

The vulnerability of the global container shipping network to targeted link disruption

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Abstract

Using complex network theory to describe the relational geography of maritime networks has provided great insights regarding their hierarchy and evolution over the past two decades. Unlike applications in other transport fields, notably air transport, complex network theory has had limited application in studying the vulnerability of maritime networks. This study uses targeted link disruption to investigate the strategy specific vulnerability of the network. Although nodal infrastructure such as ports can render a network vulnerable as a result of labour strikes, trade embargoes or natural disasters, it is the shipping lines connecting the ports that are more probably disrupted, either from within the industry, or outside. In this paper, we apply and evaluate two link-based disruption strategies on the global container shipping network, one based on link betweenness, and the other on link salience, to emulate the impact of large-scale service reconfiguration affecting priority links. The results show that the network is by and large robust to such reconfiguration. Meanwhile the flexibility of the network is reduced by both strategies, but to a greater degree by betweenness, resulting in a reduction of transshipment and dynamic rerouting potential amongst the busiest port regions. The results further show that the salience strategy is highly effective in reducing the commonality of shortest path sets, thereby diminishing opportunities for freight consolidation and scale economies.