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Investigating how SMEs' behaviours can enhance resilience to flooding using agent-based modelling and simulation

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KEYWORDS: Flood modelling, Agent-based modelling, Small businesses.

ABSTRACT

Objectives

Recent years have seen flooding cause major disruption to UK businesses resulting in significant losses to the economy. Given Small and Medium sized Enterprises (SMEs) in the UK account for 99.9% of businesses, 60% of the working population and 47% of annual turnover, there exists a need to investigate ways in which this size of business can better prepare for, respond to and recover from flooding thus making them more resilient to these disruptive events. The objective of this research is to enable such an investigation using computer modelling and simulation of a flood event and the actions of SMEs immediately prior to, during and in the short-term aftermath of the event.

Methods

To investigate the effect of SMEs' behaviours in response to and recovery from flood events, flood modelling and simulation has been coupled with agent-based modelling and simulation (ABMS). The development of a virtual geographic environment capable of accurately representing any UK location has provided a platform for inundation prediction to be integrated with ABMS of SMEs' response to and recovery from a flood event. Inundation prediction enables all flood affected SMEs within the geographical area of interest to be identified, and the flood depth at their respective

premises and adjacent roads to be known at each simulation time step. Simultaneously, ABMS in the flood affected area allows the actions taken by SMEs to be simulated. Based on semi-structured interviews with over 100 SMEs with experience of flooding, the development of agents to model and simulate SMEs during and in the aftermath of a flood event provides a means of investigating how changes in their preparedness could lead to improved response and recovery.

Results

A case study has been undertaken of the severe 2007 flooding in Tewkesbury, Gloucestershire. This study has investigated the effect of different preparedness behaviours of manufacturing SMEs on the response to and recovery from flooding in relation to expediting the resumption of operations. Results include key performance metrics of manufacturing SMEs that provide an indication of the effectiveness of the preparedness behaviours of each business modelled. Based on the simulation results, suggestions have been made as to which behaviours may provide most benefit to manufacturing SMEs in terms of responding to and recovering from flood events.

Conclusions

Based on the case study undertaken, computer modelling and simulation has shown that physical measures taken to protect manufacturing SMEs' premises offer a greater means of minimising the disruption to business operations than social measures. However, social measures, such as mutual aid, do contribute in enabling manufacturing SMEs to maintain operations during flooding.