

IOWA STATE UNIVERSITY

Department of Industrial and Manufacturing Systems Engineering

Simulating Severe Supply Chain Disruptions with Multiple Suppliers and Firms

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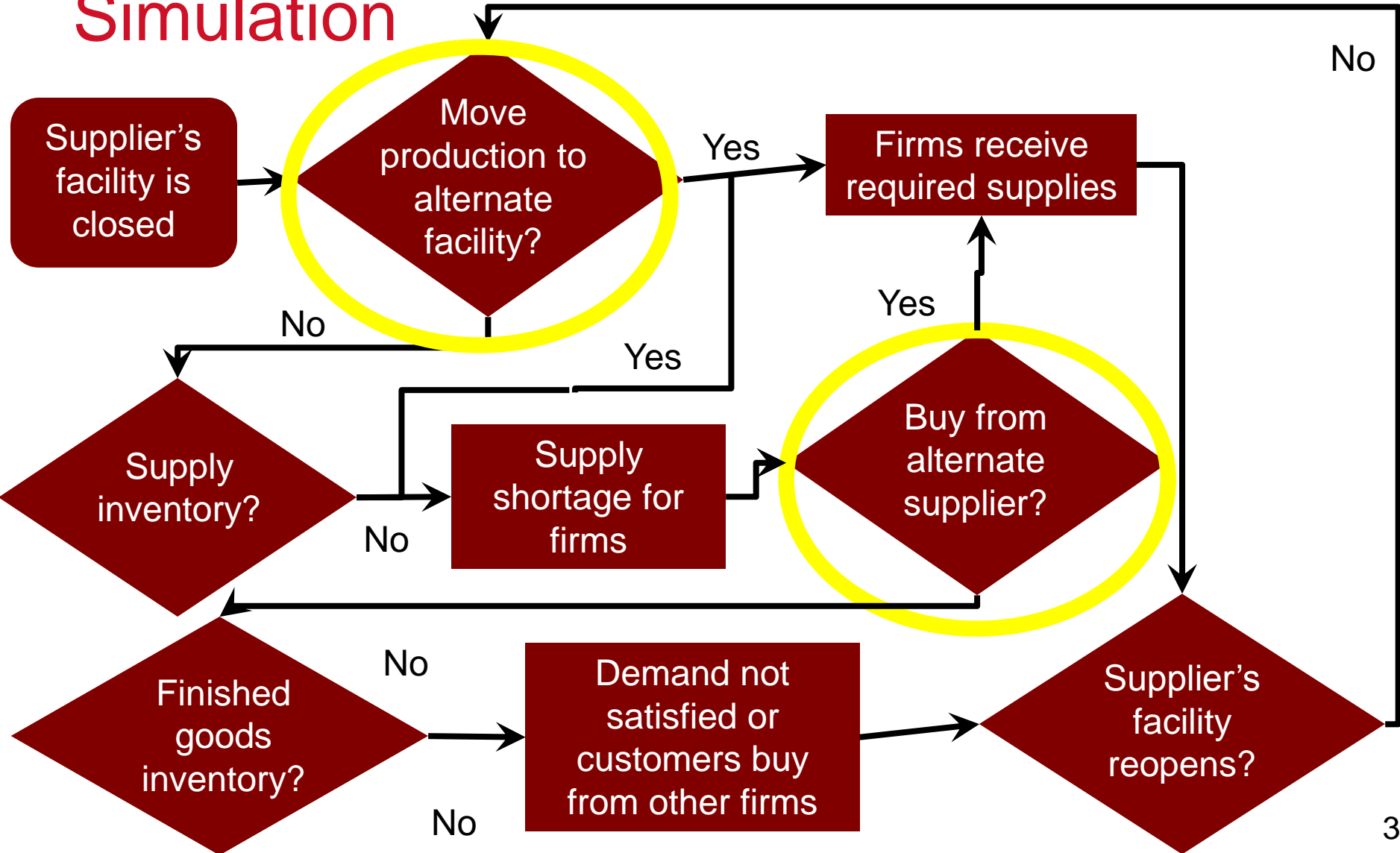
Production and Operations Management Society

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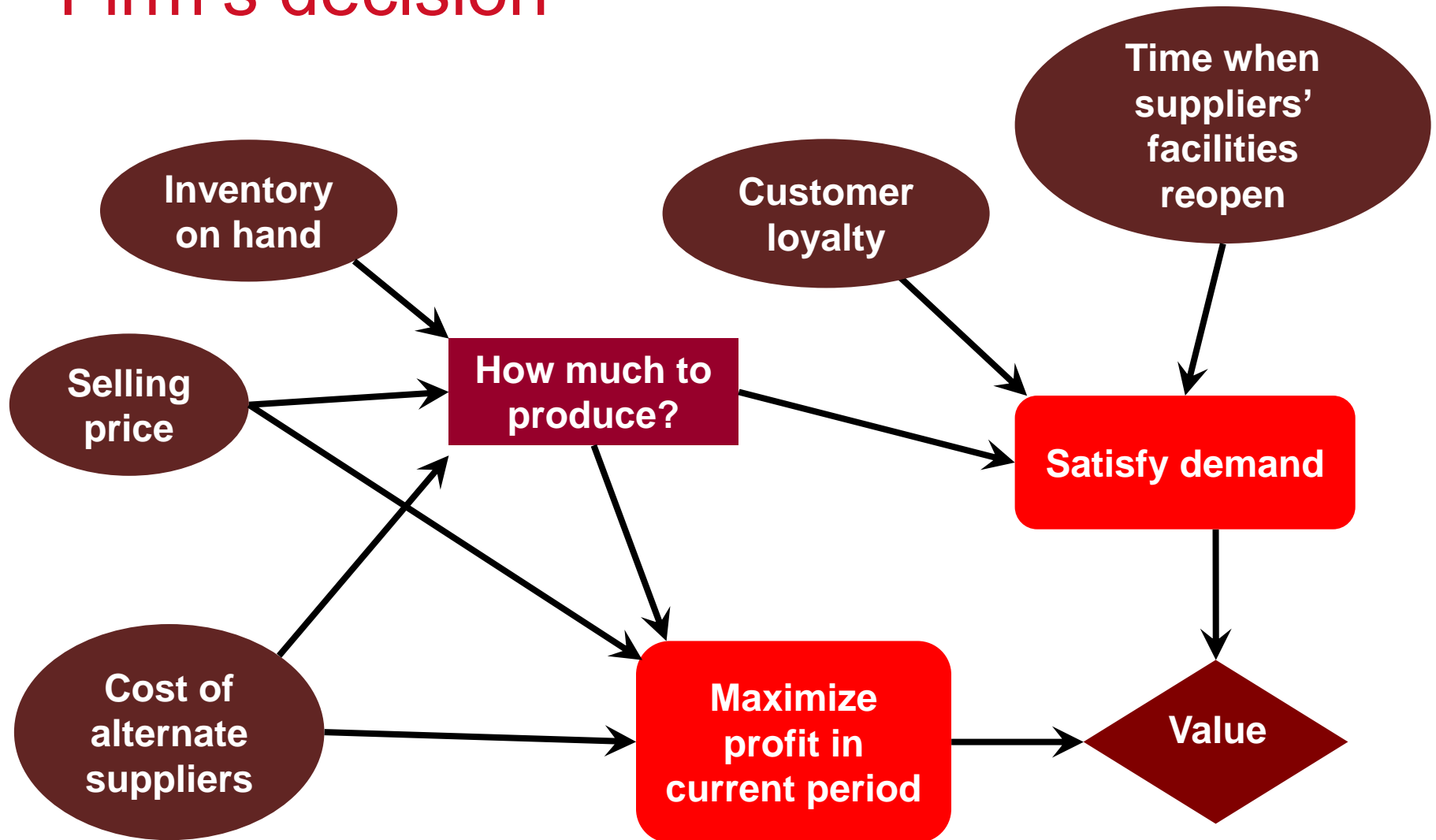
Interdependent economy



Simulation



Firm's decision



Results in automobile sector

Average percent of total demand satisfied

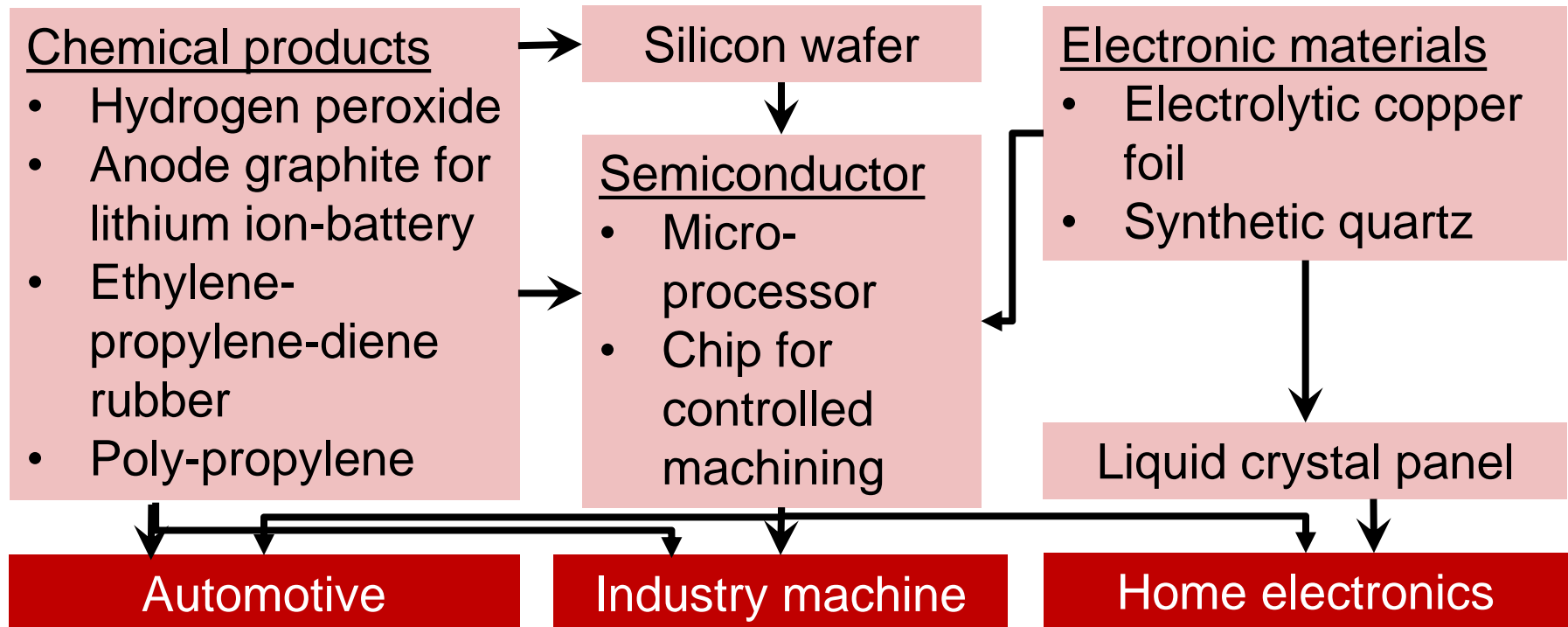
	Maximize profit and no alternate facility	Sacrifice profit to meet demand and no alternate facility	Sacrifice profit to meet demand and alternate facility
Ford, GM, and Chrysler	91.7	98.7	99.0
Toyota and Honda	68.7	86.7	93.4
Nissan	82.5	92.7	96.1

MacKenzie, C.A., Barker K., & Santos, J.R. (2014). Modeling a severe supply chain disruption and post-disaster decision making with application to the Japanese earthquake and tsunami. *IIE Transactions*, 46(12), 1243-1260.

Research extension

- Previous work had 4 suppliers and 3 firms
- Can we extend the simulation to include more firms and suppliers?
- Extend to multiple industries with multiple firms
 - Automobile
 - Electronics
 - Chemical

Previous work



Ono, K., Akakura, Y., Kanda, M., & Ishihara (2015). Analyzing and simulating supply chain disruptions to the automobile industry based on experiences of the Great East Japan Earthquake. *Journal of Integrated Disaster Risk Management*, DOI10.5595/idrm.2015.0102

Simulation extension

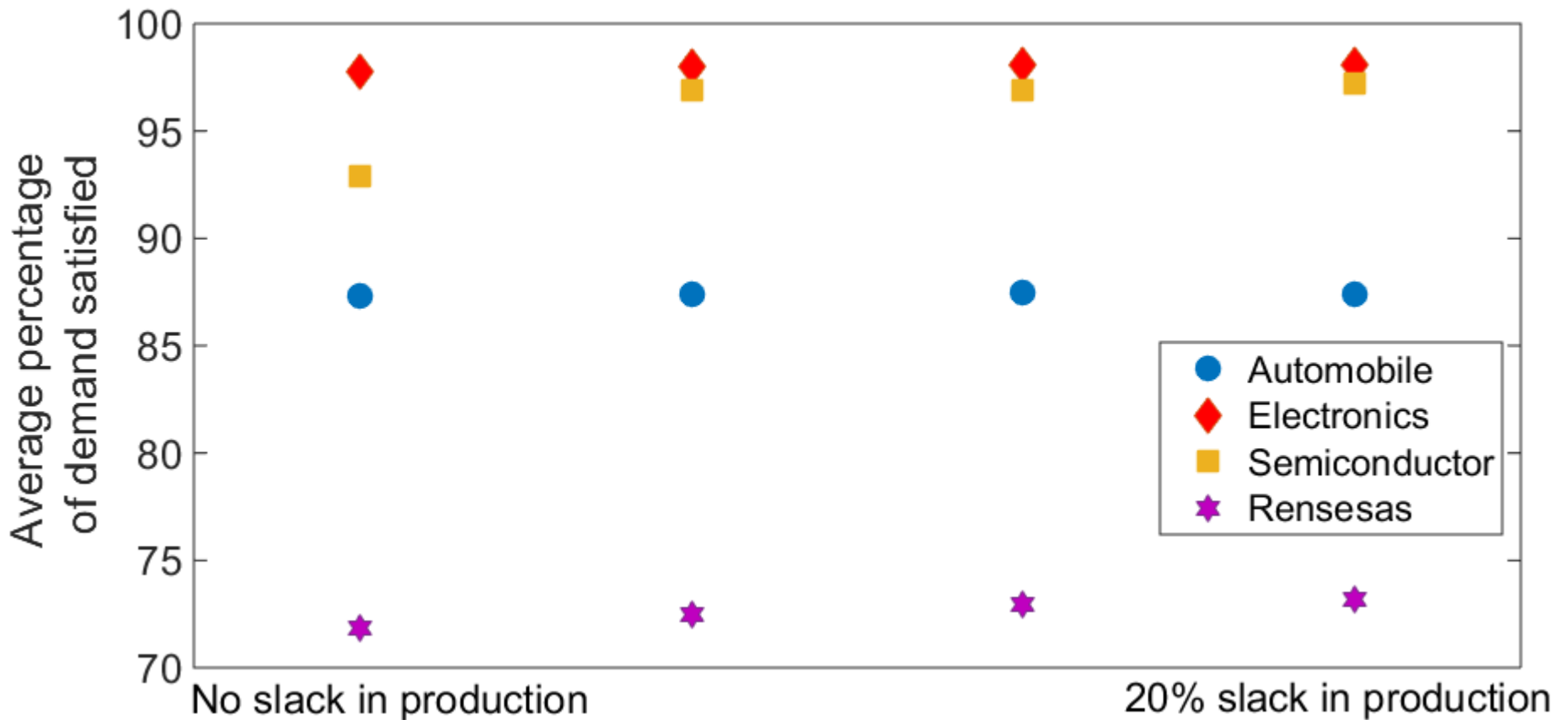
- 6 suppliers and 6 firms (Toyota, Honda, Nissan, GM, Ford, Chrysler) in automobile sector
- 5 suppliers and 6 firms (Apple, Sony, Nokia, HTC, Huawei)
- 1 semiconductor firm
- 9 suppliers in chemical industry

Preliminary results (concept demonstration)

Average percent of total demand satisfied

Industry	Maximize short-term profit and no alternate facility	Sacrifice profit to meet demand and no alternate facility	Sacrifice profit to meet demand and alternate facility
Automobile	57.9	87.2	95.7
Electronics	38.9	98.1	99.4
Chemical	100	100	100
Semiconductor	44.3	97.3	100

Chemical industry impact



Further research

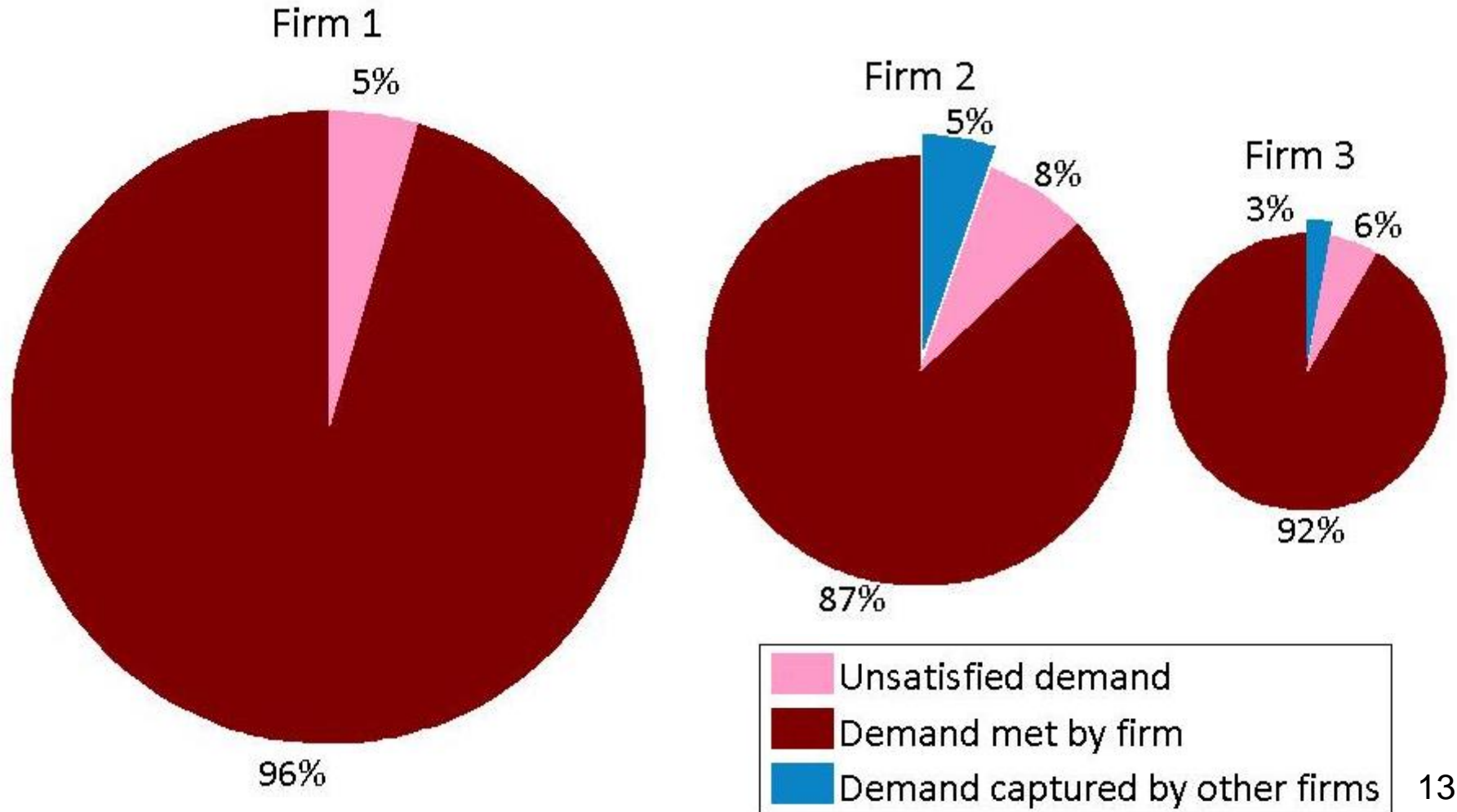
- Create more complex model of supply chain to simulate disruption after tsunami
- Find better input data
- Explore interdependencies among industries
 - How does one industry's supply chain disruption impact other industries?

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BACKUP

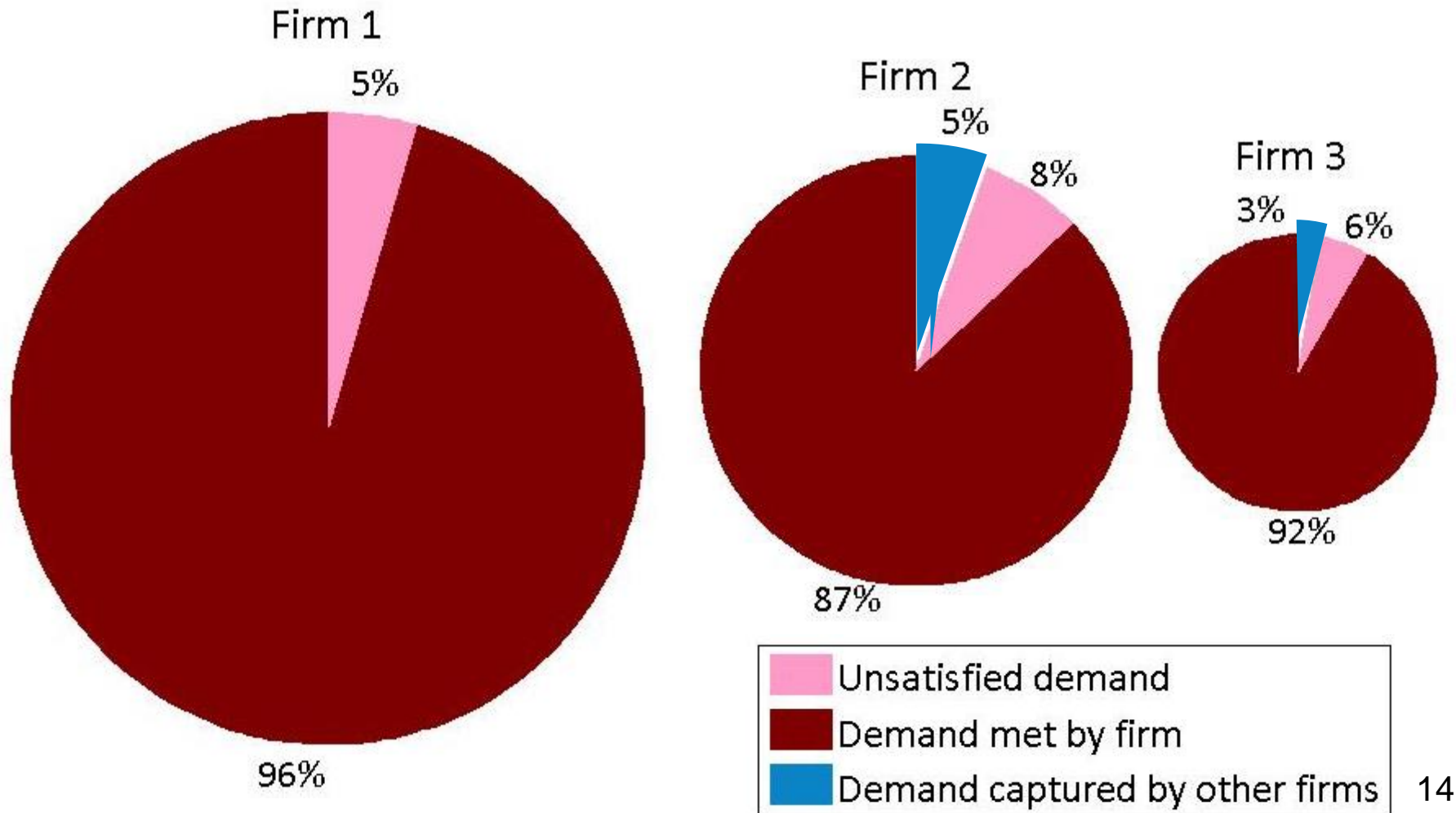
Simulation results

Average production when suppliers do not move to alternate facility



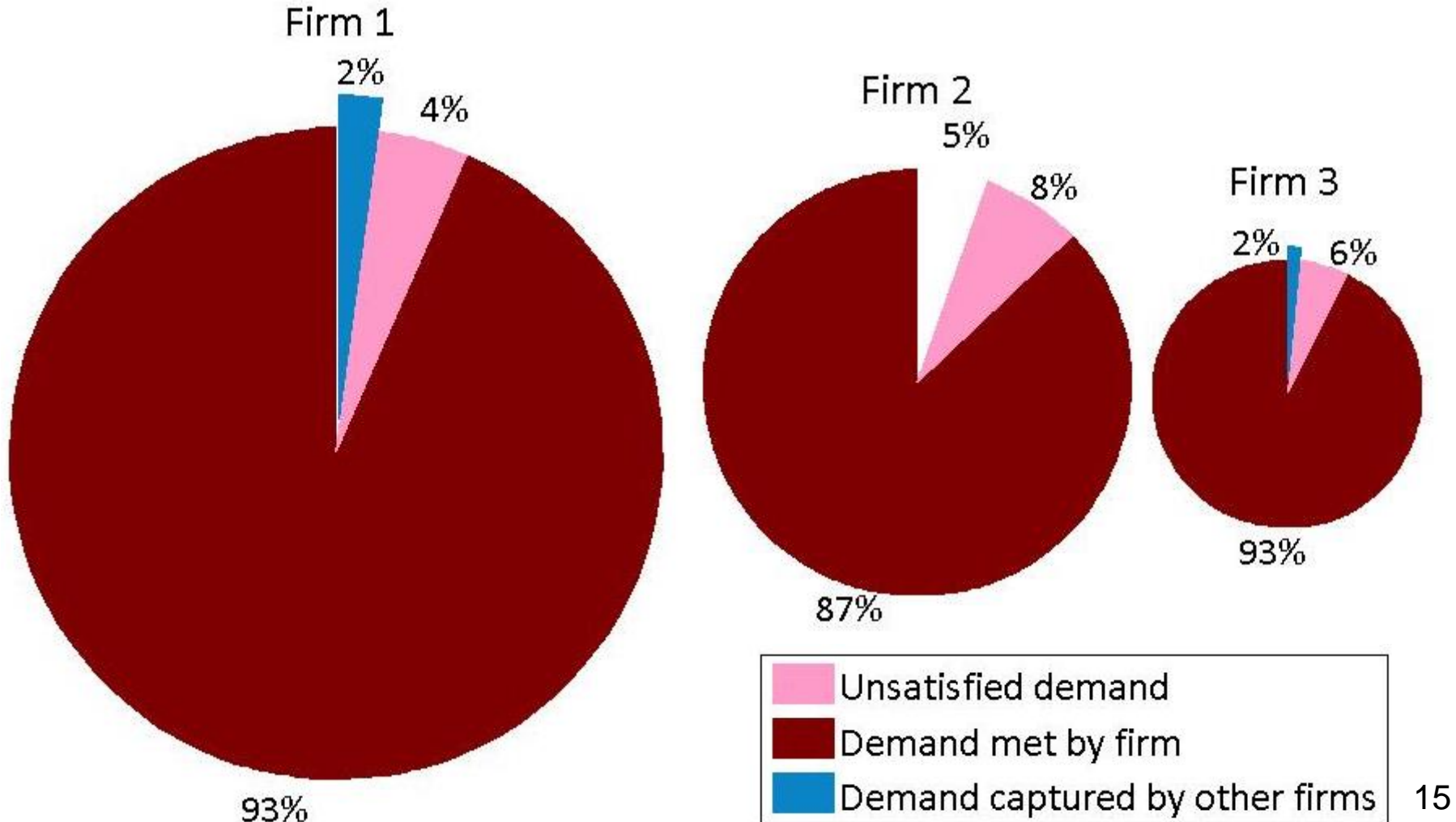
Simulation results

Average production when suppliers do not move to alternate facility



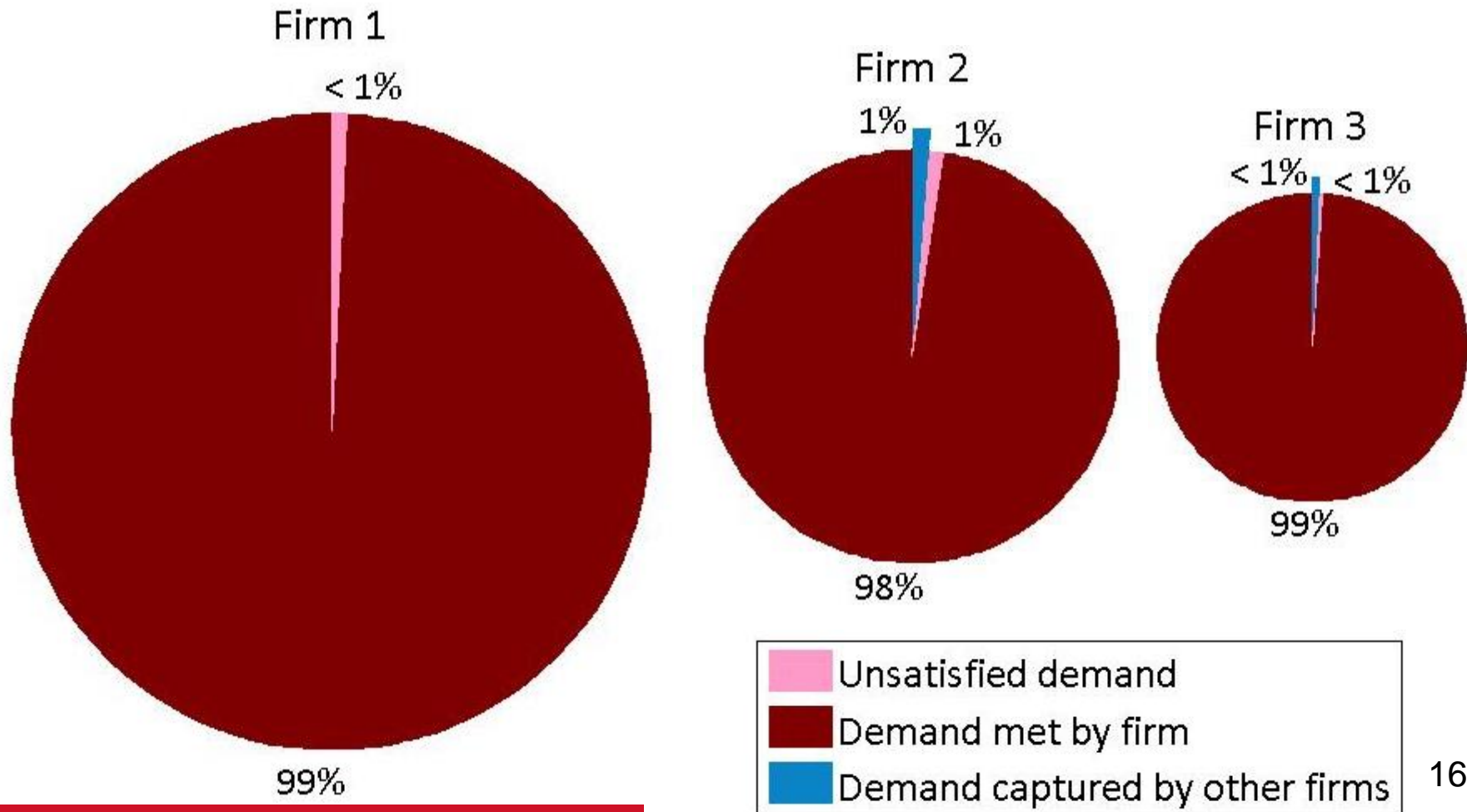
Simulation results

Average production when suppliers do not move to alternate facility



Simulation results

Average production when suppliers move to alternate facility



Supply chain risk management

- Mitigating risk of supply chain disruption vs responding to disruption
- More realistic model of company behavior
- Use of game theory for severe supply chain disruptions

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