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Framework Development for Disaster Risk Dynamics and Resilience Analytics in Complex Socio-Technical Systems

Tailin Huang¹, Hwa-Lung Yu², Efthymios Nikolopoulos³, Andreas Langousis⁴, Jin Zhu⁵, Sarah Dunn⁶, and Maeda Yasunobu⁷

¹National Cheng Kung University, Urban Planning, Tainan, Taiwan (tailinhuang@mail.ncku.edu.tw)

²Department of Bioenvironmental Systems Engineering, National Taiwan University, Taiwan

³Department of Mechanical and Civil Engineering, Florida Institute of Technology, USA

⁴Department of Civil Engineering, University of Patras, Greece

⁵Department of Civil and Environmental Engineering, University of Connecticut, USA

⁶School of Engineering, University of Newcastle, UK

⁷Graduate School of Integrated Science and Technology, Shizuoka University, Japan

In most cases, disasters are assessed at an event-level, for example, by focusing on quantitative surveys of casualties, physical damages, and qualitative root-cause analyses of individual events. The disaster risks are evaluated based on expected utility loss by calculating the probability of occurrence and potential consequences. However, we should know that disaster causes are increasingly sophisticated and usually entangle quickly with deep social and organizational problems, and their impacts are prolonged with a further complication in the nexus of societal systems. To reduce disaster risk, we propose to consider disasters as inseparable parts of the societal operation and critical resource and service circulation, deviating from the well-established concept that a disaster is simply the tragic outcome of human casualties and property damages. Therefore, we will develop a novel DR3 analysis framework to address the dynamic change patterns of risks, i.e., “risk dynamics,” as a key concept for analyzing risk in complex socio-technical systems. In this proposition, DR3 analysis should consider all components of the socio-technical systems that are susceptible to disaster-induced functional perturbations and the DR3 assessment is associated with the overall state change of the socio-technical systems and their performance controllability of the organizations. The failures of the physical systems and individual human factors in the organizations are critical for comprehensive risk analysis. To achieve the goal, we establish a multidisciplinary team to address DR3 vital issues by using the participatory system dynamics modeling approach in this project. Consortium partners will focus on unique disaster cases and test the underlying hypotheses from multiple perspectives. Stakeholders from government agencies and infrastructure service providers will be engaged through continuous and direct involvement in dialogues and activities, supporting the development of risk-dynamics based DR3 solutions.