Artificial Intelligence for Logistics Program Conference
May 17th -18th 2023 - Ottawa

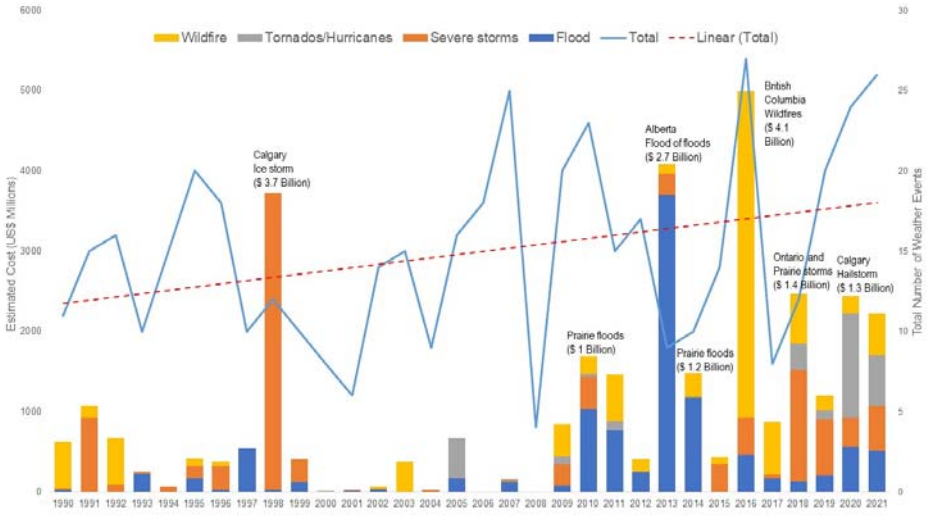
Road freight transport network resilience to extreme weather events: Concepts and open challenges

Phani Kumar Patnala, Ph.D. [a]
Jonathan D. Regehr, Ph.D., P.Eng. [*,a]
Babak Mehran, Ph.D., P.Eng. [a]
[a] University of Manitoba
Chaouki Regoui, Ph.D., P.Eng. [b]
[b] National Research Council Canada

Abstract

As road freight transportation systems (FTSs) are drivers of modern economies, operational interruptions in freight movements due to road network disruptions have received heightened attention from all levels of government. When extreme weather events such as hurricanes, flooding, or winter storms impose road network disruptions, trucking companies may choose to delay, reschedule, or reroute freight shipments. The resulting delays have considerable economic impact on road network operations (see figure). Rising demand for FTSs coupled with an increase in the frequency and intensity of weather-related disruptive events have motivated governments of all levels to shift from risk-based to resilience-based approaches for assessing system performance [1]. Resilience is a complex, multidisciplinary concept that deals with rapid response and recovery of a system experiencing a disruption [2]. Despite this motivation and extensive research, there is a need to clarify resilience concepts in the context of the multi-dimensional nature of FTSs (physical infrastructure, users, and managing organizations) and to identify persistent knowledge gaps concerning the characterization and measurement of FTS resilience vis-à-vis disruptive events. This study addresses these shortcomings through a systematic review of 122 research studies. The synthesis of findings clarifies inconsistencies associated with the characteristics of FTS resilience and in so doing, establishes a unified framework for measuring FTS resilience through the life cycle of disruptive events. By focusing on weather-related disruptions, this study posits a novel way to categorize such events and advances resilience theory by demonstrating how they may be considered using resilience triangles. Critical knowledge gaps concerning FTS resilience to long-term, climatic events remain. Addressing those gaps requires robust analytical approaches supported by comprehensive, multidisciplinary, time-series data.

* Jonathan.regehr@umanitoba.ca



Economic Impact of Extreme Weather Events in Canada, 1990-2021

Keywords: resilience; road freight transportation systems; infrastructure; users; organizations; disruptive events; extreme weather

References

[1] Ta, C., Goodchild, A. V., & Ivanov, B. (2010). Building resilience into FTS: Actions for state departments of transportation. Transportation research record, 2168(1), 129-135.

[2] Markolf, S. A., Hoehne, C., Fraser, A., Chester, M. V., & Underwood, B. S. (2019). Transportation resilience to climate change and extreme weather events–Beyond risk and robustness. Transport policy, 74, 174-186.