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Civil Infrastructure Subjected to Changing Risks: An Adaptive Decision Framework

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Letter

Adaptive decision-making (ADM) is a systematic and efficient process of learning, enhancing understanding, and ultimately adjusting management decisions to reduce uncertainty over the course of the management timeframe. This approach has a lot of promise for dealing with the challenges that civil infrastructure facilities face over their lifetime, especially those that are exposed to changing risks caused by changes in environmental and urban settings, changing public expectations and preferences, tightening budgets, and unpredictable political circumstances. This study proposes ADM as a method for regularly reassessing risks and implementing more adaptable and flexible management actions to improve infrastructure resilience in the face of dynamic changes and evolving situations. A benchmark problem based on a test bed residential neighborhood in the envisaged ADM is illustrated [1].

Decisions aimed at guaranteeing the adequate performance and operational integrity of civil infrastructure vulnerable to natural disasters have significant consequences for the health and financial well-being of the populations they serve. To assess the effectiveness of engineering strategies – design, maintenance, and rehabilitation – in mitigating the risk to civil infrastructure over their service periods (through risk assessment) and to establish investment priorities within financial constraints, quantitative risk-informed decision methods are required (through optimization techniques). Although modern probabilistic risk assessments have enabled educated civil infrastructure management and decision-making, such evaluations are often static, focusing on understanding existing threats [2].

Civil infrastructure disaster risks, on the other hand, have been rapidly rising as a result of fast changing urban environments, rising operational and social demands, technological advancements, and other factors. In many developing countries, for example, incremental building growth plays a substantial role in increasing their seismic collapse vulnerability. Furthermore, there has been mounting evidence in recent years that global climate change may result in more frequent and more severe extreme natural hazard events, such as hurricanes, tsunamis, floods, and droughts, which cause more damage to civil infrastructure and result in increased economic and human losses. Disaster risks to civil infrastructure are not static in this context, and on going re-evaluation is essential to move toward a more resilient future [3].

Civil infrastructure design and maintenance, as well as community development, have all grown more resilient as a result of resilient development. Seismic resilience of a system/community is commonly regarded to include three measures: reduced failure probability, reduced repercussions from failures, and reduced time to recovery. Its interpretation may vary depending on its use.

This study focuses on the first two measures of resilience, which are related to disaster preparedness, by allowing decision-makers to consider the effects of dynamic conditions and evolving risks in life-cycle performance evaluation and become more flexible to those changes and shocks. Unintended consequences may occur as a result of our incomplete knowledge of dynamic conditions in hazard, exposure, and vulnerability (and the associated uncertainties) as a result of our incomplete knowledge of dynamic conditions in hazard, exposure, and vulnerability (and the associated uncertainties) [4].

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Some critical infrastructure projects, such as high-speed rail and intercity highways, may require even greater investments and private sector experience and innovation. As a result, the use of public-private partnerships (PPPs) as an alternative and integrated project delivery mechanism for infrastructure projects is becoming more common. Not just huge construction corporations, but also lenders and investors such as financial institutions and sovereign funds, are drawn to PPP infrastructure projects.

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Conflicts of Interest

The author has no known conflicts of interested associated with this paper.

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