



Simulating the impacts of policy scenarios on the sustainability performance of infrastructure projects

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ABSTRACT

Sustainable development principles have been implemented in various sectors including the construction industry since it was published in the Brundtland Commission Report in 1987. In line with this development, implementation of infrastructure construction projects has been given particular attention as they have more significant impacts on the environment, society and economy. It is considered that proper development and operation of infrastructure projects such as highways can contribute significantly to the mission of sustainable development. However, there is little existing work to provide appropriate methods to assess the sustainability performance of infrastructure projects. The study described in this paper introduces a simulation model, using system dynamics principle, to evaluate the sustainability performance of highway infrastructure projects during the construction and operation stage. The study introduces the indicators which measure the sustainability performance of highway projects and identifies the dynamic factors affecting indicator performance by referring to the relevant feasibility studies of highway projects. A real highway project is presented to demonstrate the application of the simulation model in evaluating the sustainability performance of the project. The case study is used to explore the solutions for improving those poor sustainability performance areas through policy scenarios.

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1. Introduction

Sustainable development is commonly defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs [1]”. As a result, infrastructure projects have been given particular attention as they have significant impact on the economy, social aspects and the environment. It is considered that the proper development and operation of infrastructure construction projects can contribute significantly to the mission of sustainable development.

Infrastructure projects include a wide range of construction works such as power plants, highways, railways, telecommunication facilities, provision of water and sanitation, and safe disposal of wastes. Developing infrastructure projects plays an essential role in economic and social developments. It is estimated that one percent increase in infrastructure stock is associated with one percent increase in GDP [2]. Kessides [3] pointed out that infrastructure projects contribute to economic growth, both through supply and demand channels by

reducing costs of production, contributing to the diversification of the economy and providing access to the application of modern technology. Easterly and Rebelo [4] opined that investment in transportation and communication has a positive effect on economic growth. Esfahani and Ramirez [5] asserted that the contribution of infrastructure services is substantial to economic growth.

Noted, are other further studies on the significance of infrastructure provision to raise the quality of life and poverty reduction. A study by Kessides [3] suggests that infrastructure projects contribute towards raising the quality of life by creating amenities in the physical environment and by providing consumption goods (transport and communication services). Infrastructure projects are also important conditions for improving labor productivity and access to employment, and thus the capacity to earn future income and increasing consumer demands. In addition, a number of studies [6–8] pointed out the significant impact of infrastructure projects on poverty reduction through economic growth.

While infrastructure projects make significant contributions to economic and social development, they may cause undesirable consequences to the environment if they are not properly implemented. For example, power plants and vehicle emissions on roads are typical contributors to air pollution. Combustion of fossil fuels leads to greenhouse gas emissions. Overuse of water for irrigation (which accounts for about 90% of water withdrawal in most low-income countries) damages soil and severely restricts water availability for

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