Chapter 9
Fostering a Sustainable and Disaster-Resilient Transportation Infrastructure

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ABSTRACT

The chapter addresses resilience engineering's role in sustainable and disaster-resistant transportation infrastructure. Integrating autonomous cars, intelligent transportation systems (ITS), and network reconfiguration methodologies improves transportation network flexibility and recovery. The technology may decrease traffic, increase safety, and improve inhabitants' commuting experiences. Integration requires stakeholder involvement, infrastructure development, and strategic planning, according to the research. Contraflow, crossing removal at junctions, optimisation models, traffic assignment problem (TAP), and gradient projection increase traffic flow, congestion, and evacuation efficiency in resilient engineering. It strengthens transportation systems' ability to adapt, respond, and recover from disturbances to protect communities and ensure infrastructure sustainability. Finally, resilience engineering reduces transportation system disruptions and makes infrastructure more adaptive, durable, and sustainable.

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INTRODUCTION

Automobiles that operate autonomously and smart cities that decrease congestion are intended to improve urban transportation and mobility by enhancing energy efficiency, resident satisfaction, and safety (Butler et al., 2020). Participation of stakeholders, infrastructure development, and strategic planning are all critical components in ensuring a successful integration process (Shareeda et al., 2021). Transportation resilience engineering focuses on methods to assist transport networks in recovering from natural disasters while constructing and maintaining infrastructure that is resilient to sustainability and disasters (Serdar et al., 2022). Disaster mitigation and evacuation require robust infrastructure, network reconfiguration, and evacuation readiness (Heaslip et al., 2009; Freckleton et al., 2012). It is imperative to comprehend the impact of infrastructure disruptions on vulnerable communities in the event of catastrophes in order to establish infrastructure resilience that prioritises human needs (Tachaudomdach et al., 2021). Critical infrastructure, social capital, nutritional security, information and communication technology, and institutional integrity are all assets that can aid in mitigating catastrophe losses (Radvanovsky et al., 2018).

This chapter aims to bridge this gap by examining the integration of autonomous vehicles and ITS technologies within the context of resilience engineering for sustainable and safe urban transportation. By exploring the strategies for network reconfiguration and their implementation challenges, this research seeks to provide insights into how transportation systems can enhance their resilience to disruptions and ensure the safety and well-being of communities during emergencies (Raadsen et al., 2020; Nipa & Kermanshachi, 2021).

The objectives of this chapter are twofold: firstly, to assess the current state of knowledge regarding the integration of autonomous vehicles and ITS technologies in urban transportation; and secondly, to investigate the strategies for network reconfiguration in resilience engineering and their potential benefits and implementation challenges.

Through this chapter, we aim to contribute to the existing body of literature by providing actionable insights for policymakers, transportation professionals, and urban planners to enhance the resilience and sustainability of transportation infrastructure in the face of evolving challenges and uncertainties.

In the subsequent sections, we reviewed the existing literature on intelligent transportation systems, autonomous vehicles, and resilience engineering. We also discussed the conceptual framework guiding this study and outline the research methodology employed. Finally, we will present the findings of our analysis and discuss their implications for theory, practice, and future research directions.