

## ABSTRACT

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**Title:** Enhancing Critical Capacity of Infrastructure Supply Chain to Improve Resilience of Associated Communities and Infrastructures to Disaster

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Failure of any type of infrastructure due to natural and/or man-made disastrous events may impact operational capacities of (inter)dependent infrastructures as infrastructures are becoming increasingly interconnected in the modern society. In other words, infrastructures are exposed to the risk caused by failures of their (inter)dependent infrastructures. Moreover, failure of these infrastructures may result in economic and social losses for the associated communities. Hence, the decision-makers need to enhance their post-disaster operational capacities with respect to not only failures of themselves but also failures of their (inter)dependent infrastructures.

Although a large number of studies on post-disaster capacity developments for infrastructure systems and associated communities have been conducted for decades, significantly less attention has been paid to (1) investigating disaster impact propagation and (inter)dependency on infrastructure networks which consist of various infrastructure types (e.g., civil, civic, social, financial, educational, environmental, and cyber), diverse stakeholders (e.g., private- or public-owned), and multiple tiers of entities, (2) incorporating impacts of upstream infrastructures' existing operational capabilities onto downstream (i.e., dependent) infrastructures' post-disaster capacity development plans, and (3) studying effective decision-making rules for post-disaster capacity development strategies by considering criticalities of its internal operational (inter)dependent processes and external (inter)dependencies with other infrastructure systems.

The main objective of this research is to enhance resilience of communities and infrastructures through strategic and systematic capacity developments by exploring a supply chain of various (inter)dependent infrastructures and addressing post-disaster capacity needs that may refer to business continuity plans corresponding to their internal and external (inter)dependencies.

To accomplish this objective, this study (1) investigated the nature of (inter)dependencies for the different types of infrastructures based on historical case studies, (2) developed a platform for infrastructure supply chain that incorporates internal and external components of various infrastructures at different tiers, (3) developed a methodology to evaluate criticalities and (inter)dependencies of these internal and external components to construct unified infrastructure supply chain, and (4) developed an integrated decision support system to select optimal capacity development strategies by conforming the decision-makers' customized risk appetite at the decision-making process. With these developed platform, methodology, and decision support system, the decision-makers of communities and infrastructures are expected to enhance their resilience to disasters.

This research, therefore, contributes to the body of knowledge and practice by (1) adding a new dimension to the concept of seven infrastructure layers by systematically analyzing criticalities and interdependencies of both upstream and downstream entities at different tiers, (2) advancing analysis methods of infrastructure (inter)dependencies by constructing an infrastructure supply chain with respect to seven-layer classifications of infrastructure systems, (3) modeling disaster impact propagations by capturing the impact flows through different types of infrastructures at different tiers, and (4) developing a unified methodology to evaluate the post-disaster capacity needs of infrastructures supply chains by flexibly and proactively reflecting the decision-makers customized risk appetites with the different levels of details during the decision-making process