Cascading Failures and Recoveries within Supply Chain Systems

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The events related to the recent COVID-19 pandemic have reminded us of the foremost importance of health and safety within our communities. It has also prompted us to branch out to investigate the impact on other aspects of our societies and economies, such as the availability of goods and services; our healthcare system; ecosystems, and policy. In my research, I study these aspects through the lens of helping individuals and organizations consider uncertainty, thereby empowering decision-makers to leverage evidence, knowledge, and expert opinions when deciding on the most appropriate investments for managing risk.

In my most recent research, coauthored with Professor Aros-Vera from Ohio University, we have explored the concept of cascading of failures and recoveries within supply chain systems. We have seen this type of cascading activity related to the recent COVID-19 pandemic. This virus has caused cascading disruptions through the manufacturing industry, healthcare, social services, supply chains, etc. I use the term “cascading” to imply that a failure in sector #1 can cause failures in related sector #2. In some instances, the failures can be cyclical, such that the failure in sector #2 can cause additional failures in sector #1, and so forth. We have found that in some cases, recoveries can also cascade in a similar way. Active risk-based investment in key features of a sector can support efficient recovery and also cascade into effective recoveries of related sectors. Using this notion, we explore how to leverage or model these cascading recoveries to help decision-makers coordinate among sectors to create a robust and resilient supply chain system.

An example we explored used infrastructure data from Puerto Rico, which back in 2017 was impacted by Hurricane Maria. We looked at the Electricity/Power and the Communications infrastructure, recognizing that Electricity/Power is needed for Communications, and in some cases, Communications is needed for functioning Electricity/Power. We modeled various structures for connections, or interdependencies, among those networks to understand the relationship between those interdependencies and overall performance of those infrastructures combined. The broader goal is to understand what properties of designed interdependencies are most beneficial for overall recovery in both infrastructures. This helps decision-makers decide on the most appropriate investment strategies for designing interdependencies, or investing in new or reduced interdependencies within those infrastructures. This was not sponsored by any company – but instead served as a methodological study.

In related recent research, coauthored with Professor Aven from University of Stavanger, we have explored the concept of balancing performance and risk within the
context of Enterprise Risk Management. We promote frameworks that encourage organizations to actively manage risk using available data and evidence, while also being mindful of the supporting knowledge that is featured within the available evidence. Some information may be credible, such as based on relevant measurements and facts. Other types of information may not be as credible, such as those with disputed sources or minimal evidence. We also argue that uncertainty is not always bad, but instead, it can be leveraged to improve systems in the future. For example, the current disruptions to the supply chain system are creating a platform for better decisions and policies that will further protect societies in the future. Supply chains will be more agile to changing conditions; there will be more conversations about policy related to safety within healthcare facilities, logistics, manufacturing, and other sectors; and finally, there will be more attention toward the role we ourselves play in the health and safety of our communities.