THE IMPACT OF FLOOD RISKS ON SUPPLY CHAINS: A STUDY USING A DISCRETE EVENT SIMULATION AND NETWORK ANALYSIS

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ABSTRACT :

Floods negatively impact the global economy through disruptions in supply chain networks. Today's global supply chain has achieved cost savings through reduced inventories, shortened transit cycles, and streamlined production processes. Even though the supply chain is very efficient, it is still susceptible to systemic risk. Thailand, for example, was economically devastated by prolonged flooding in 2011. The Thai Central Bank estimated that the disruption to the supply chain reduced the Thai GDP growth rate by 76%; from a 4.1% increase that was expected to an actual increase of 1%. Thailand accounts for approximately 40% of the world's production of hard disk drives (HDD). Western Digital, which produces one-third of the world's HDD, lost 45% of its shipments due to a plant closure in Thailand during the flood. HDD shipments from the industry's five major manufacturers declined severely in the fourth quarter of 2011 to 123.3 million units, which was down 30% from 175.2 million units during the previous quarter. As a result, United States consumers faced an 80%-190% price increase for certain hard drive models. Other industries were also affected by the Thailand floods, including the automobile sector. Since the Japanese automakers consist of more than 90% of automobile productions in Thailand, Japanese automakers' operating profits drastically declined on the global scale. By examining the case study of Thailand and other cases related to extreme events and their concurrent risks, Haraguchi and Lall (2013), which is my preliminary work, suggests four research questions and one hypothesis using the concept of Network Analysis:

Q1: How can critical nodes and/ or links such as assembly factories or transportation hubs whose flooding would lead to significant and persistent supply chain losses be reliably identified in the supply chain network?

Q2: How can the effectiveness of bridge ties to a different supply network be established as an aid to recovery from a flood induced supply chain problem? What are the associated global material supply chain constraints and resulting impacts?

H1: If a supply chain is comprised of strong ties to one company exclusively, then immediate damages from a disaster will likely be greater. Yet, even if business partners in the same supply chain network are not directly impacted by disaster, the impacted node may receive help from them and may therefore be able to recover more quickly, with the result that damages may be mitigated.

Q3: How does the complexity of a network, including the direction of links affect the robustness and resiliency of a supply chain network to floods?

Q4: How do transportation and lifeline systems affect the performance of entire supply chains during floods?

These research questions and hypothesis are related to indices, such as locations of facilities, alternate locations of production, the diversified sources of procurement, emergent assistance from other partner companies in the same supply chain, and degree of the recovery of customers. This paper will demonstrate how a Discrete Event Simulation and a Bayesian Network is an effective methodology to analyze supply chain risks and try to build a simple model to test these hypotheses.

REFERENCE:
Haraguchi, Masahiko, and Upmanu Lall. "Flood risks and impacts: future research questions and implication to private investment decisionmaking for supply chain networks." *Background paper prepared for the global assessment report on disaster risk reduction* (2013)