U.S. Department of Homeland Security
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University research and workforce development for a safe and secure Homeland

Model Development for Bayesian Risk Assessment and Management of Supply Chains Impacted by COVID-19 and Other Converging Threats

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CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE
A Department of Homeland Security Center of Excellence

TEXAS A&M UNIVERSITY

SGL Stochastic Geomechanics Laboratory

Homeland Security Challenge

COVID-19 has generated disruptions on Supply Chains across the world with impacts reflected in shortage, or delay of supplies, accompanied by strong shifts of demand for several economic sectors. Under such a disruption, the challenge is to address the social, environmental, and economic impacts on U.S. Supply Chain infrastructure, and identify critical nodes and processes in order to protect and restore the Supply Chains for an uninterrupted flow of supplies and materials critical to Homeland Security.

Approach / Methodology

Risk = **Hazard** x **Vulnerability** x **Consequences**

R = **P[T]** x **P[C | T]** x **u(C)**

Threat | **System** | **Impact**

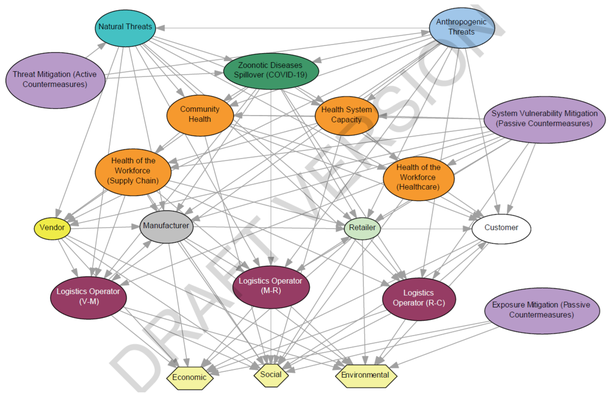
Hazard = The probability that a particular Threat T with a given intensity **P(T)** is exceeded within a given period of time.

Vulnerability = The probability of reaching a Consequence or damage in the element or system of interest, conditioned on a given Threat intensity **P(C|T)**.

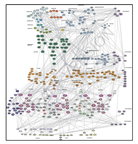
Consequences = The expected Consequence value **u(C)** of the element or system of interest exposed to a given Threat intensity.

Threats	COVID-19 and other natural, and anthropogenic converging threats
Vulnerable systems	Vulnerability or robustness of the systems subjected to the threats
Impacts	Social, environmental, and economic impacts on vulnerable systems
States of Risk	Social, environmental, and economic states of risk
Mitigating strategies	Strategies aimed at mitigating the state of risk; acting on the threat (Active), or on the systems and/or impacts (Passive)

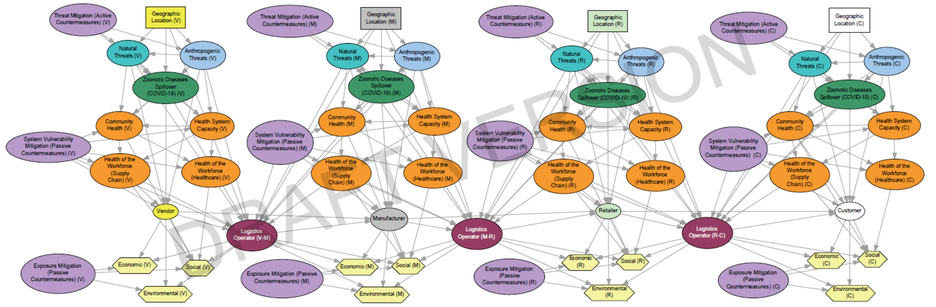
Outcomes / Results



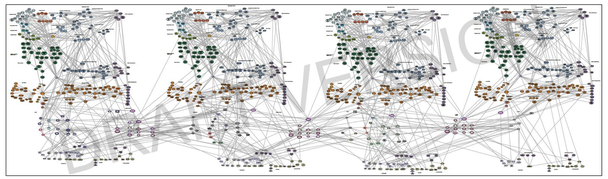
Minimum conceptual BN Model



This is how the complete model looks like, with 365 different variables/nodes.



Version of the Risk Assessment & Management model, for the case when the entities of the supply chain are located in multiple geographic regions, each one with the corresponding threat intensities.



Complete model for multiple locations. 1098 variables/nodes

Conclusions

- A Bayesian Network model for Risk Assessment & Management was developed using an innovative Risk Framework
- The model developed capture in a graphical way the cause-effect relationships between processes changing in space and time.
- The model developed will serve as a guide for evidence collection, and a subsequent qualitative Risk Assessment & Management, supporting actionable decision making for protecting U.S. Supply Chain infrastructure.
- The proposed methodology, including the risk mapping, and he formulation of mitigating strategies, can be applied to other threats impacting relevant systems to DHS.

References

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