SUSTAINABLE ASSESSMENT OF OPERATIONAL NON-TOLLED ROADS IN MALAYSIA USING pH JKR RATING TOOL

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ABSTRACT

The construction industry is a vital sector that affects sustainability and is a major contributor to economic growth. Therefore, it needs to be regulated carefully to balance out the Triple Bottom Line. This is even more pronounced for the infrastructure sector which covers substantial swathes of land and spans throughout regions. Roads rank top most among infrastructure development and yet sustainability assessment for roads still lag behind those of buildings. Globally, there are a few rating tools that have been developed exclusively for roads, and in Malaysia, MyGHI and pH JKR are applied. The former has been developed by The Malaysian Highway Authority (LLM) to assess highways which are nominally closed access tolled roads. pH JKR was developed in 2012 by the Malaysian Public Works Department to assess non-tolled roads. Despite this, the assessment is only mandatory for new projects valued at RM50 million and above, federal roads and siting at environmentally sensitive areas. This proves a large setback as the state road coverage makes up more than 90% of the road network in Malaysia. Another deficiency is that rating is only done for projects during the planning, design and construction stage with no emphasis on the operational stage of the road. With this said, it will be necessary to develop a rating tool that not only is applicable to all road hierarchies, but also assesses the sustainability of the already operational road networks. pH JKR is identified as a suitable rating tool that can be modified to serve this purpose. This study aims to determine the pH JKR criteria that are relevant for operational non-tolled roads in developing sustainability rating tools. A literature review was carried out to determine the sustainability criteria that are common in road sustainability rating tools. Subsequently, current operational non-tolled roads that have not been previously assessed was evaluated using pH JKR to identify the sub-criteria that is already prevalent. Lastly, a focus group discussion was conducted consisting of experts from road concessionaires, public and private sector personnel in road development and operation to identify the pH JKR criteria that are relevant for current operational non-tolled roads. The accumulated data was subjected to a factor loading and the applicable sub-criteria was then ranked. From the comparison done among other sustainability rating tools and pH JKR, it was found that pH JKR is a suitable platform for increasing the road hierarchies that can implement it. It is also noted that pH JKR may need improvements if it is to include operations. From the 21 projects evaluated, out of the 80 sub-criteria, only 24 sub-criteria scored a frequency of 50% or more. Following the focus group discussion, these 24 sub-criteria were further narrowed down to only 12 that were deemed relevant in the operational phase. This study will help to pave the way in modifying the current pH JKR or establishing sustainability rating tools that encompass all road hierarchy in the operational stage.

ABSTRAK

Industri pembinaan adalah sektor penting yang mempengaruhi kelestarian dan menyumbang kepada pembangunan ekonomi. Oleh sedemikian, adalah mustahak agar keseimbangan antara aspek ekonomi, sosial dan alam sekitar dicapai. Ini lebih penting untuk pembangunan infrastruktur yang merangkumi kawasan yang luas dan antara negara. Jalan merupakan infrastruktur yang utama dan penilaian kelestarian jalan masih jauh di belakang berbanding penilaian untuk bangunan. Terdapat banyak sistem penilaian kelestarian dibangunkan pada peringkat antarabangsa dan di Malaysia, MyGHI dan pH JKR digunapakai. MyGHI dibangunkan oleh LLM untuk menilai lebuhraya bertol atau jalan tertutup. pH JKR dibangunkan pada tahun 2012 oleh JKR untuk menilai jalan tidak bertol atau jalan terbuka. Walaubagaimana pun, pH JKR hanya digunakan untuk menilai projek baru jalan persekutuan RM 50 Juta ke atas dan projek yang di kawasan alam sekitar sensitif. Ini merupakan suatu masalah kerana jalan negeri meliputi lebih 90% daripada keseluruhan rangkaian jalan. Selain itu, penilaian tidak termasuk fasa penggunaan. Justeru itu, sewajarnya satu sistem penilaian kelestarian diwujudkan untuk tujuan ini. pH JKR dikenalpasti sebagai sistem yang dapat diubahsuai untuk penilaian menyeluruh. Kajian ini dilaksanakan untuk mendapatkan tahap kepatuhan jalan sedia ada terhadap pH JKR. Kajian literatur dijalanakan untuk menetapkan kriteria yang bersamaan dengan sistem penilaian yang lain dan 21 projek dinilai untuk mengenalpasti sub-kriteria yang sedia diamalkan. Akhirnya, satu perbincangan dengan pakar-pakar dibuat untuk mendapatkan sub-kriteria yang sesuai dan keutamaan bagi fasa penggunaan. Daripada kajian ini didapati hanya 24 sub-kriteria daripada 80 sub-kriteria diamalkan. Perbincangan pakar menunjukkan hanya 12 sub-kriteria ini sesuai dalam fasa penggunaan. Kajian ini dapat membantu dalam menyediakan asas untuk kajian lain agar sistem penilaian kelestarian jalan yang menyeluruh dapat dihasilkan.

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LIST OF ABBREVIATIONS

BCA	-	Building and Construction Authority (Singapore)
CBA	-	Cost Benefit Analysis
FGD	-	Focus Group Discussion
LCA	-	Life Cycle Analysis
JKR	-	*Jabatan Kerja Raya*
MC	-	Main Criteria
MCDA	-	Multiple Criteria Decision Analysis
MyGHI	-	Malaysian Green Highway Index
OECD	-	Organization for Economic Cooperation and Development
pH JKR	-	Penarafan Hijau JKR
PWD	-	Public Works Department (JKR)

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Infrastructure development must be given adequate attention and planning in order to accomplish a significant impact that assists a nation to thrive economically. Infrastructure is the intertwining network of systems and facilities mobilizing a country for example; roads, bridges, tunnels, water supply, sanitation, electrical grids, and telecommunications structures. Almost all other socio-economic sectors of a nation rely heavily on this nexus of infrastructure provided (Bhattacharyay, 2009). In most countries, infrastructure is generally regulated and developed by the respective governments and sometimes with the aid of the private sector through joint initiatives, for example Private Finance Initiatives (PFI). National development policies have to be given careful thought and thorough planning so as that the objectives are met and in turn propel the nation’s economy.

The first recorded definition of sustainable development was coined in the Brundtland Report (1987) as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It would be favourable to have existing and planned infrastructure development that are harmonious in terms of economic, social and environmental considerations, in keeping with the Triple Bottom Line. It is therefore imperative that current and projected infrastructure development, especially those of roads, are deemed sustainable in light of the growing concerns towards environmental impacts that are brought about (Van Damme et al., 2016). Infrastructure facilities have been determined to be one of the leading agents that have a lasting impact on the environment, being detrimental in the majority of cases (Ihsan, 2018). The general consensus is that most infrastructure albeit existing or future, have a substantial effect towards the environment. Despite this, in depth thought and consideration has not been accorded towards the planning and implementation of such infrastructures in the sense of sustainability. There are a number of high-profile projects that have been deemed as unsustainable in certain cases, and subsequently aborted. It can be put forward that having such a lasting impact towards the state of the environment, infrastructure projects should strive to focus on sustainability.

In the past few decades, maturity towards sustainability has seen a progressive and positive advancement. Although the progress has been relatively slow, the construction industry has acknowledged and accepted the need for the incorporation of sustainable elements in the life cycle of an asset. The incorporation of sustainable elements has shown to extend the life span of such facilities. This case has been extensively proven in the construction of building projects. The acceptance and usage of such sustainable elements has always been benchmarked against traditional methods, such as over the wall and wet construction, and are required to perform better if there is to be a case towards implementation. An extended life span is usually followed by a surge in initial cost despite savings being made during the operation and maintenance phase of an asset. Shi et al. (2013) has determined that not only the initial cost of a project is likely to increase, the overall project cost will also escalate with the introduction of green technologies into a project. There are many organisations throughout the world that have successfully developed rating systems which are in line with current guidelines, regulations and statutory requirements that are able to measure sustainable elements in development.

A number of rating systems have been widely adopted in the sustainability evaluation of building projects. Despite this, the number of tools that are available for infrastructure projects are relatively low. Consequentially, the execution of infrastructure projects that can be deemed as sustainable is hampered. With regard to the profound impact infrastructure development has towards the surrounding environment, this situation is alarming. Many tools related to sustainable infrastructure development are still in the conceptual or development phase (United Nations ESCAP, 2006). The few established rating tools that are contemporary in the general infrastructure works are such as; BCA Green Mark – Singapore, CEEQUAL – UK & Ireland version / Hong Kong Version, Envision – US and Infrastructure Sustainability – Australia. The rating tools that have been solely developed to assess roads that are currently available are; Greenroads – US, GreenLITES – US INVEST - US, STARS -US and Infrastructure Sustainability – Australia (Balubaida et al., 2015).

Despite having initial costs increasing substantially with the incorporation of green technologies into a project in comparison with conventional methods, the savings that can be derived later on in terms of operation and maintenance savings will assist in the recoupment of these costs (Robichaud & Anantatmula, 2011). In most cases, governments spearhead all major infrastructure development initiatives making it essential to address the issue of sustainability at a policy making level. The approaches toward measuring sustainability has been debated exhaustively regarding what needs to be measured and what not. To achieve an acceptable level of balance between economic, social and environmental concerns, the scrutiny towards sustainability has to be done at every stage of an asset's life cycle. Therefore, it would be prudent that governments acquire reliable tools that measure and reflect eco-efficiency with a degree of accuracy (United Nations ESCAP, 2006).

Governments throughout the world prioritize economic advancement through development, but it can be seen that most nations concede that sustainability has to be afforded due consideration through concentrated efforts on ensuring that policy development takes into account measures that are required for safeguarding the environment. Green Growth is one of the often-heard terms being applied when it comes to sustainable development. This concept needs to be assimilated into any framework of infrastructure development at all stages of an asset's life cycle (United Nations ESCAP. 2006). In Malaysia, the governance and execution of road infrastructure is under the responsibilities of the Ministry of Public Works. The Public Works Department (JKR) which is under the purview of the aforementioned Ministry, is tasked to carry out this responsibility. In 2015, the JKR Strategic Framework 2016-2020 was drawn up as a continuum from the previous framework. The fourth theme that has been outlined is Leading Sustainability, which acknowledges the government's commitment towards implementing sustainable infrastructure development (JKR Strategic Plan, 2016).

In line with the fourth theme in the Strategic Plan to lead sustainability, JKR has in turn established the JKR Sustainable Development Policy 2016-2020. Through this policy, ten working committees in charge of ten key areas have been set up that are chaired by the respective Directors in JKR. Under the oversight of the Road Engineering Branch (Cawangan Jalan), the Committee for Green Roads has produced Penarafan Hijau JKR Sektor Jalan (pH JKR) to monitor and assess the sustainability of road projects.

1.2 Problem Statement

Currently, despite the numerous rating tools on sustainability that can be found, the only rating tool for open access roads in Malaysia is pH JKR. MyGHI evaluates the sustainability of highways where the operations are only within the demarcated highway boundaries and usage is charged (tolled). Meanwhile non-tolled roads are considered as open access systems where there is no physical delineation of road boundaries. The road alignment can therefore be accessed at any time at any given point by humans and animals without any restrictions. The various attributes in relation to the local communities and environment that take place along these alignments can bring certain changes that will not occur within a closed access system.

The development of pH JKR in 2012 was based on the Greenroads-US platform. With this being said, it would therefore be prudent to study the elements and criteria contained within pH JKR to further enhance the suitability towards the local environment. The need arises due to the fact that the local road conditions in Malaysia differ widely in contrast to those of the United States, thus there is a necessity in ascertaining the viability of pH JKR (Mirzaei, et al., 2015). In addition to this, having a rating tool that is based on the local climate, geography and social environment, may increase the acceptance of the system not only in Malaysia but also throughout Asia. Such acceptance will further strengthen the implementation of sustainable elements being taken into account for road projects, simultaneously encouraging Green Growth. In summation, pH JKR is a possible rating tool in evaluating various factors related to physical engineering design, function, safety, environmental, economic and social considerations. However, certain modifications are expected to be carried out in order to match road infrastructure characteristics and the local surroundings.

One of the major drawbacks in pH JKR is that the implementation is based on two main prerequisites. Firstly, that the project is the construction of Federal Roads. Secondly, the project value has to be in excess of RM 50 Million. The statistics obtained show that currently Federal Roads (excluding highways) only amount for 8.4% of all roads in Malaysia (Statistik Jalan, 2018). Where else, in terms of paved road length, federal roads only constitute 19,950.611km while state roads consist of 159,566.979km and highways with 2,000.88km. Drawing from this, most likely a majority of roads were considered incompatible with the specified project prerequisite for assessment. The repercussion of this situation would be that most roads were not subjected to this assessment and further restricting the sustainability evaluation of all road hierarchies in Malaysia.

In the 2012 following the launch, the application of the pH JKR rating tool was not very widespread because of the requirements towards project characteristics and some of the allocated assessment criteria. Furthermore, pH JKR is only applicable in the planning, design and construction phase with no assessments being conducted in the succeeding life cycle phases. The road networks constructed pre-2012 have not been assessed in any manner with regards to sustainability. This study may shed light on what sustainable elements have been employed previously and would also give information on developing a tool for road projects that do not require the prerequisites imposed.

1.3 Aim & Study Objectives

The study is aimed at determining the pH JKR criteria that are relevant for operational non-tolled roads in further developing sustainability rating tools.

The study strived in attaining the following objectives:

(a) To identify pH JKR criteria that match with other sustainability rating tools criteria.

(b) To identify pH JKR criteria that can be traced based on current operational non-tolled roads.

(c) To establish pH JKR criteria that are applicable for operational non-tolled roads.

1.4 Scope of the Study

This study focuses on a comparison of available sustainability rating tools for operational roads and pH JKR. MyGHI, INVEST and GREENLITES were also utilised as reference guides to evaluate the applicability of sustainable criteria in pH JKR for operational roads. A sample of operational non-tolled roads was identified to collect data regarding the level of adherence to pH JKR for obtaining data on sustainability. The targeted study group was the design, construction and operation teams involved in the identified roads that were evaluated. Criteria outlined in pH JKR that are most prevalent in projects preceding the implementation was ascertained. This helped to eliminate criteria that are deemed unsuitable for operational roads. The identified criteria were then ranked through focus group discussions that comprise of experts in the field. The FGD included professionals from multi-level stakeholders of road construction and green rating in Malaysia. The scorecard outlined in pH JKR to achieve ratings is suggested to be modified by considering roads that are already constructed, which have not been appraised after the construction stage.

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