Railway Network Resilience Modelling
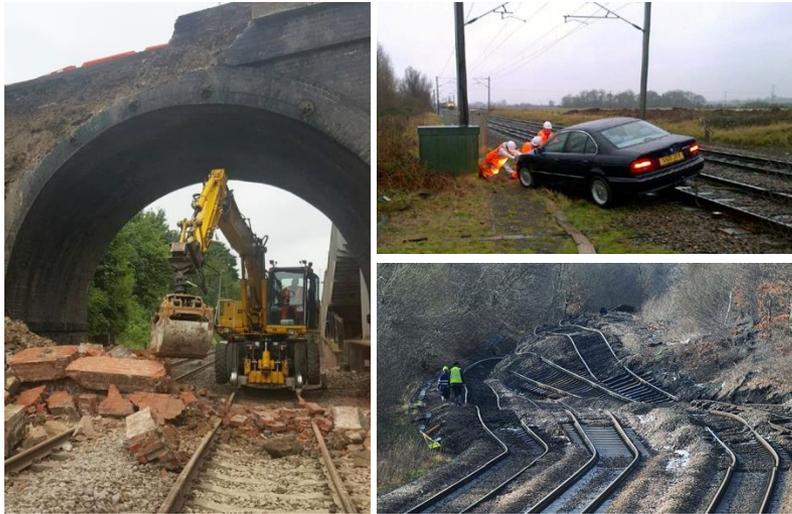
Resilience concept
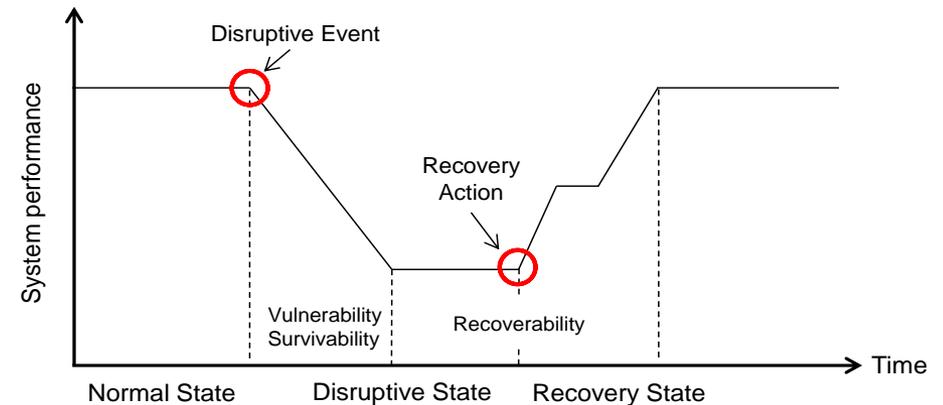
Background

Railways have been significantly impacted by many different disruptive events such as technical failures, natural disasters and man-made disasters.

Objective

(i)   To estimate system performance during a disruption.

(ii)   To identify the critical components of railway networks (e.g. block sections or railway links).

(iii)   To evaluate mitigation strategies for minimising the impacts of a disruption.

Modelling Framework

INPUT DATA

Railway Network data:
- Network Structure Data;
- Operational Data;
- Passenger Data.

Disruptive scenario data
- Types?
- Occurrence Time?
- Location?
- Magnitude (speed restrictions or blockages)?
- Duration?

Mitigation Strategy data
- Time to recover;
- Mitigation strategies such as cancellations, route shortening and bus replacement services.

KPIs ESTIMATION

Railway Network Performance Estimation Model

(Stochastic-Discrete Event Simulation)

Outputs (KPIs):
- Train-Graph;
- Train delays;
- Passenger delays;
- Train service cancellations,
- Passenger journey cancellations

RESILIENCE ANALYSES

Vulnerability Analysis
- Mitigation strategies are not required;
- Mapping a network with threats;
- Considering frequency of threats;
- Risk based criticality of network components.

Recoverability Analysis
- Require mitigation strategies;
- evaluate the efficiency of mitigation strategies;
- Optimise the best strategy to maximise the resilience of a railway network (minimise KPIs).