



NATIONAL SCIENCE FOUNDATION  
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**NSF 23-080**

## Dear Colleague Letter: Next Generation Supply Chains

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April 3, 2023

Dear Colleagues:

The COVID-19 pandemic has led to major dislocations in global supply and demand, exposing vulnerabilities in almost every supply chain and bringing their importance to the functioning of civil society into sharp focus. The need for improvements to supply chains is specifically highlighted in the recent [National Strategy for Advanced Manufacturing](#) and [Executive Order on America's Supply Chains](#). With this Dear Colleague Letter (DCL), the Operations Engineering (OE), Engineering Design and Systems Engineering (EDSE), Advanced Manufacturing (AM), and Manufacturing Systems Integration (MSI) programs announce their interest in receiving research proposals seeking to significantly advance our understanding of global supply chains, especially their ability to provide industrial goods, critical healthcare and medical products, consumer products, and key services reliably and equitably under a wide variety of operating conditions, including disruptions and emerging threats. Proposals addressing research questions of interest to multiple programs are especially encouraged.

Supply chains are complex global networks of economic actors and resources that mediate the production and delivery of products, systems, and services to market, encompassing product design and development, material and component sourcing, manufacturing, and distribution. For more than fifty years, global supply chains for consumer products have focused on meeting stable demand at low cost. Remarkable efficiencies have been achieved in design, manufacturing, logistics, and inventory management (such as lean manufacturing, cross-docking, design for manufacturability/assembly, etc.), enabled by significant research investments in manufacturing technologies, digital transformation, optimization techniques, and computational methods. However, the widespread supply chain disruptions observed during the recent pandemic highlight the broader societal role of supply chains in providing essential goods and services to all segments of the population. Emerging concerns related to climate change, labor sector shocks and evolving geopolitics require new research that can enhance our understanding of these critical socioeconomic systems as they respond to these challenges. This broader view must consider the fact that supply chains consist of multiple

geographically distributed, interacting, autonomous decision units that are subject to a wide variety of strategic, tactical and operational uncertainties. At the same time, the availability, scope, and scale of new and diverse data sources (e.g., design documentation, procurement contracts, shipping bills, production schedules, lead time quotes, manufacturing data, etc.) and greatly enhanced computing capabilities provide opportunities for computational and data-driven methods that can extract relevant information and use it to enhance decision making in extant supply chains and create novel opportunities for the supply chains of the future.

Research proposals in a wide range of areas and employing diverse methods are encouraged. Projects must focus on fundamental research that advances the scientific understanding of supply chains and must be responsive to one or more of the core programs listed above. Potential topics of interest include, but are not limited to:

**Computational and data-driven methods that provide transparency and insight into the competitive behavior arising from the multilayer network structure of supply chains.**

Potential research directions include:

- What information do supply chain partners need to share for supply chains to operate reliably? To what extent can this information be synthesized from publicly available sources without requiring the explicit sharing of potentially sensitive data?
- Early warning systems that can identify supply chain fragilities and expose vulnerabilities by monitoring changes in demand, supply, technologies, or workforce availability, particularly during global disturbances such as pandemics.
- Systematic approaches to stress-testing the performance of supply chains on multiple performance dimensions, such as privacy-preserving, secure approaches that allow multiple firms to collaborate in assessing shared risks.
- How are the costs of resilience defined and estimated by different supply chain partners, and how to define and achieve a fair distribution of these costs among the participating entities?
- What is the role of standardization and regulation in ensuring effective supply chain operation for essential products?

**New physical and cyber infrastructure to support the design of products, systems, and services and the supply chains that produce and distribute them.**

Potential research directions include:

- New methods and approaches for integrating supply chain considerations throughout all stages of the product/system design, development, and manufacturing process, supporting rapid design updates, substitutable component sets and raw materials, and alternative sourcing in the face of changing conditions experienced by the supply chain.

- Design representations, data structures, and cyberinfrastructure that capture and retain designs through various stages of the design, production, and support cycle and allow reliable and sustainable communication across different entities within the supply chain.
- New methods to support the design and management of reconfigurable logistical infrastructure in the face of changing economic and geopolitical conditions.

**Methods and cyber infrastructure that will allow firms of different sizes and competencies to participate in global supply chains in an economically sustainable manner.**

Potential research directions include:

- What new technologies will allow smaller players to become integrated into the global supply chain, overcoming the high initial cost of the extensive sensing, networking and computing infrastructure required to take advantage of the data revolution?
- How can suppliers and integrators be identified and better matched, including through secure sharing of capabilities, capacities, and product data?
- What are the implications of increasing specialization in the supply chain, notably the outsourcing of manufacturing operations to specialized contract manufacturers with large economies of scale, the emergence of firms specializing in design with no manufacturing resources of their own, and specialized logistics providers?
- How can conventional high-volume supply chain concepts leverage novel one-of-a-kind manufacturing technologies (e.g., additive manufacturing) and distributed manufacturing capabilities to complement and extend their current capabilities?
- How can supply chains efficiently access and coordinate specialized, very expensive, 'few in the world' manufacturing facilities to orchestrate production at the cutting edge of technology?

This DCL constitutes neither a new competition nor a new program. Rather, interested proposers should prepare and submit proposals in accordance with the instructions for the relevant CMMI core programs ([Operations Engineering](#), [Engineering Design and Systems Engineering](#), [Advanced Manufacturing](#), and [Manufacturing Systems Integration](#)) and the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG). Additionally, to call attention to responsiveness to this DCL, the project title should start with "SupplyChainDCL:". For consideration for FY23 funding, PIs are encouraged to submit proposals by June 1, though proposals will continue to be considered beyond that date.

Sincerely,

Susan S. Margulies  
Assistant Director  
Directorate for Engineering