The Key to Successfully Implementing Sustainable and Socially Responsible Construction Management Practises : A Project Feasibility Analysis.

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a b s t r a c t

By embracing the principles of sustainable development, this paper provides a new method for performing project feasibility studies. Infrastructure projects in particular have a significant impact on achieving sustainable development, hence project sustainability must be taken into account. Particularly in those emerging nations or areas, like China, where numerous development projects are presently underway or will be in the near future, this becomes an urgent issue. The importance of project feasibility analysis to project sustainability performance has not received much attention in prior research. Project stakeholders do not fully comprehend the significance of implementing sustainable development principles while performing a feasibility study. The Chinese construction sector is used as an example to discuss the key difficulties in conducting a project feasibility analysis in line with sustainable construction practises. The primary research methodology used in this study is a case study technique. 87 feasibility study reports from diverse projects were gathered by the research team. 18 economic performance factors, 9 social performance attributes, and 8 environmental performance attributes are among the attributes used to gauge project performance. According to research findings, social and environmental performance are now given less consideration during project feasibility studies than economic performance. The study shows how inadequate it is to evaluate a building project's implementation performance from the standpoint of sustainable development. The findings also point to the necessity of switching from the conventional method of project feasibility research to a new method that incorporates the ideas of sustainable development.

1. Introduction

ocial, and economic systems interact, integrate, and have meaningful relationships [1, 2]. In the context of the construction industry, sustainability is about attaining a win-win situation that benefits both the environment and society at large while also providing competitive advantages and financial gains for construction enterprises. The significance of corporate social responsibility (CSR) in achieving sustainable construction is discussed in other studies [3-5]. CSR is defined as ethical behaviour that affects the environment, society, and economics [1]. Construction businesses frequently create CSR policies to implement appropriate procedures when sustainability is established as a company aim. The social aspect of sustainability, which is frequently ignored, is recognised by CSR as well as environmental responsibilities [1].

In order to implement construction projects with the best possible economic, social, and environmental performance, sustainable construction practises must be promoted. The term "sustainable construction practise" refers to a variety of techniques used to carry out construction projects that cause less damage to the environment (i.e., prevent waste production) [6], more waste is reused in the production of construction material (i.e., waste management) [7,8], are advantageous to society, and are profitable for the company [9–12]. Striking for sustainability might result in a conflict between long-term environmental benefits and short-term economic operational goals because sustainability is typically seen as being environment-oriented in the construction industry [13,14]. In a complicated notion known as sustainability, it is often defined as the ability to satisfy fundamental human requirements while also providing opportunity for people to realise their aspirations for a better life [15It advocates for a balance between social, economic, and environmental growth. Nonetheless, other research revealed that applying sustainable practises when carrying out construction projects can increase profits.

making [9]. It is particularly important to embrace the principle in conducting project feasibility study. Strategies such CSR are sug- gested to implement sustainable practice [16]. Therefore, project feasibility studies are often conducted beforehand to gain a better understanding [17] for facilitating gaining better sustainability in the process of implementing construction project. [18].

Feasibility study is the first and most important thing before undertaking project design and construction. The effectiveness of the feasibility study will affect directly the success of a project. Project client or the consultant will work out the project feasibility study traditionally by considering financial issues, such as return of investment, demand and supply in the market, risk analysis on the market conditions [19]. It has been appreciated that the project feasibility study is one of the most easily misunderstood aspects in developing a project [20]. It is nevertheless, the most important stage, as mistakes at this stage can permanently handicap project's performance, even fatally. A proper and effective feasibility study is therefore more than just a set of financial projections, which can become a market-driven strategic plan and a road map for all subsequent decisions.

However, promoting the sustainability in any business sector has become increasingly important and at the operational level within businesses. In line with this development, there is a growing concern that social and economic issues have been outweighing environmental issues in the current practice of conducting project feasibility study [21]. Environmental impact assessment is nor- mally conducted on the preliminary design stage of the project if required [22–25]. It is usually appreciated that construction orga- nizations are environmental polluters, and this has been widely echoed in the previous studies [11,14,26–39]. While these findings demonstrated the significant adverse impacts of construction businesses on the environment, they also reflected the tradition of focusing on controlling cost, time and quality but less attention to environmental and social performance in implementing construc- tion projects. The realization of these impacts has led to the growth of studies on solutions for practicing sustainable construction across a project life cycle [34,36,40–42]. However, the effectiveness of sustainable construction methods has been limited in practice. This limitation is partly due to profit-driven culture in the industry where cost, quality and schedule have been the determinants ensuring maximum benefits to the construction business. It is also due to the difficulties of measuring the contribution of a specific construction project to sustainable development in project feasi- bility stage.

Construction activities in those developing countries and regions, such as China, have caused particular concerns such as environmental pollution, resources waste, safety problems, and effects to the public interests [29,42]. It has been reported that these problems present fundamental barriers to implement the principles of sustainable development in developing countries such as China [43–45]. In fact, there is a close association among these problems and the ineffectiveness of the current practice in con- ducting project feasibility study.

Therefore, this paper aims to examine the current practice of conducting project feasibility study, with employing the data collected from the Chinese construction industry [46]. Challenges of the existing practice for the implementation of sustainable construction are highlighted. Recommendations for the successful implementation of the sustainable construction are also discussed from the perspectives of different project participants.

2. Research methodology

To provide in-depth discussions and understanding of the surveyed projects, a case study approach is adopted in this study.

The research team collected 87 feasibility study reports in 2008 and 2009 for various types of projects which are classified into four categories: 29 residential projects (P_{I}), 27 public sector projects (P_{II}), 20 industrial projects (P_{III}), and 11 commercial projects (P_{IV}). These samples are collected through visiting Construction Departments in Beijing, Shenzhen and Chongqing. The research team has interviewed project managers, construction managers, site foremen, site engineers, site surveyors and frontline workers for a number of selected surveyed projects. The scales of residential projects are between 20,000 and 2,600,000 m^2 construction areas. The collection of these practical cases enables the research team to obtain first-hand information on the practice of conducting feasi- bility study in addressing social, economic and environmental issues. The examination on these cases leads to the understanding on what and how attributes are adopted in these considerations in the current practice. Therefore, analysis can be given on whether these attributes are proper or sufficient for implementing sustainable construction principles. The analysis can reveal the challenges for implementing sustainable construction practice in China by highlighting the areas which have not been given attention. Measures therefore should be taken to improve these weak areas.

3. Results and analysis

The existing practice of conducting project feasibility study varies largely among different types of projects. The difference can be found by examining what factors or attributes are considered in the process of feasibility study. These attributes can be broadly divided into three major pillars, namely economic performance attributes, social performance attributes and environmental performance attributes. The attributes used for measuring the three types of project performance are examined in this paper with the reference to the Chinese context.

Economic performance attributes

Economic performance attributes (EPAs) are used for assessing economic performance of construction projects. These attributes are used to reflect market availability, project financing and economic benefit from implementing a construction project. By examining the surveyed feasibility study reports, a list of EPAs havebeen considered in various reports and shown in Table 1.

The application of these attributes in the surveyed projects varies significantly. Table 2 provides statistical summary on the application of various attributes (EPAs) for assessing economic performance in project feasibility studies of the EPAs in the four types of the surveyed projects.

It can be seen from Table 2 that about 90% of the surveyed residential projects take into account EPA_4 ''market forecast''; however, only about half of the projects considered EPA_{14} ''finance risk assessment'', EPA_{15} ''return of investment'' and EPA_{16} ''net present value''. It is found that good attention is given on the future market in conducting feasibility study for residential projects; however, lack of risk assessment is induced.

In referring to the public sector projects, the feasibility study on about 96% of the surveyed projects implemented EPA_3 ''demand and supply analysis''; however, only 3% of the surveyed projects implemented EPA_6 ''market competition''. The importance is given to the understanding of the market needs in developing public sector projects. However, limited consideration is given to market competition. This reflects the nature of public sector project in particular in China where public projects are administered by government. This situation normally does not happen in the private sector.

Table 1
Attributes in project feasibility study.

Economic performance attributes	
EPA_1: Governmental strategic development policy	EPA_{10}: Financing channels
EPA_2: Tax policy	EPA_{11}: Investment plan
EPA_3: Demand and supply analysis	EPA_{12}: Life cycle cost
EPA_4: Market forecast	EPA_{13}: Life cycle profit
EPA_5: Project function and size	EPA_{14}: Finance risk assessment
EPA_6: Market competition	EPA_{15}: Return of investment (ROI)
EPA_7: Location advantage	EPA_{16}: Net present value (NPV)
EPA_8: Technology advantage	EPA_{17}: Pay-back period
EPA_9: Budget estimate	EPA_{18}: Internal rate of return (IRR)
Social performance attributes	
SPA_1: Influence to the local social development	SPA_6: Safety standards
SPA_2: Provision capacity of employment	SPA_7: Improvement to the public health
SPA_3: Provision capacity of public services	SPA_8: Cultural and heritage conservation
SPA_4: Provision capacity of public infrastructure facilities	SPA_9: Development of new settlement and local communities
SPA_5: Provision of the infrastructures for other economic activities	
Environmental performance attributes	
$EnPA_1$: Eco-environmental sensitivity of the project location	$EnPA_5$: Waste assessment
$EnPA_2$: Air impacts	$EnPA_6$: Environmental friendly design
$EnPA_3$: Water impacts	$EnPA_7$: Energy consumption performance
$EnPA_4$: Noise assessment	$EnPA_8$: Land consumption

Considering industrial type projects, about 90% of the surveyed industrial projects implemented EPA_9 ''budget estimate'' in project feasibility study; however, only 50% of the surveyed projects implemented EPA_6 ''market competition'' and EPA_{14} ''finance risk assessment''. It seems that decisions on developing industrial projects commonly consider cost situation by estimating project budgets. However, less attention is given to the provision of competitive service and risk assessment. This can also be explained by similar service and small price ranges offered by the industrial projects.

Furthermore, in referring to the commercial projects, about 91% of the surveyed commercial projects implemented EPA_5 ''project function and size''; however, only 18% of the surveyed projects implemented EPA_6 ''market competition'' in the feasibility study reports. Decision making on developing commercial projects have to properly assess the functions and sizes of the project. However, it is interesting to note that not much attention is given to the factor of competition in developing commercial projects.

Social performance attributes

Social performance attributes (SPAs) are used for assessing social performance of construction projects. By examining the surveyed feasibility study reports, a list of SPAs are identified and shown in Table 1.

The application of these attributes in the surveyed projects varies significantly. Table 2 provides statistical summary on the application of various attributes for assessing social performance in project feasibility study. It is noted that no social performance attributes are considered in the surveyed residential, industrial and commercial projects. It seems that social responsibilities have not been given due consideration in developing non-public projects in China. This is considered a major reason for causing the huge gap between the rich and the poor in the society. Even for the public sector projects, many social performance elements are not given consideration in many projects. In fact, one of the major aims for the development of public sector projects is to fulfill the social requirements, which should be addressed in all public projects. However, among the surveyed projects, only about 70% of the public sector projects concerns on the SPA_1 ''influence to the local social development''. It is further noted that some important factor such as 'safety standard' has not been properly considered in the practice of project feasibility study. This element is addressed for 0, 11, 0 and 36% of the surveyed residential, public sector, industrial and commercial projects respectively. The lack of consideration on the safety standard is considered as a major reason contributing to the high rate of safety accidents in the Chinese construction industry.

Environmental performance attributes

Environmental performance attributes (EnPAs) are used for assessing environmental performance of construction projects. In fact, a large number of research works have been conducted in this area [11,28,29,32,36,38,43–45,47–53]. By examining the surveyed feasibility study reports, a list of EnPAs are identified andshown in Table 1.

The application of these attributes in the surveyed projects varies significantly. Table 2 provides statistical summary on the application of EnPAs in the four types of projects surveyed.

The data in Table 2 provide the information about the applica- tion of various attributes for assessing environmental performance in project feasibility study. It is found that the majority of the projects did not concern the environmental performance attri- butes, of which only public sector and industrial projects concern $EnPA_2$ ''air impacts'', $EnPA_3$ ''water impacts'', $EnPA_4$ ''noise assess- ment'', $EnPA_5$ ''waste assessment'' and $EnPA_6$ ''environmental friendly design''. Furthermore, environmental impact assessments required on projects mainly only concern on the four major envi- ronmental pollutions, including air, noise, water and waste. In fact, it has been well appreciated in the previous studies that the envi- ronment in China has suffered a lot from the implementation of a huge number of construction projects. As implementing construction projects has been a driving force to the economic growth in China over previous two decades, the effects of the construction industry on the degrading environment is huge. One of the major reasons for this is considered as the lack of consideration given to the environmental protection in project feasibility study.

Based on the above analysis, it is found that the economical performance attributes are given more concerns than that given to the social and environmental performance attributes in conducting construction project feasibility study. Interesting evidences include that limited concern is given on *market competition* in assessing the economical performance attribute, limited concern is given to the *safety standards* in assessing social performance attributes, and *eco-environmental sensitivity of the project location* and *land consumption* are given limited concern in assessing the environ- mental performance attributes.

4. Recommendations

To improve the existing practice of construction implementa- tion towards contributing to sustainable development, all the three dimensions, including economical, social and environmental issues, need to be fully concerned in conducting project feasibility studies. In particular, the project feasibility study should allow more focus on the methods for improving project quality, safety performance and environmentally friendly practice for the future practice of the industry. This highlights the urgent need for shifting the traditional approach of project feasibility study to a new approach for embracing the principles of sustainable development. The

Table 2
Application of attributes in feasibility study. P_I – residential; P_{II} – public sector; P_{III} – industrial; P_{IV} – commercial; R – application rate.

Attributes	P_I (max: 29)	R_I (%)	P_{II} (max: 27)	R_{II} (%)	P_{III} (max: 20)	R_{III} (%)	P_{IV} (max: 11)	R_{IV} (%)
EPA_1: Governmental strategic development policy	20	69	9	33	14	70	5	45
EPA_2: Tax policy	23	79	11	41	10	50	8	73
EPA_3: Demand and supply analysis	24	83	26	96	17	85	6	55
EPA_4: Market forecast	26	90	4	15	16	80	9	82
EPA_5: Project function and size	25	86	19	71	14	70	10	91
EPA_6: Market competition	20	69	1	3	10	50	2	18
EPA_7: Location advantage	23	79	20	74	16	80	8	73
EPA_8: Technology advantage	19	66	19	70	17	85	7	64
EPA_9: Budget estimate	19	66	24	89	18	90	8	73
EPA_{10}: Financing channels	16	55	18	67	15	75	4	36
EPA_{11}: Investment plan	20	69	12	44	12	60	7	64
EPA_{12}: Life cycle cost	24	83	8	30	16	80	6	55
EPA_{13}: Life cycle profit	23	79	3	11	16	80	5	45
EPA_{14}: Finance risk assessment	15	52	3	11	10	50	4	36
EPA_{15}: Return of investment (ROI)	15	52	3	11	14	70	5	45
EPA_{16}: Net present value (NPV)	15	52	9	33	16	80	5	45
EPA_{17}: Pay-back period	16	55	9	33	17	85	5	45
EPA_{18}: Internal rate of return (IRR)	16	55	9	33	17	85	5	45
SPA_1: Influence to the local social development	2	7	19	70	3	15	6	55
SPA_2: Provision capacity of employment	3	10	3	11	3	15	5	45
SPA_3: Provision capacity of public services	3	10	15	56	1	5	3	27
SPA_4: Provision capacity of public infrastructure facilities	2	7	14	52	1	5	3	27
SPA_5: Provision of the infrastructures for other economic activities	2	7	4	15	1	5	2	18
SPA_6: Safety standards	0	0	3	11	0	0	4	36
SPA_7: Improvement to the public health	2	7	3	11	0	0	2	18
SPA_8: Cultural and heritage conservation	0	0	0	0	2	10	4	36
SPA_9: Development of new settlement and local communities	2	7	17	63	7	35	2	18
$EnPA_1$: Eco-environmental sensitivity of the project location	1	3	7	26	6	30	2	18
$EnPA_2$: Air impacts	4	14	15	56	14	70	2	18
$EnPA_3$: Water impacts	4	14	17	63	12	60	4	36
$EnPA_4$: Noise assessment	5	17	19	70	12	60	3	27
$EnPA_5$: Waste assessment	0	0	17	63	12	60	5	45
$EnPA_6$: Environmental friendly design	0	0	16	59	14	70	0	0
$EnPA_7$: Energy consumption performance	3	10	4	15	11	55	4	36
$EnPA_8$: Land consumption	0	0	7	26	7	35	2	18

following highlights necessary actions required for different levels of project participants to ensure sustainable construction practice be implemented:

Government

Government has an important role to play in promoting sustainability of construction project at the stage of project feasi- bility study. The government should guide with policies, laws and regulations, and balance the interests among economic, social and environmental stakeholders through awards and punishment. This role should be practiced through various ways including laws and regulations, industrial specifications, administrative examination and approval, tax fine and other means.

Clients

Project owners have a key role influencing sustainability performance for construction projects. Problems contributing to poor project sustainability in project life cycle have close relation with owners. If owners consider and require construction project works from a perspective of sustainable development, the real driving force can be gained to achieve better sustainability. In the traditional practice, as presented in the previous sections in this paper, project clients focus on the analysis on project economic performance in project inception and design stages. To improve project sustainability, clients should work closely with other parties, including governmental offices, planning professionals, architects and engineers. Their advice should be incorporated in conducting project feasibility.

Architects and engineering consultants

Design documents have great influences on the sustainable performance of construction projects. Designers and engineering consultants should be consulted in the feasibility stage for professional advice on various alternatives and their influences to the project sustainability. Designers and engineering consultants should be equipped with the knowledge of sustainable construc- tion principles, and they should have the know-how of practicing these principles in their professional activities, such as the choice of sustainable design plans, choice of environmentally friendly materials, energy efficient designs for services, and sustainable structure design to enable safer and healthier living andworking environment.

Contractors and suppliers

In the traditional practice, contractors and suppliers have no or very little involvement in project feasibility study stage. However, it is considered valuable to consult with contractors and suppliers for advice on improving project buildability and gaining better understanding on the influence of alternative construction methods, materials and plants on the project sustainability. As contractors and suppliers are knowledgeable of construction process and characteristics of various building materials and plants, their roles in contributing to better project sustainability are significant. They can provide information and suggestions about the environmental effects of construction activities and various materials and plant, such as waste generation, air and noise pollution, safe uncertainties, energy consumption, water pollution.

The incorporation of these information in the project feasibility study will contribute to improve the assessment effectiveness on the project sustainability.

5. Conclusion

This paper discussed major challenges of conducting project feasibility study to the sustainable construction practice with reference to Mainland China construction industry. Eighty seven project feasibility study reports under four groups of projects including residential, public sector, industrial and commercial projects were examined. The study on the practice of feasibility study helps understanding the key factors considered in the prac- tical applications. Eighteen economical, nine social and eight environmental performance attributes were explored from the 87 feasibility study reports. Major results from the analysis on these reports included that some attributes are given more commonly used that others, indicating that individual factors are given different level of significance in the practice. The results also indi- cated that more economic factors are considered than those social and environmental attributes. In facts, some social and environ- mental factors are given limited or no consideration at all among the surveyed projects, for example, cultural and heritage conser- vation, safety standards, and environmental friendly design. The study demonstrated that there is a need for shifting the traditional approach of project feasibility study to a new approach for embracing the principles of sustainable development. The structure of using the new approach for a project feasibility study includes 18 economical, nine social, and eight environmental performance attributes. The performance of these attributes should be assessed when conducting project feasibility with embracing the principles of sustainable development. In recommendation, the imple- mentation of this new approach requests for the concerted actions and participation from all project stakeholders, including govern- ment, clients, architects, engineering consultants, contractors and suppliers.

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