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ASSURING SUSTAINABLE CONSTRUCTION AT PROJECT FEASIBILITY STAGE IN SRI LANKA

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ABSTRACT

Construction activity is commonly considered to have adverse impacts on the environment, which is the basis of sustainable development for human being. Further, sustainability should be addressed mostly in developing countries, such as Sri Lanka, where a considerable amount of construction works is currently in progress and remain to emerge in the future. It is considered that the proper development and operation of a construction project can make significant contribution to the mission of sustainable development. However, the existing difficulty is the lack of the guidance for implementing sustainable development principles in construction industry. Therefore, this research intends to bring the necessity of mandated project feasibility studies as a guideline for sustainable development in the Sri Lankan Context. The research aim was approached through a qualitative survey strategy. To solicit the perceptions of experts on the identified sustainability performance criteria, a semi-structured interview survey was conducted. Ten experts were selected through purposive sampling strategy, who had experience in sustainable construction and project feasibility evaluation criteria. The manual content analysis method was used to analyse the collected data. Findings of the research revealed that though numerous sustainability assessment tools are being practised, there is a failure in sustainable construction in the current context. Thus, the minimum sustainability requirements were identified under the three pillars of sustainability, aiming to develop the project feasibility study as a guideline and to ensure sustainability performance from the project inception stage. These findings are helpful for industry practitioners especially the project owners to initiate a sustainable construction with concerted actions of all project stakeholders to safeguarding the future.

Keywords: *Government policies, Minimum sustainability requirements, Project feasibility study, Sri Lanka, Sustainable construction.*

1. INTRODUCTION

The construction industry and its activities have significant impact on the environment economy, and society (Osei, 2013). Further, the construction industry is continuously exploring appropriate strategies required to make constructions more sustainable (Abidin, 2010; Kandil *et al*., 2010), due to its negative impact (Sfakianaki, 2019). Appreciation of the significant impacts of construction activities on Sustainable Development (SD) has led to the development of various management approaches and methods to guide construction participants in achieving better project sustainability performance. However,

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government policies and regulations act as the primary solution to mitigate adverse effects from construction activities (Zhang *et al.*, 2012).

The SD was defined in Brundtland's report published by World Commission on Environment and Development as meeting the current generation's necessities and aspirations without minimising the future potential (World Commission on Environment and Development (WCED), 1987, p. 43). When concerning construction as a business, the fusion of sustainability is about achieving a mutually beneficial outcome for project stakeholders and a satisfactory profit for the developers (Hutchins and Sutherland, 2008; Zuo and Zhao, 2014). Sustainability performance of an individual construction project across its life cycle is an indispensable aspect in attaining the goal of SD. Hence, incorporating them in the project's inception stage is the most critical phase for sustainable decision-making (Braganca *et al.*, 2010; Heralova, 2017). Although Environmental Impact Assessment (EIA) and feasibility study include sustainable assessment criteria at early construction stages (Li *et al.*, 2010), only EIA is under the legal system of environmental protection as the guideline for the ecological consequences. Therefore, implementing a feasibility study as a policy guideline to comply with sustainable requirements may be the best option as feasibility criteria are better matched with the three pillars of sustainability.

Generally, the implementation of Sustainable Construction (SC) practices in developing countries was found to be low (Abidin, 2010; AlSanad, 2015). Sri Lanka (SL), as a developing country, has a high demand for SC even though the country is not adequately furnished with SC practices (Jayalath and Gunawardhana, 2017). The research findings of Athapaththu and Karunasena (2018) suggested that contracting organisations established in SL lack in adopting existing SC practices. The proper implementation of SC has been obstructed by many barriers (Adetunji *et al.*, 2003), where lack of project owner's demand has been considered as the main barrier for SD (Pitt *et al.*, 2009). However, SD is still regarded as a 'nice-to-have' practice by the owners that enhances usual practice without being incorporated into decision making (Du Plessis, 2002). Therefore, governments can explicitly assist in introducing sustainability into the construction sector through policies and guidelines while balancing the interests among economic, social, and environmental stakeholders through rewards and penalties (Chong *et al*., 2009). Shen *et al*. (2010) identified the existing social, economic, and environmental attributes relating to sustainability in the project feasibility study. Yet, there is a research gap in studying the shifting of the traditional method of a project feasibility study to a new path while embracing the principles of SD in the Sri Lankan Context. Thereby, it is necessary to research minimum sustainability requirements in implementing the project feasibility study as a policy guideline for every project within a country. This research aims to discover minimum sustainability requirements to embrace the principles of SD into project feasibility checks on construction work in SL. The aim was achieved by critically reviewing the relationship between feasibility studies and assuring sustainability to identify sustainability performance criteria at project inception stage and accomplishing the minimum sustainability requirements essential to be achieved by construction projects from the country perspective.

2. LITERATURE REVIEW

2.1 THE RELATIONSHIP BETWEEN PROJECT FEASIBILITY STUDIES AND ASSURING SUSTAINABILITY

The concepts of SD should be integrated into all stages of the project life cycle (Tam *et al*., 2012). The Royal Institute of British Architects (RIBA) Plan of Work organises the project life cycle into a process of eight (08) stages: i.e. (i) strategic definition, (ii) preparation and briefing, (iii) concept design, (iv) spatial coordination (v) technical design, (vi) manufacturing and construction, (vii) handover, and (viii) use of a building (Royal Institute of British Architects (RIBA), 2020). The different sustainability tools have been developed to evaluate the success of the development over the stages of the project life cycle in terms of balancing energy and environment while considering the social and technological aspects (Clements-Croome, 2004). Even though there are number of sustainability assessment tools, the time of application (Wilkinson and Reed, 2007), single-dimensional nature (Ding, 2008), regional variations (Kohler, 1999), complexity (Crawley and Aho, 1999), lack of government intervention are identified as limitations of current sustainability assessment tools to achieve SC.

The early involvement of stakeholders, even before the design stage, will ensure the successful execution of SC (Tam *et al*., 2012). Hill and Bowen (1997) suggested that more attention should be given to the application of environmental, social, and economical assessment for implementing a construction project in particular at project feasibility stage. At this stage, the new project will be investigated with multiple options while addressing the issues in such a way as to why, when, and how to invest (Shen *et al*., 2007). The preliminary feasibility study and the project proposal are conducted at this stage, where the most feasible option will be detailed into a proposal with the needed sustainable activities of the client to make the investment decision (Shen *et al*., 2007). However, the effectiveness of sustainability assessment tools at the inception stage is limited due to the limited project information at the beginning (Shen *et al*., 2010). Hence, the sustainability criteria that can be assessed in the project's inception have been identified by Shen *et al*. (2007). Shen *et al*. (2010) had analysed 87 feasibility study reports of various types of projects in China and identified eighteen economic, nine social, and eight environmental performance attributes. Table 1 illustrates the findings of both papers.

Table 1: Sustainability criteria at the inception stage

Sustainability criteria at Inception Stage		
Economic	**Social**	**Environmental**
Governmental strategic development policy	Influence on the local social development	Eco-environmental sensitivity of the project location
Tax policy	Provision capacity of employment	Ecological assessment
Demand and supply analysis	Provision capacity of public services	Air impacts
Market forecast	Provision capacity of public infrastructure facilities	Water impacts
Project function and size	Provision of the infrastructures for other economic activities	Noise impacts
Market competition		Waste impact
Location advantage		
Technology advantage		

Sustainability criteria at Inception Stage		
Budget estimate	Safety standards	Environmentally friendly design
Financing channels	Improvement to the public health	Energy consumption performance
Investment plan	Cultural and heritage conservation	Land consumption
Life cycle cost	Development of new settlement and local communities	
Life cycle profit	Land use	
Finance risk assessment	Safety assessment	
Return on Investment (ROI)		
Net Present Value (NPV)		
Pay-back period		
Internal Rate of Return (IRR)		
Scale and business scope		
The effect on the local economy		

Although the currently used environmental building assessment tools have given less attention to financial aspects, the project feasibility studies include more concern over financial criteria as per the table above. Hence, the number of SCs has been reduced in practice due to the profit-driven culture in the industry (Shen *et al*., 2010). Therefore, even the projects are environmentally friendly, and they will make it less attractive to developers as they may be too costly to build. Thus, both environmental issues and financial considerations should be given equal concern in the feasibility evaluation framework (Larsson, 1999), including environmental goals, sustainability certification, and the budget for sustainability. Hence, Shen *et al*. (2010) highlighted the necessity of shifting the project feasibility study to a new dimension by embracing more social and environmental principles of SD into it.

2.2 OVERVIEW OF SUSTAINABLE CONSTRUCTION IN SRI LANKA

The successful implementation of SD principles is a must to overcome environmental issues in developing countries (Zeng *et al.*, 2002; Shen *et al.*, 2005). Yet SL has not taken sufficient measures to mitigate the current challenges that occur in the construction industry (Jayalath and Gunawardhana, 2017). In SL, the GREENSL® rating system is introduced in 2010 by the Green Building Council of SL as an assessment tool to guide SC. Along with that, Tsunami Sustainable Building Guidelines for South-East Asia was published. It was a SC management guideline with several environmental, safety, and financial benefits (United Nations Environment Programme, 2007). There are 64 LEED, and GREEN^{sl} certified green buildings in SL (Green Building Council Sri Lanka (GBCSL), 2020). For example, Heritance Kandalama is one of the LEED Bronze rated hotels in the world (Seneviratne, 2014) and MAS Intimates Thurulie-Clothing Factory is the first LEED Platinum rated newly built manufacturing factory in the world (MAS Holdings, 2020).

The Sri Lankan government has already implemented several rules and regulations to support local green growth (Thalpage and Karunasena, 2016). The primary legislation for environmental conservation in SL was the National Environmental Act. According to this Act, Part IV C requires Environmental Impact assessment (EIA) approval for 'Prescribed Projects,' which are listed under the Act and government gazette notifications (De Mel *et al*., 2009). Further, there are many Physical Planning Acts and Ordinances such as Urban Development Authority (UDA) Law No 41 of 1978, Town and Country Planning

Ordinance No. 16 of 1946, Housing and Town Improvement Ordinance No.19 of 1915, Municipal Council Ordinance, Urban Council Ordinance and Pradeshiya Sabha Act of 1987 for protection of the Environment and promoting economic, social, and physical development at early stages. However, the legal framework in SL has accomplished environmental aspects compared to economic and social issues (Abeynayake, 2010). Therefore, SL has experienced unsustainable development during the past decades. Abidin *et al*. (2012) argued that with more government actions, the construction activities will move towards better environmental, social, and economic safeguards. Yet there is a lack of policies and regulations that directly concerns Sustainability practices in SL compared to environmental protection (Hewage and Mallika, 2011). Finally, issuing the devised project feasibility criteria as a sustainability guideline as approval for project commencement will uplift the green building practices in SL.

3. METHODOLOGY

The major objective of this study is to find out the minimum sustainability requirements that can be incorporated into the project feasibility study to assure SC and used by all project participants to understand and improve sustainability performance at inception stage. The data used for data collection were mainly from a comprehensive literature review. The qualitative research approach was selected as the best method to collect data due to the lack of knowledge and experience on both sustainability and project feasibility study with Sri Lankan construction professionals and it is difficult to go for a large number of respondents for the data collection. A preliminary list of sustainability performance criteria gathered was presented through semi-structured interviews to the invited professionals for their comments. There were ten (10) experts with more than 20 years of experience. They were selected through judgemental sampling technique, including two (2) quantity surveyors from road projects, two (2) quantity surveyors from building projects, two (2) civil engineers from building projects, and four (4) civil engineers from water projects. These interview discussions provide valuable comments on the selection of the minimum sustainability requirements. However qualitative data obtained from expert interviews were analysed through manual content analysis by tracking the findings within identified themes.

4. RESULTS

Findings of the Expert survey can be elaborated under the three pillars of sustainability as identified in the literature review and the interviewee's opinions were analysed through manual content analysis and the obtained summary is presented in Table 2. Criteria in the Table includes literature findings in Table 1 and criteria from LEED sustainability assessment tool. The common view of the respondents was marked as "✓" in Table 2.

Out of 79 sustainability performance criteria identified, 77 were from the literature findings and remaining one was from expert interviews. That proposed criterion was Cost-Benefit Analysis (CBA). Then experts identified 68 criteria as minimum sustainability requirements to assess all the project at the feasibility stage as illustrated below. However, to make the project feasibility study as a guideline under the law of SL, the collected data was analysed to come up with the criteria which are not assessed in EIA and government authorities. Hence, ultimately 36 criteria were found to be the final output that need to be mandated to come up with the sustainable feasibility guideline.

Table 2: Common view of the respondents

Literature Findings	Common View of Expert Survey Findings			
Sustainability performance criteria	**Minimum sustainability requirements**	**Feasibility study**	**EIA**	**Government authorities**
Economic sustainability factors				
Government strategic development policy	✓	✓	✓	-
Tax policy	✓	✓	-	-
Market forecast	✓	✓	-	-
Demand and supply analysis	✓	✓	-	-
Market competition (Sell/rent price competition)	✓	-	-	-
Project Promotion	✓	✓	-	-
Project scope, scale, and functions	✓	✓	✓	-
Effects on the local economy	✓	✓	-	-
Location advantage	✓	✓	-	-
Technology advantage	✓	✓	✓	-
Budget estimate	✓	✓	-	-
Financing channels	✓	✓	-	-
Investment plan	-	✓	-	-
Total life cycle cost and profit	✓	✓	-	-
Financial risk assessment	✓	✓	-	-
Overhead cost	-	✓	-	-
Uncontrolled inflation.	✓	✓	-	-
Fluctuation in foreign currency.	✓	-	-	-
Return on investment (ROI)	-	✓	-	-
Net present value (NPV)	-	✓	-	-
Pay-back period	-	✓	-	-
Internal rate of return (IRR)	-	✓	-	-
Project Affordability	✓	✓	-	-
Regulation in export-import limitation	✓	-	-	-
Change in loan interest rate.	-	✓	-	-
Influences of domestic product and resources use policy	✓	-	-	-
Policy in stopping subsidy	✓	✓	-	-
Increasement in regional minimum payment for workers.	✓	-	-	-
Cost-Benefit Analysis	✓	✓	-	-
Social sustainability factors				
Influence on local social development (welfare)	✓	✓	-	-

Literature Findings	Common View of Expert Survey Findings			
Provision of the infrastructures for public/ economic activities	✓	✓	-	-
Influence on land prices in the surrounding location.	✓	-	-	-
Influence by surrounding people to the new development (protest)	✓	✓	✓	-
Land use and its relationship with immediate surroundings	✓	✓	✓	-
Provision capacity of employment	✓	✓	-	-
Provision capacity of public services (access to public services)	-	✓	-	-
Improve public health and safety standards/ assessment	✓	✓	-	✓
Cultural and heritage conservation	✓	✓	✓	✓
Development of new settlement and local communities/ resettlement	✓	✓	-	-
Thermal comfort	-	✓	-	-
Day lightning and natural ventilation	✓	✓	-	✓
Acoustic performance and noise control	✓	-	✓	-
Indoor air and water quality performance	✓	-	✓	-
Low emitting materials	✓	-	-	-
Indoor occupant health and safety quality performance	✓	-	-	-
An unhealthy political climate for investment.	✓	✓	-	-
NGO involvement in the investment plan	✓	✓	-	-
Lack of law enforcement.	✓	-	-	-
<u>Environmental sustainability factors</u>				
Access to the location	✓	✓	✓	-
Influences of traffic jams around the location.	✓	✓	-	✓
Unsupported facilities and other infrastructures around the location	✓	✓	-	✓
Protection of environmentally sensitive project location	✓	✓	✓	✓
Selection of project location with high development priorities	✓	✓	✓	-
Access to public and ecological transportation	✓	-	✓	-
Reduce parking footprint	✓	-	-	✓
Protect or restore natural habitats and promote biodiversity	✓	✓	✓	-

Literature Findings	Common View of Expert Survey Findings			
Green space for environmental and social interaction	✓	-	✓	-
Site assessment for sustainable design options	✓	✓	-	✓
Building water conservation	✓	✓	-	✓
Leak detections and innovative water-efficient equipment	✓	-	-	-
Water-efficient landscaping	✓	-	-	-
Water recycling and reuse	✓	-	✓	-
Rainwater management	✓	-	-	✓
Construction and demolition waste management	✓	✓	✓	-
Innovative technologies for waste reduction	✓	-	✓	-
Optimise energy performance	✓	✓	-	-
Participation in demand response energy technologies and programs	-	✓	-	-
Renewable energy production	✓	-	-	-
Enhanced refrigerant management	✓	-	-	-
Recycle and renewable material use	✓	-	-	-
Local and regional materials	✓	✓	-	-
Environmentally friendly design	-	✓	-	-
Building orientation	✓	-	-	-
Air impacts	✓	-	✓	-
Noise impacts	✓	-	✓	-
Water impacts	✓	-	✓	-
<u>Other sustainability factors</u>				
Environmental Management Certificate	✓	-	✓	-
Green Building Accredited Experts to support investment	✓	-	-	✓
Inappropriate technology in the construction and operation phase	✓	-	-	-

4.1 ECONOMIC SUSTAINABILITY CRITERIA

Economic Performance Criteria (EPC) are used for assessing economic performance of construction projects. These criteria are used to reflect market availability, project financing and economic benefit from implementing a construction project. Through the literature findings, a list of EPC has been identified and they were directed to the interviewees to select minimum feasibility requirements.

It can be seen from Table 2 that out of the 29 EPC, 22 were selected as the minimum sustainability requirements at project feasibility study, 24 were already being assessed in the current project feasibility study, 3 were included in the EIA and no EPC were assessed

in the governmental authorities. Hence it is clear that EPC were given less consideration in the mandated sustainable assessment criteria which were used for sustainable decision making at project inception stage.

As evident through the respondents' views, tax policy, project scope, scale and functions, location advantage, the influence of domestic product and resources use policy, technology advantage, and budget estimate are the most critical factors to be considered under economic sustainability requirements at project feasibility stage. Although these EPC are given good attention in conducting project feasibility study, market competition, fluctuation in foreign currency, regulation in export and import limitation, influence in domestic products and resource use policy, and increasement in regional minimum payment for workers were given limited attention in conducting project feasibility study where experts suggested them under the minimum sustainability requirements at feasibility stage.

Other than this, experts highlighted that tax policy needs to be implemented according to any framework where government should provide tax concessions and subsidy to identified projects to promote SC. Then that will expose to new technologies available in foreign countries it will increase the work efficiency. Further, the strategic development policy in SL changes with the government changes, where any strategy should be implemented through national policy as they are not changed with the ruling party.

4.2 SOCIAL SUSTAINABILITY CRITERIA

Social Performance Criteria (SPC) are used for assessing social performance of construction projects. Through the literature findings, a list of SPC have been identified and they were directed to the interviewees to select minimum feasibility requirements.

It can be seen from Table 2 that out of the 19 SPC, 17 were selected as the minimum sustainability requirements at project feasibility study, 13 were already being assessed in the current project feasibility study, 5 were included in the EIA and 3 of SPC were assessed in the governmental authorities. Same as EPC, SPC were also given less consideration in the mandated sustainable assessment criteria which were used for sustainable decision making at project inception stage.

It seems that social responsibilities have not been given due consideration in Sri Lankan projects. This is considered a major reason for causing the huge gap between the rich and the poor in the society. As evident through the respondents' views, influence on local social development, influence by surrounding people to new development, Land use and its relation with immediate surroundings, improve public health and safety standards/ assessment, cultural heritage conservation, development of new settlement/ local communities/ resettlements, unhealthy political climate, and lack of law enforcement are the most critical factors to be considered under social sustainability requirements at project feasibility stage. Although above SPC are given good attention in conducting project feasibility study, influence by surrounding people to new development, lack of law enforcement, and most of indoor environment quality criteria were given limited attention in conducting project feasibility study where experts suggested them under the minimum sustainability requirements at feasibility stage.

Moreover, to expert opinion, providing employment opportunities to local labourers will be a social benefit to the public as well as an economic benefit local economy, where indirectly the society will get indirect opportunities to earn by providing

accommodations, shops. Further a proper law should be implemented through local government to approve building permit only if the sewerage line is taken up to the board connection.

4.3 ENVIRONMENTAL SUSTAINABILITY CRITERIA

Environmental Performance Criteria (EnPC) are used for assessing environmental performance of construction projects. In fact, a large number of research works have been conducted in this area and many EPC were identified compared to other pillars of sustainability. This may be because most works consider only the environmental factors when comes to the sustainability.

It can be seen from Table 2 that out of the 28 EnPC, 26 were selected as the minimum sustainability requirements at project feasibility study, 13 were already being assessed in the current project feasibility study, 12 were included in the EIA and 7 of EnPC were assessed in the governmental authorities. Hence it is clear that EnPC were given considerable attention in the mandated sustainable assessment criteria which were used for sustainable decision making at project inception stage. This is because EIA required on projects mainly concern on the four major environmental pollutions, including air, noise, water and waste.

As evident through the respondents' views, access to location, protect or restore natural habitats and promote biodiversity, green space for environmental and social interactions, site assessment for sustainable design options, air impacts, noise impacts, water impacts, and rainwater management are the most critical factors to be considered under environmental sustainability requirements at project feasibility stage. Although this EnPC are given good attention in conducting the project feasibility study, water conservation mechanisms, renewable energy production, enhanced refrigerant management, recycle and renewable material use, and building orientation were given limited attention in conducting project feasibility study where experts suggested them under the minimum sustainability requirements at feasibility stage.

As implementing construction projects has been a driving force to the economic growth in SL over previous decades, the effects of the construction industry on the degrading environment are huge. One of the major reasons for this is considered as the lack of consideration given to the environmental protection in the project feasibility study. Hence based on the above analysis, it is found that the EPC are given more concerns than that given to the SPC and EnPC in conducting construction project feasibility study.

5. CONCLUSIONS

SC is not yet standard practice in SL. This paper concludes that the proper development and operation of a construction project can make a significant contribution to the mission of SD. There is the existence of a lack of the guidance for implementing the SD principle in the construction business, and the lack of mechanism of assessing the practice of applying the principle at the project feasibility stage. Further, the traditional practice of assessing the feasibility of a construction project concerns more on the economic and social contribution of a construction project. Hence this research used project feasibility study as the sustainability tool to ensure SC from the inception stage earns the full benefits environmentally, socially, and economically by targeting the right group criteria. Hence, that right group includes 36 sustainability out of 79 to facilitate sustainability decision

making. Based on those principles, the judgment can be made as to whether or not the development of a construction project is in line with SD principles. Thus, there was a requirement of guideline for sustainable decision making and it was fulfilled by assisting project feasibility study towards sustainability. It is proposed to implement the identified minimum sustainability requirements after benchmarking each criterion under possible government authority. However, this becomes an effective practice for SCs rather than governing under other sustainable assessment tools.

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