

# MAPPING THE COSTS AND EXTENT OF DISRUPTION ON BRITISH RAILWAYS FOLLOWING ACUTE SHOCKS FROM INFRASTRUCTURE FAILURE

**ABSTRACT** Mature economies such as the UK possess extensive networks of ageing infrastructure, the maintenance of which presents significant asset management challenges. For example, UK railways contain over 25,000 masonry arches on bridges and viaducts. This study has investigated the impacts of unexpected railway infrastructure failures, beginning with the partial collapse of the masonry Plessey Viaduct in Autumn 2023. Lying north of Newcastle and carrying passenger and freight traffic on the East Coast Main Line, this suffered the sudden loss of a ~20m section of spandrel wall and adjacent fill, undermining one of the railway tracks and initially closing both north- and south-bound lines. While a single line was subsequently reopened, the line speed remained substantially reduced.

Spatio-temporal analysis found that 6,704 railway services from Scotland to Cornwall were disrupted over the following month with delay penalty costs calculated at ~£8.5 million, using the methodology in [1]. This compares to £2 million allocated to the viaduct for structural repairs. Ultimately, cumulative delay time totalled ~23.5 days, making this the third largest cause of delays to GB rail services in the last 10 years [2]. The first and second largest causes – flooding in Carlisle due to Storm Desmond and a freight train derailment in London – are also studied in this work. Broader analysis of the rail delay dataset in [2] indicates a Pareto-like relationship, whereby approximately 80% of total delay time is caused by 20% of events.

This paper maps the propagation of delays on GB railways for the first time, reframing these failures as system-level resilience challenges [3], and studying network recovery after acute shocks to assess resilience. Broader economic impacts of these events have also been estimated. Primary causes of delays and patterns in the data are highlighted, with consequences for maintenance prioritisation. This provides important context for transport decision-makers.