

A SYSTEMATIC REVIEW OF RESILIENCE MEASUREMENT APPROACHES FOR EVALUATING CLIMATE ADAPTATION INTERVENTIONS IN CRITICAL INFRASTRUCTURE SYSTEMS WITH A FOCUS ON APPLICABILITY TO UK RAIL

ABSTRACT The UK railway network is a complex, interdependent, and ageing critical infrastructure system that is essential to the mobility of passengers and freight across the UK and the economic stability of the nation. The railway network faces increasing strain from the effects of climate change, including rising average temperatures and more frequent and extreme weather events such as flooding, heatwaves and storms.

Network Rail's Control Period 7 delivery plan identifies £2.8 billion in expenditure to protect their most vulnerable assets against these consequences over a five-year period [1]. Given the scale of these investments, it is that essential funds are strategically allocated to maximise impact.

Resilience metrics are widely used in infrastructure systems to quantify a system's response to stressors such as climate change. However, a key limitation observed in the literature is their inability to link measured changes in resilience directly to adaptation interventions. This limits their effectiveness in supporting evidence-based decision-making and targeted investment in interventions with proven resilience benefits.

This paper presents a systematic review of approaches to measuring resilience across global critical infrastructure systems, covering multiple sectors and hazard types. It assesses the extent to which existing resilience metrics and alternative quantification methods support the attribution of resilience improvements to adaptation efforts and identifies key limitations in current measurement practices.

Insights from this review will inform the development of a UK rail-specific resilience measurement framework that enables stakeholders to target high-risk assets and optimise return on investment in climate adaptation strategies, ultimately supporting the long-term resilience of the UK railway network to climate change.

[1] Network Rail. (2024). Control Period 7: GB Delivery Plan. <https://www.networkrail.co.uk/wp-content/uploads/2024/03/Network-Rail-CP7-GB-Delivery-Plan.pdf>