An optimization framework for prioritizing cyber-security mitigations for securing information technology infrastructure

Challenge:

Our nation's information technology (IT) infrastructure is dependent on global supply chains. IT supply chain contains many risks that can be managed through security mitigations. Selecting security mitigations requires a systems approach for managing risk in supply chain networks.

Objective: to explore how to prioritize investments in security mitigations that enhance the security of the Federal IT supply chain and that balance cost, threat reduction, and consequence mitigation.

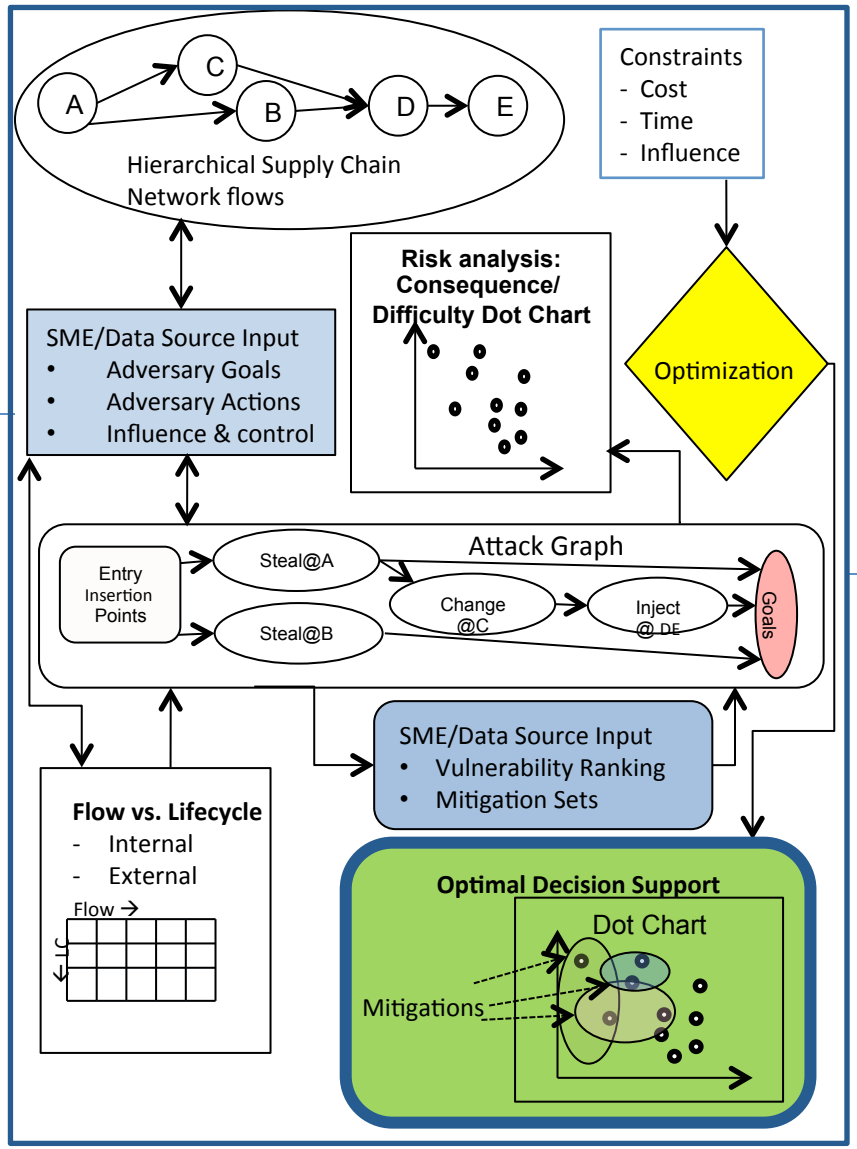
Solution:

Our research introduces and analyzes new models and algorithms:

- Introduces new optimization models for protecting IT supply chains, starting with a core mixed integer linear programming model.

- Extends models to include the impact of adaptive adversaries by formulating and solving bi-level programming.

- Explores models that are robust to data uncertainty using stochastic optimization methodologies.



Scientific Impact:

Project outcomes include:

- New covering and network interdiction models to prioritize investments in security mitigations.

- Theoretical contributions, which include an analysis of the model features, performance guarantees associated with the approximation algorithms, and new valid inequalities.

- New algorithms for solving the models.

- New insights for prioritizing and deploying security mitigations that can be used as part of a layered IT supply chain defense.

Broader Impact:

Broader impacts include:

- This project provides a set of tools that can be used by Federal decision-makers for prioritizing cost-effective security implementations.
- Collaboration with Sandia National Laboratory.
- Mentoring of graduate students and REUs.
- Educational impact includes K12 outreach, and outreach to women in STEM.

Laura Albert McLay and James R. Luedtke

NSF Award No. 1422768

University of Wisconsin-Madison
Industrial and Systems Engineering
laura@engr.wisc.edu, jim.luedtke@wisc.edu