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From Fragility to Resilience

A Systems Approach to Critical Infrastructure

Editor: Polinpapilinho F. Katina, University of South Carolina Upstate, USA

From Fragility to Resilience: A Systems Approach to Critical Infrastructure provides a comprehensive examination of the systems, networks, assets, facilities, and services essential to the functioning of modern society and the global economy. Drawing on systems theory, complexity science, and systems-of-systems thinking, the book explores how increasingly interconnected critical infrastructures can be better understood, governed, protected, and strengthened.

Today's critical infrastructures operate in environments defined by volatility, uncertainty, complexity, and ambiguity (VUCA). Energy, water, transportation, communications, healthcare, finance, manufacturing, government, food systems, defense, and emergency services face evolving natural, technological, environmental, human-made, and cyber-physical threats. Because these systems are deeply interdependent, disruption in one sector can rapidly cascade across others, amplifying consequences for public safety, economic stability, national security, and social continuity.

In this environment, resilience requires more than protecting individual assets. It demands adaptive governance, systems integration, data-informed decision-making, sustainable planning, and the capacity to anticipate, absorb, recover from, and adapt to disruption. This edited volume brings together current research on the methodologies, tools, technologies, frameworks, and strategies needed to address these challenges.

Topics include systems-of-systems engineering, complex systems governance, cyberworthiness of cyber-physical systems, adaptive systems practices, artificial intelligence and augmented analytics, additive manufacturing security, healthcare integration, sustainable supply chains, and AI-enabled food redistribution. Together, these perspectives demonstrate how systems thinking can translate into practical approaches for strengthening infrastructure across sectors.

Bridging theory, methodology, technology, and application, *From Fragility to Resilience* provides a roadmap for transforming critical infrastructure from fragmented and vulnerable systems into more resilient, adaptive, sustainable, and governable networks. It is an essential resource for researchers, engineers, infrastructure managers, policymakers, project management professionals, practitioners, and students working to strengthen the systems on which modern society depends.

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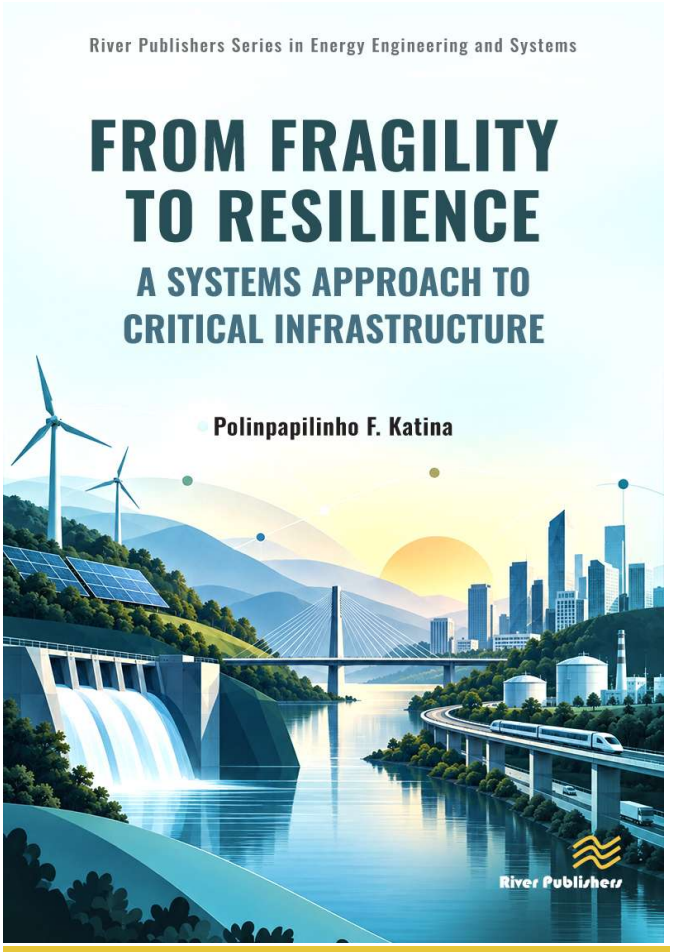

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