

Supply Chain Research: Past, Present, Future, and where does the NSF fit in?



Georgia-Ann Klutke

Program Director, Operations Engineering

Division of Civil, Mechanical, and Manufacturing Innovation

National Science Foundation

Disclaimer: The views expressed are my own and not the official position of the National Science Foundation



Preliminaries: What are supply chains?

Complex *global* networks of *relationships* among entities that mediate the movement of goods from producers to consumers

Organizations - raw material suppliers, manufacturers and assemblers, warehouses, transporters, third party logistics providers, banks, governments

Flows: materials, information, financial (mix of physical and digital)

Global economic rules – supply/demand, cost competition, market exposure



Looking back over the last 20 years ...

Tremendous increase in global trade, particularly since 2001

Remarkable efficiencies in design, manufacturing, logistics, inventory management (including JIT), enabled by significant research investments in manufacturing technology, digital transformation, optimization and computational methods

Supply chains are longer, geographically dispersed, opaque; design/manufacture now often disjointed

Better data sharing on inventories with proximal suppliers

Improved resilience to isolated disruptions but vulnerable to broader disturbances and political risks

In short, we've leaned the supply chain

But The world is certainly **not flat[†]**

[†]Thomas Friedman, *The World is Flat: A Brief History of the Twenty-first Century*, Farrar, Straus and Giroux, 2005.

Beyond temporary dislocations in supply and demand, what has the pandemic exposed?



Globalized economic structure – supply chains are leaned to the point of fragility; networks are sparse, not dense, centralized and asymmetric, not decentralized and fragmented; supplier concentration leads to geopolitical vulnerabilities and potential for coercion

Trend away from government intervention in liberal democracies has been counterproductive; short-term (market dominance) vs. the long game (market ownership)

Incentive structure is misguided; need to harmonize private- and public-sector priorities

Heightened importance of critical industries (integrated circuits, batteries, critical minerals, pharma, defense-related, food)

Rise of counterfeit and illicit economy enabled by digital currency

Lack of transparency/visibility into networks has degraded decision-making



Looking forward 20 years, and how research can help....

Greater supply chain transparency and visibility to allow better long-term decision-making; fundamentally important to know who supplies what to whom (supply chain mapping); political friends and foes matter to supply chains and should affect design

View supply chains not as fixed, deterministic enterprises but as complex, adaptive networks

Recognize fragility as a cost so that supply chains can be designed to be cost-competitive, secure, resilient and sustainable (next gen supply chains)

End-to-end design and optimization of supply chains, transcending functional, siloed research

Continued digitalization and modernization of logistics operations, especially at ports of entry, global shipping

Securing supply chains from counterfeit and substandard inputs

A new paradigm for supply chain management education that integrates engineering expertise (manufacturing, logistics) with global economic and political expertise with cyber expertise



Acknowledgements and all-around good reading

Eleftherios Iakovou and Chelsea C. White III, “How to build more secure, resilient, next-gen U.S. supply chains,” Brookings Institution, published December 3, 2020 <https://www.brookings.edu/techstream/how-to-build-more-secure-resilient-next-gen-u-s-supply-chains/>

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and: <http://henryfarrell.net/wp/weaponizedinterdependence/our-writing/>