

Abstract

Mohamed S Eid

Sustainable Infrastructure Development: A Holistic System Based Decision Making Framework Integrating Vulnerability Indicators and Stakeholders Objectives

Infrastructure systems enable the host communities to expand, develop, and prosper in adequate socioeconomic conditions and healthy environment. Thus, the strategies for sustainable infrastructure development should aim to increase the individual utility of the local stakeholders, while reducing the vulnerability of the built environment to perturbations. Nevertheless, the available frameworks consider the development of the infrastructure systems as isolated projects and do not simultaneously address the needs of the stakeholders the vulnerability of the built environment. The goal of this research is to provide decision makers and the research community with a novel infrastructure development framework that holistically balances between the short-term development objectives and long-term sustainability goals. This research presents an innovative decision making framework that assimilates the needs of the broad community stakeholders while decreasing the vulnerability of the built environment (i.e. social, economic, and environmental). The framework utilizes a bottom-up agent based modeling approach to account for the needs, decision actions, and learning behaviors of the different stakeholders. The framework integrates well-established vulnerability indicators into the objective functions of the associated stakeholders to guide the infrastructure development strategies. Finally, the developed framework utilizes a multi-dimensional evaluation module to balance between the needs of the stakeholders and the vulnerability of the built environment. The developed framework was implemented on the post-Katrina housing and infrastructure redevelopment projects in three Mississippi coastal counties. The proposed framework was tested against the existing conditions and null hypothesis tests. Each of the infrastructure development strategies had its positive and negative impacts on the vulnerability and/or redevelopment of the community. Through utilizing the proposed framework, a set of Pareto optimal strategies were developed that dominated the existing conditions and the null hypothesis tests. Those strategies increased the individual utility of the stakeholders, and decreased the social, economic, and environmental vulnerabilities of the host community. This novel infrastructure development decision making framework will enable the communities to identify strategies that balance between the short-term development objectives and the long-term sustainability goals. Thus, this innovative approach will ensure the prosperity of the current and future generations.