SUMMARY

Catastrophes, with the features of high negative impact and low frequency, are causing increasing losses to the human society due to the increasing exposure and vulnerability. Seaports are critical lifeline infrastructures in coastal cities and are at the same time vulnerable to both natural and man-made catastrophes, such as typhoon, earthquake, fire, and explosion. Any disruptions to a seaport will have a direct impact on the supply chain where the port lies and have a second order or even a third order propagation to the industrial clusters in the hinterland.

The literature review reveals research gaps of port catastrophe risk management, especially the multi-dimensional assessment of port vulnerability against catastrophes as well as propagation vulnerability assessment of hinterland industrial clusters resulting from catastrophe-induced port disruptions. Therefore, to close these gaps, this study firstly identifies the major port catastrophic hazards by literature review and document review. Based on the framework, this study assesses port vulnerability against non-repetitive catastrophes by utilizing the method of vulnerability index which integrates the fuzzy evidential reasoning (ER) and the fuzzy technique for order preference by similarity ideal solution (TOPSIS). By using Tianjin Port Explosion in 2015 as the case study, vulnerability estimates of the four port sub-systems as well as the whole port system in two assessment periods are obtained. Further, port vulnerability assessment against repetitive catastrophes is conducted by using the developed port operation simulation-based model. Relationship between catastrophe magnitude and port loss is revealed by quantifying decreased port throughput and physical damages. The typhoon hazard and the Port of Shenzhen, China is selected as the case study. Finally, the research takes a further step in considering the hinterland industrial clusters into the research scope. Propagation vulnerability of hinterland industrial clusters is evaluated by an original three-layer port-cargo-industrial cluster model. The most vulnerable industrial clusters resulting from catastrophe-induced port...
disruptions are identified. Consequently, the port and industrial clusters vulnerability estimates obtained from this study could be used by decision makers in identifying and prioritizing critical port protection targets, ship route planning, and risk mitigation strategy formulating. As for (re)insurers, the results show their usefulness in processes of catastrophe risk modelling and product pricing.