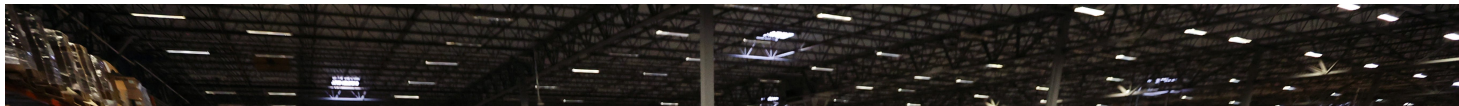

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How to build more secure, resilient, next-gen U.S. supply chains

December 3, 2020 | [Eleftherios Iakovou](#) and [Chelsea C. White III](#)





Tens of thousands of medical supply packages are sorted daily for regional and international shipping from the DHL Supply Chain facility in Southaven, Mississippi, on Monday, Oct. 5, 2020.

Beginning in the 1990s and accelerating after the inclusion of China in the World Trade Organization in 2001, many companies globalized their sourcing and production and embraced lean manufacturing techniques to reduce costs. As supply chains moved abroad, global trade jumped from 39% of global GDP to 58% between 1990 and 2019. But this move toward globalization exposed companies to a plethora of supply chain risks,

such as extreme weather events, labor disputes, cyberattacks, and supplier disruptions.

Growing awareness of these risks slowed globalization—a phenomenon sometimes called

“slowbalisation”—and between 2008 and today global trade as percentage of GDP shrunk from 61% to 58%. The COVID-19 pandemic and the economic crisis accompanying it has only accelerated these trends and revealed additional supply chain risks.

COVID-19 is not the first epidemic to disrupt supply chains—SARS, measles, swine flu, Ebola, and avian flu all resulted in business interruptions—but none of these epidemics disrupted global trade and domestic supply chains as much as COVID-19. The ongoing pandemic has highlighted structural problems in global supply chains. Chinese manufacturing of essential medical goods and equipment has revealed what some regard as a dangerous over-reliance on products critical to national health and economies. Surging customer demand for some goods (healthcare products and equipment, groceries, and household products) that often shifted geographically—moving from hotspot to hotspot—and dramatic decreases in demand for other goods (essentially everything non-healthcare) exposed the inability of supply chains to quickly shift production and logistics in response.

These stresses revealed the fragility of the modern supply chain and require a reset in the design of supply chain networks to improve resilience and agility. Companies and governments alike are realizing that efficiency at the expense of resilience cannot be the sole criterion around which supply chains are designed. Now more than ever, a new paradigm for competitive resilience is necessary in order for companies to redesign their supply chains for the long haul without reverting to their pre-pandemic practices.

Supply chain resilience

Supply chain resilience refers to the ability of a given supply chain to prepare for and adapt to unexpected events; to quickly adjust to sudden disruptive changes that negatively affect supply chain performance; to continue functioning during a disruption (sometimes referred to as “robustness”); and to recover quickly to its pre-disruption state or a more desirable state. To achieve supply chain resilience the following are important tenets:

- **Rapid detection, response, and recovery.** Supply chains need to be able to quickly detect, respond to, and recover from changed conditions.
- **End-to-end, data-driven, supply chain control.** Supply chain integration, transparency, and visibility are necessary but not sufficient conditions for enhanced resilience. Being able to view raw materials, semi-finished goods, and finished products starting from your “suppliers’ suppliers” to your “customers’ customers” is more important than ever. However, to extract value from these data requires action to be taken quickly. Preparing for a disruption before it occurs (e.g., planning, scenario planning, war gaming) is key. It may take months to determine what data to collect and how to convert these data into actions for rapid disruption detection, response, and recovery.
- **Redundancies, including emergency stockpiles, safety stocks, and diversified sourcing from offshored, nearshored, and/or reshored suppliers.** These suppliers must be able to provide additional surge capacity when there are disruptions of supply to ensure business

continuity.

- **Collaboration of private and public supply chain stakeholders.**
- **Effective demand planning processes.**

The leading multinationals have long recognized that managing supply chain risks is necessary for their sustained competitiveness. To this end, the last two decades have seen the development of supply chain risk management and risk mitigation strategies that have attracted growing interest from corporate management and boards. But this has not led to the broad adoption of supply chain risk management tools. A singular focus on operating margins and asset efficiency has resulted in sometimes brittle, lean, and offshored supply chains. Because more resilient, and hence more costly, supply chains built on high levels of redundancies can have a short-term negative effect on the bottom line, corporate boards and shareholders have often resisted them. Assuming a longer-term perspective may make investing in resilience a better value proposition, although a variety of issues, such as the financial condition of the firm, macro-economic conditions, S.E.C. reporting requirements, and investor impatience, could serve as barriers to such a perspective.

Toward a next-gen resilient supply chain

Supply chain resilience can be strengthened by increasing inventory levels of raw material, work-in-progress, and the final product; adding manufacturing and/or storage

capacity to improve manufacturing surge capability; and increasing the number and ensuring the surge capability of suppliers of key materials or work-in-progress to mitigate potential supplier disruption. Such risk-mitigation techniques are expensive; however, competitive advantage will result if a firm's supply chain resilience and agility is identical to the competition's but at a lower cost. The level of investment a company makes in coping with risk will depend on the identified risks that the company is concerned about, the awareness that some risks the company might face are unimaginable, and the company's appetite for risk.

New information and manufacturing technologies provide great potential for improving resiliency and productivity in response to real-time demand analysis. Real-time demand data can be used to determine transshipment decisions of raw materials, work-in-progress, and finished products in order to ensure inventories are kept in balance. Further, real-time decision making can rebalance relocatable production. For example, for distributed multi-facility additive manufacturing systems, 3D-printers can be relocated as demand shifts geographically, in conjunction with delaying product differentiation (postponement) for a more agile supply chain.

The result is supply chain performance that blends the advantages of *distributed* supply chain systems (having inventory and/or manufacturing capacity close to demand to enable fast fulfillment) and *centralized* supply chain systems (to enable economies of scale, inventory and risk "pooling," reduced total safety inventory, and reduced total capital expenditures). This performance is in contrast to lean supply chains that minimize

cost but may be unable to effectively respond to and recover from unexpected and disruptive events. A *dynamically resilient data-driven supply chain network* will quickly

detect, respond to, and recover from such changes by adjusting manufacturing capacity as needed. Such a supply chain will be resilient and either lean or agile, depending on need.

The role of government in supply chain resilience

Supply chain resilience has already emerged at the forefront of the United States' research and development agenda. In identifying R&D priorities for federal agencies for fiscal year 2021, the Office of Science and Technology Policy at the White House has called for the development of resilient advanced military capabilities and improved resilience of critical infrastructure and U.S. advanced manufacturing to natural and man-made disasters, including cyber-attacks and exploitation of supply chain vulnerabilities.

Following the COVID-19 pandemic, policymakers are now calling for supply chains of critical goods, especially medical supplies and high-tech products, to be reshored to the United States. But the complete reshoring of such supply chains cannot be the answer. Domestic suppliers can also be disrupted. And such a move would make U.S. businesses less competitive, putting them at a disadvantage with businesses of other (often adversarial) nations that continue to embrace globalization and support key industries with aggressive industrial policies, including subsidies and currency manipulation. The result may be reduced appeal of U.S. products in foreign markets, increased costs to U.S. consumers, reduced shareholder value for investors, and the erosion of the United States'

global innovation leadership, as complete reshoring would hinder its openness to ideas, people, and sourcing of parts and may not make the U.S. economy more resilient to

pandemic-type shocks.

The design and operation of a supply chain is highly dependent on the product. *Functional* products with long life cycles and relatively small demand variability require cost efficient supply chains that can be offshored. *Innovative* products with short life cycles and relatively high demand variability require market-responsive supply chains with nearshored or domestic sourcing and production. Products of critical importance to defense, security, health, and national competitiveness require the federal government to take a special interest in their supply chains. Today, such products include rare-earth metals, artificial intelligence, hypersonic weaponry, 5G technology, semiconductors, pharmaceuticals, synthetic biology, and specialized medical equipment.

The competitiveness, resilience, and security of these supply chains, embracing holistically R&D, planning, procurement, manufacturing, distribution, and maintenance along with the cultivation of a national manufacturing ecosystem of small to medium enterprises is key to U.S. national security. Achieving this requires an understanding of a given industry's "clock speed", which refers to the speed at which it introduces new products, processes and organizational structures; government and regulatory processes; and manufacturing operations for repair and maintenance, which are often not synchronized across these supply chains. Federal government interventions to cultivate supply chain resilience must work in tandem with a given industry's clock speed.

As it responds to the pandemic, the United States has made some moves to improve its supply chain resiliency, including provisions in the CARES Act economic relief package to

investigate U.S. medical supply chains. President-elect Joe Biden has announced a plan to rebuild U.S. supply chains that aims for broad-based resilience as opposed to pure self-sufficiency. Additionally, there have been multiple Senate hearings to examine the integrity and reliability of critical supply chains following the onset of the pandemic. There are a number of other policy interventions the U.S. government might take to promote more resilient and competitive supply chains. These interventions include:

- **Mapping supply chains that are critical to U.S. health and economic security in order to identify potential vulnerabilities and threats. Supply chain mapping provides visibility to “the suppliers’ suppliers” and can be laborious and time intensive, as it is often conducted on paper. Following the 2011 tsunami in Japan, for example, a team of 100 executives of a global semiconductor giant needed more than one year to complete this task. Embracing novel digital approaches to illuminate the relevant extended supply networks is imperative to help identify what data are important for the development of well-informed policy interventions and operations.**
- **Investing to improve national logistics infrastructure, including its “hard” (ports, roads, rail networks) and “soft” infrastructure (the service industries that underpin logistics) with a focus on improved customs performance, supply chain reliability and service quality, cybersecurity, environmental sustainability, and skills shortages. These priorities would further raise the United States’s ranking in supply chain performance, global logistics connectivity, and competitiveness. Such long overdue**

investments unfortunately were not made in the globalization-driven economic boom of the 1980s, when policymakers failed to embrace long-term thinking.

- **Ensuring that IP law, R&D incentives, education and work force training infrastructure, and societal attitudes toward diversity and inclusion support the innovation ecosystem to accelerate idea creation and the process of turning ideas into useful products, services, or processes.**
- **Establishing a “one stop shop” federal agency for harmonizing relevant regulatory interventions (e.g. relevant efforts by the General Services Administration, the Defense Logistics Agency, NIST, Department of Labor, DHS, the Federal Trade Commission, and the State Department), and the development of comprehensive national strategies for competitive, secure, and resilient U.S. manufacturing supply chains.**
- **Further investing in public-private partnerships, such as the Manufacturing USA program, supporting a continuum of research from early (basic research) to late technology readiness levels (commercialization) to facilitate the transition of innovative technologies into scalable, competitive, and high-performing domestic manufacturing capabilities.**

By contrast, China is already making significant investments to improve its supply chains, investing more than 1 trillion dollars to develop an advanced logistics network as part of

its Belt and Road Initiative (BRI). This network of road and rail routes, ports, airports, and oil and gas pipelines linking Central and West Asia, the Middle East, Europe and East Africa provides both geostrategic and economic benefits. The advanced supply chain innovations and capabilities that BRI is unleashing include:

- **New trade routes and modal choices.** The state-owned China Ocean Shipping Company (COSCO) is investing to expand capacity at the Greek port of Piraeus. With a new container terminal at Piraeus, cargo flows from China to Europe can be delivered directly from the Suez Canal to the port and then transported by truck and/or rail to European markets, avoiding lengthy maritime shipping through the Mediterranean Sea, the Strait of Gibraltar, and Northern Europe in order to reach the continent's northwestern ports (Rotterdam, Hamburg, and Antwerp).
- **Novel supply chain designs and increased cross-border trade.** While taxes and tariffs add friction to global trade, BRI works in the opposite direction, allowing developing countries that were otherwise disadvantaged to have an opportunity to embed themselves in global value chains. In East Africa, for example, Ethiopia can now play a major part in global supply chains for apparel and shoes due to BRI investments. As Ethiopia is a landlocked country without a seaport, Chinese firms have invested in a new logistics network of roads and an electrified railway line connecting Ethiopia to the nearest seaport in Djibouti. Additionally, Chinese firms have built the country's largest industrial park focused on apparel and textiles, brought know-how for Ethiopian factories to improve their sustainability footprint.

and helped attract global apparel brands to manufacture in the country.

BRI has attracted criticism for lacking transparency and accountability. It has often been used by China as a tool of “debt trap” diplomacy towards developing countries, where lending leads to the seizure of recipient countries’ strategic assets. As a result, the United States has an opportunity to fill a pressing gap in global trade and supply chain infrastructure by working with trading partners to promote a new generation of diversified, resilient, and competitive supply chains with a sophisticated portfolio of offshored, nearshored, and reshored manufacturing, an effort that would support employment, trade and national security.

Knowledge-sharing in the supply chain

In its efforts to strengthen the supply chain, the federal government could benefit by adopting best practices and state of the art strategies developed by industry and academia. Diffusion of best practices should not be limited from the private to the public sector. Commercial supply chains have much to learn from military logistics, including how to best deliver vaccines in the event of a future pandemic. Today, the old adage that the public sector has to rise up to the level of the private sector is no longer valid. As businesses are having to engage with a growing number of constituencies and to comply with demands for higher transparency, there is a confluence of policy management and business, and corporate leaders have much to learn from leaders of the public sector.

We have seen first-hand how public-private partnerships can benefit efforts to improve supply chain resilience. The new SecureAmerica Institute at Texas A&M University is one

such a partnership, made up of a network of about 100 partners across several technical domains within the manufacturing base. The program employs a novel interdisciplinary paradigm to build on policy, economics, and supply chain management research and education. By bringing together academia, industry, and government, the United States has terrific opportunities to strengthen the competitiveness, security and resilience of its supply chains to further boost its global technological, military, economic, and geopolitical strength.

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