and increase investment returns. Since the Agenda 21 appeared at the 1992 Earth Summit, the need for applying sustainability in project management activities arose. Accordingly, new targets for the investment project selection as cost, profit along with sustainability implications should be addressed in conventional project selection approaches

are. Hereby, it is necessary to develop new tools and optimization model that will take into account sustainability concerns of the project besides cost and profit.

Sustainability is defined by World Commission on Environment and Development as a development that meets the needs of the present without compromising the ability of future generations in order to meet their own needs (Mebratu, 1998).

In the past decade, sustainable development has gained lots of researchers' attention. Since the concept of sustainable development arose, countless sustainability indicator sets have appeared especially in construction project. Specifically, in 1994 the concept of sustainable construction appeared at a tactical level in the building sector and in civil engineering (Fernández-Sánchez & Rodríguez-López, 2010). Finally, the term "sustainable construction" has been captured exclusively on material selection, building, but gradually, sustainability targets have been introduced into investment of road construction with respect of cost maintenance. However, with threatening awareness on global warming challenges, sustainability concerns expanded to project selection practices (Kaveh et al., 2012).

This study has proposes the new framework for managing the projects in sustainable ways with the focus, especially, on the environmental aspects simultaneously with regards to cost of investment project. The initial purpose of the study is to propose quantitative approach in sustainable project selection practices. Based on literature review, sustainability covers three main aspects: environment, society and economy. Regarding to this we try to identify and analyze how road construction projects influence environment, society and economy. Hereby, the secondary aim of the research is based on the analyses of several road construction projects to build a framework for sustainable project management with regards to cost and emission levels and sustainability assessment. We expect the proposed framework serve as a tool or guideline that investors can use for launching new construction projects with reasonable cost on the other hand with long term future sustainability.

2. Traditional Project Selection: Project selection is a complex decision making process evolving multiple and often inconsistent objectives to be considered while choosing a subset from extensive number of projects. Conventionally project selection problem have been concerned with selecting a suitable combination of projects from candidates so that the company can obtain maximum profit. A major contribution to the theoretical formulation of the problem was made by Weingartner (1962). Weingartner employed net present value method and suggested a model with the maximization of the total net present value of the projects as the purpose and the investment outlays at every investment period not exceeding the capital resources as the constraints. After Weingartner, many scholars such as Padberg & Wilczak (1999), Liu & Wang (2011), Xiao et al. (2013), etc, extended the model to increase its relevance and applicability to the real world situation.

Keown and Martin (1977), Keown and Taylor (1980), proposed chance-constrained programming methods with random inflows and outlays to perform project selection decision. Medaglia et al. (2007;2008), presented a new evolutionary method for solving project selection problems with linearly constraints, later on investigated simultaneous

selection and scheduling of project portfolios. Moreover, Shakhsi-Niaei et al. (2011), employed Monte Carlo simulation to analyze two-phase framework under randomness subject to real world constrains for project selection problem. As proven, probability theory helps to achieve favorable outcome on probability distributions, once there is sufficient historical data.

With the increase of uncertainty events on decision making stages, in order to take uncertainty into account, researchers came up with chance-constrained programming models for project selection and capital budgeting with stochastic parameters appeared in field of project selection (Huang 2007;2016). Unfortunately, project selection is subject to many sources of uncertainty besides random uncertainty and fuzzy uncertainty. In the same scope, Huang (2010) first employed uncertainty theory to propose a theory on uncertain portfolio selection. Zhang et al. (2011) first applied uncertainty theory in solving multinational project selection problem. Followed by, Huang et al. (2012) discussed implication of risk index on multi-period portfolio selection, and simultaneous project selection and scheduling with investment uncertainty.

With the increase of environmental concerns in every sphere of development, project selection practices spread to sustainability incorporations in decision processes. Hereinafter, in line to the aforementioned, sustainability development frameworks been established by scholars, where highly pointed out the need for a practical framework that handles both the financial and also external factors (Lafferty and Hovden, 2003). Relatively, literature emphasized the need for an integrative approach that incorporates sustainability measures simultaneously with financial and economic dimensions in project decision-making stages in an organization and society (Steurer and Martinuzzi, 2005). Furthermore, Kaveh et al, (2013) developed a new approach in sustainable project selection decision-making and assessed the fitness of investment while considering economic, social and environmental criteria. With regards to the aforementioned development, the research framework that incorporates sustainability measures while balancing financial and economic interests in projects selection practices will be a valuable addition to the literature that emphasizes sustainable growth and society.

3. Concepts and Sustainability Dimensions: The concept of sustainability and studies on sustainable development emerged since growing awareness and incorporation of environmental crisis that gained momentum towards the end of the twentieth century. Further, the environmental concerns raised in international conferences, led to internationalization of the sustainability concept and its development (Du-Pisani, 2006). In the United Nations Conference on the Human Environment, 1972, the term sustainability was introduces with several principles. However, sustainability principles became widely renown through the Bruntland Commission Report of 1987 (Du-Pisani, 2006; Gibson, 2006; Keiner, 2005). Accordingly, the report urged the need for 'sustainable development' while balancing economic growth with environment soundness. The three fundamental components of sustainability, i.e. environment, economy and society (Fig.1.), were presented by the report and further evolved as the 'triple bottom line' (Keiner, 2005).

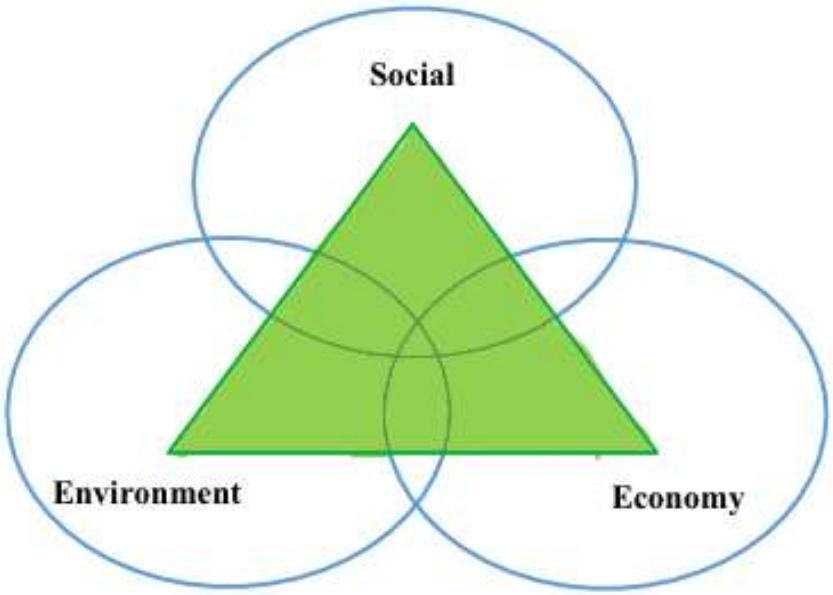

Fig.1. Sustainability triangle model (Keiner, 2005).

Recent literature on sustainability studies is widely undertaken through construction of assessment frameworks, further developing sustainability dimensions. Various dimension on sustainability served as a starting point of this literature studies (Keiner, 2005; Du-Pisani, 2006; Gipson, 2006; Omann, 2004). According to these studies, sustainability dimensions include four main prime pillars as social, economic, environmental and institutional, which are envisioned in sustainability prism (Fig.2.). These dimensions were considered as a methodological guide to evolve and develop comprehensive sustainability assessment framework. Relatively, the economic dimension ensures competitiveness, emphasizing the production, exchange and usage of goods and services and expresses market relations and its sustainability, whereas the environmental dimension emphasizes the preservation of natural systems through reduction of material throughput and mitigating impacts of usage of energy, material and land. This forms the basis of all economic activities and is considered as a base for deter- mining environmental sustainability At last, social dimension emphasizes increasing social awareness in terms of equity in income, employment, access to resources, infrastructure and social security, (such as health and pension provision) (Omann, 2004). The institutional dimension as Omann (2004) states is often included in the social dimension and might not find explicit reason to mention. However, there is a slight difference between them, which would explain why the institutional dimension has emerged as a separate component in this sustainability prism. The social dimension represents individual aspects, whereas the institutional dimension comprises interpersonal processes or group interactions. Omann, (2004) agrees that if included within the social dimension, there is a danger that these aspects might be

neglected.

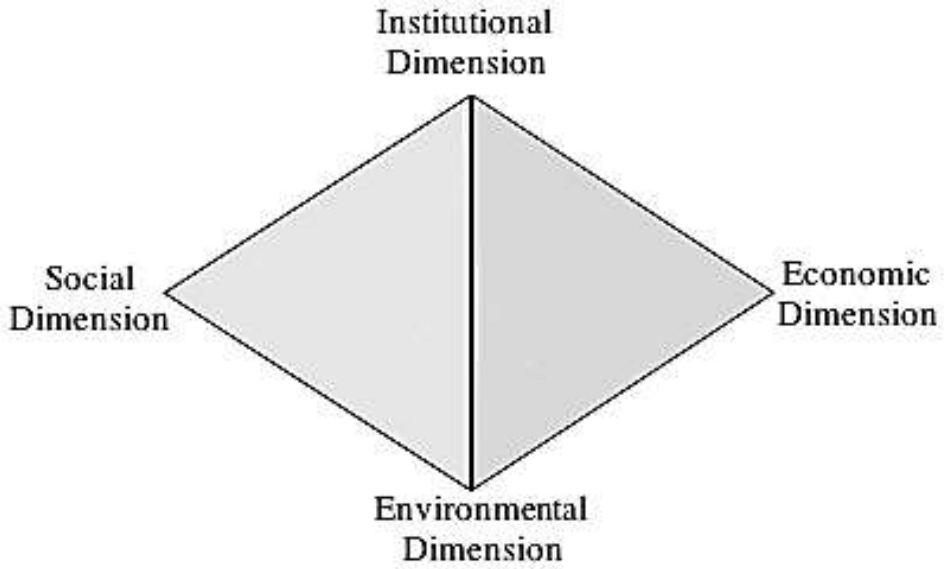

Fig.2. The sustainability prism (Keiner, 2005)

The incorporation of the four dimensions of the sustainability prism simplifies to some extents the evaluation of different sector participants in management practices. The social, economic, environmental and institutional dimensions enable the formulation of a comprehensive sustainability assessment framework to evaluate project efficiency, estimate waste management services by reducing the level of complexity and enabling greater clarity while generating in-depth understanding of the impacts (Kiran et al., 2016).

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4. Constructing Sustainability Measurement Model for Project Selection: Recent assessment frameworks in involving broaden fields of project management seek to provide decision makers with an impact of evaluation in order to adjust in determining precise aspects to be considered in mowing towards the goal of sustainability. According to researches (Omann, 2004), sustainability can be determined only 'after the fact', i.e. with ex-post evaluation. Relatively, United Nations Conference on Sustainable Development significantly emphasizes on sustainability assessments to advance the principles of sustainable development (UNCSD, 2012). Sustainability of a policy or programme can be evaluated and analyzed through the three dimensions as described in previous sections (Fig.1). However, within these dimensions there is a need provide quantitative approaches to devise clear criteria and indicators that can be used to measure the variables to be analyzed. The European Commission (1999, p. 3) emphasizes that ex-post evaluation should focus on the results and impacts of projects and in order to do that, appropriate criteria and indicators should be established. Later on, indicators are increasingly being recognized as useful tools towards criteria analysis and for designing policy frameworks (Singh et al., 2009). Godfrey and Todd (2001), state as "the main feature of indicators is their capability to summarize, focus and condense the tremendous complexity of our dynamic environment to a manageable approach of meaningful information." By visualizing phenomena and highlighting trends through assessment frameworks, indicators simplify and help in the analysis of complex and complicated information (Warhurst 2002). In summary, assessment framework indicators summarize information to reflect the state of a sustainability phenomenon and support the evaluation of this state (Omann 2004). As can be inferred, the choice of criteria and indicators are significant in making an assessment of sustainability in terms of emerged sustainability dimensions.

After precisely reviewing literature we found out, besides an increasing research on sustainability practices, there is a need for value driven modeling approaches that enables evaluation and selection of sustainable projects with regards to cost and environmental control. Taking that into account, we argue that by analyzing two pillars of the general

sustainability model, the value of the third pillar will be identified respectively. For example, by incorporating economic and environmental factors of the referred institution, the social value as of the consequences of the project operation can be identified. The precise incorporation of sustainability model pillars for aiming value estimations of social dimension of sustainability is presented in equation below (Equation 1):

$$Social\ \ Dimention\ \ Value\ \left(SDV\right) = \left[\begin{array}{c} \sum\ Economic\ \ Dimension\ \ Value\ \left(EcDV\right) \\ - \\ \sum\ Environmental\ \ Dimension\ \ Value\ \left(EnDV\right) \end{array}\right] \quad (1)$$

In order to fill out sustainability gap on quantitative measurement of the environmental criteria (Omann, 2004), qualitative dimension of sustainability as economic and environmental can be expanded along with the incorporation of project evaluation criteria (Equation 2).

$$Sustainable\ \ Project\ \ Selection\ \ Problem\left(SPSP\right) = \left[\begin{array}{c} \sum Projects\ \ Net\ \ Income \\ \left(\ Economic\ \ Dimension\ \ Value\ \left(EcDV\right)\ \right) \\ - \\ \sum Anticipated\ \ Sustainability\ \ Cost \\ \left(\ Environmental\ \ Dimension\ \ Value\ \left(EnDV\right)\ \right) \end{array}\right] \quad (2)$$

Economic and environmental dimensions involve multi dimensional criteria, wherein specific techniques as multi-criteria decision making approaches can be used to draw qualitative outcomes (Joe, 1999). However, for the sake of obtaining quantitative outcomes, in a specific project management decision stage, the most important criteria for project valuations as cost and profit can be incorporated for sustainable decision-making. If we consider economic conditions as profit and environmental conditions as expenses, then the outcome from the difference between them is positive or negative trade-off for the sustainability to restore and ensure wellbeing of society in the future.

5. Sustainability Assessment Framework for Project Selection: In line with the literature gap on quantitative sustainability measurement approach, new framework that integrates qualitative criteria with quantitative ones for better decision-making is crucial. Taking that into account, the comprehensive sustainability assessment framework was

brought to its final form after identifying important quantitative criteria on decision stages for project selection (Fig.3). As a primary goal of this study, through evaluating economic dimension research seeks to enhance environmental and social dimension of sustainability. Hence, proposed modeling idea (i.e. equation 1, 2) integrating economic and environmental dimension is the leading point to enhance social criteria and wellbeing of future generations. Moreover, to fill the literature gap, through triggering economic dimension this study is the first to incorporate sustainability concerns in project selection practices.

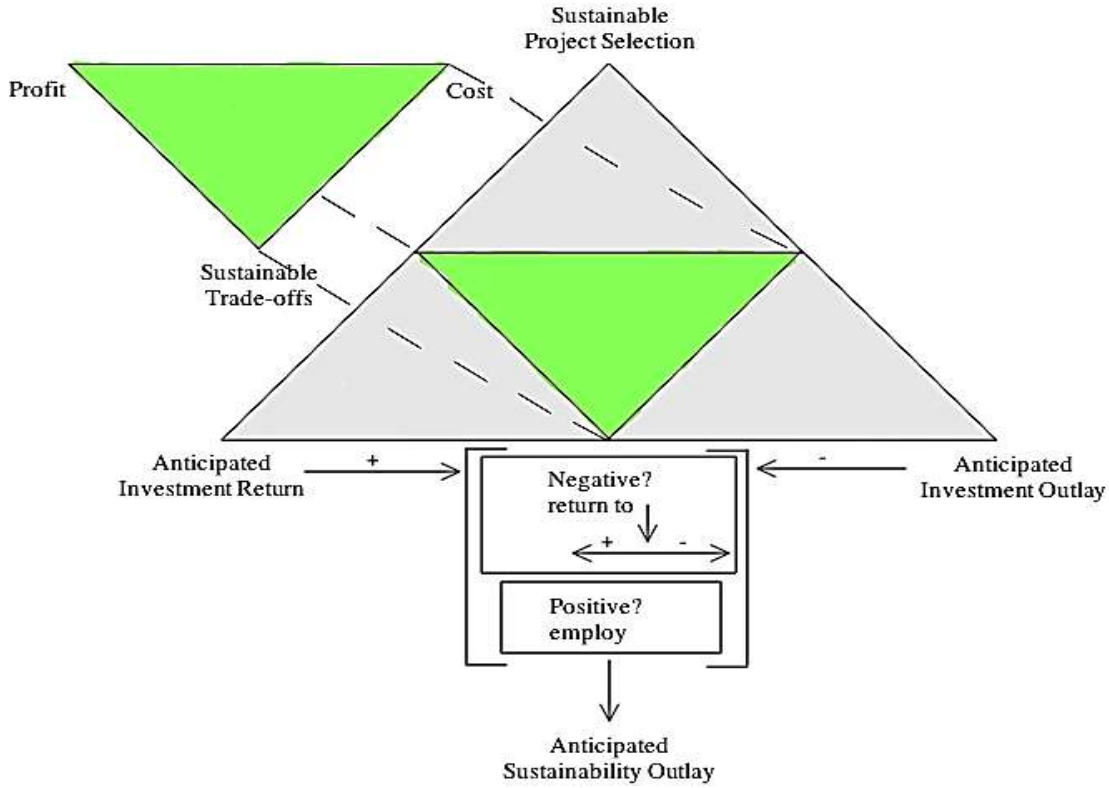

Fig.3. Quantitative Sustainability Assessment Framework

In real world, decision maker while selecting a project from a set of projects may encounter sustainability with different aspects simultaneously as the consequences of the selected project affect environment and society that is why this study is undertaken to bring balance for some extends between profit and sustainability in project selection practices.

6. Conclusion: For the support of the enhancement of environmental concerns in investment field, this study has proposed the new framework and integrated model for selecting sustainably - adjusted projects. The central focus is forwarded especially on the environmental aspects simultaneously with regards to cost of investment project. As a result, in order to ensure growth and expand investment horizon to most demanded

areas, investors need to undertake sustainability concerns into investment project proposals. From this perspective, novel optimization model on SPSP will add a significant value to the literature through enhancement of environmental concerns, simultaneously maintaining investors' competitive advantage. Finally, incorporation of sustainability cost in traditional project selection practices maintains net present value maximization objectives while enhancing environmental concerns to ensure sustainable growth of future investments.

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