University of Nottingham
Institute for Policy and Engagement

# Policy Brief:

# Can supply chain mapping help prevent dangerous products from entering the market?

## Context

Consumer product safety is the responsibility of suppliers, producers and regulators. Regulators must react quickly in response to concerns raised on potentially harmful products. This requires detailed knowledge about relevant supply chain configurations to pinpoint where an ingredient, material, or component of concern has come from, which organisations have used it, and which products consumed or used by the public are affected. However, limited guidance or support is available to map globally complex supply chains to address these concerns.

The problem faced by regulators is to independently capture and map the supply chain journey of any material of concern. Current methods of tracing supply chains are limited and insufficient. Major challenges include:

- Detailed knowledge is needed on end-product structure and composition
- Different manufacturers and producers of the same end-product may use different suppliers, which may change over time
- Information about the route a material may have taken from origin to end-product is spread across loosely connected data sources, some of which may not be accessible
- Even relatively simple consumer products may have multiple ingredients, each with complex supply chains that cross numerous international borders and different territorial regulatory environments.

Collecting data first hand from producers and manufacturers to capture the journey of a material of concern from origin to end-product is both time and resource intensive. The process may not generate accurate results. There may be many information blind spots. The data collection problem is further exacerbated when suppliers are dispersed across distant territories.

Manufacturers and producers know their primary suppliers but can legitimately argue they know little about the prior origin of a specific material - i.e., their supplier's supplier and so on up the chain. Outside of highly regulated sectors, the legislative requirements to provide assurances on origin and prior processing are limited.

## Key recommendations

(1) Deploy cross-disciplinary working groups to utilise accessible secondary data sources for mapping supply network configurations

(2) Use a multi-level mapping methodology to generate actionable policy insights for globally distributed supply networks

(3) Develop effective supply chain mapping guidance to support and enable compliance with existing and emerging legislation on product safety and chemicals and materials of concern.

## The Safer Consumer Products Case Studies

The University of Nottingham (UoN) has led a research project in partnership with Queen Mary University of London (QMUL) and the California Department of Toxic Substances Control's Safer Consumer Products (SCP) Program to map supply network configurations of certain product-chemical combinations of concern to support policy decision-making on product safety.
The SCP Program studies combinations of products and chemicals and identifies those that may pose a threat to human health or the environment [1]. When SCP determines that scientific evidence warrants regulation of product-chemical combinations, it needs to identify which products are in scope and their manufacturers.

This project focused on mapping the supply chain of two product-chemical combinations that SCP evaluated or intended to evaluate: 6PPD-containing Automotive Tyres and PFAS-containing Artificial Turf. The research utilised a wide range of secondary data sources to compile comprehensive datasets that supported supply chain mapping at different levels of granularity (e.g., from high level global material flows down to specific supplier-producer relationships).
The generated data provides details about where key ingredients used in product-chemical combinations of concern are made, the key firms producing them, and the key supplier-buyer relationships in their supply networks. These datasets will help SCP better understand the global dispersion of these industries' supply chains, identify key suppliers and clusters in each industry that retain most substantial control on the ingredients used in each product, allowing better approaches for allocating scarce investigative resources and the targeting of communications.

This extensive study showed the benefits of multi-level views of supply networks for policymakers and industry, enabling the identification of the dominant actors in the supply network and their inter-relationships. The approach enabled the visualisation of problematic chemical supply chains feeding into the supply, production and distribution stages. It identified supplier locations in regions of the world with limited transparency on supply relationships and highlighted the challenges in detecting some buyer-supplier relationships accurately from accessible data sources. Various methods were used including data mining techniques for data structuring and cleansing and open-source visualisation tools for different supply chain maps. The insights derived will help SCP:

- Understand the global locations and dispersion of targeted supply chains

- Identify which supplier(s) has the most substantial control over the intentional (or unintentional) addition of a chemical of concern to the manufacturing process

- Understand scope of potential use of chemicals at early stages of a product development

For instance, we have identified more than a thousand global suppliers involved in the global supply of automotive tyres including producers of some of the chemicals of concern (e.g., zinc oxide and 6PPD) and the final tyre and vehicle producers globally and in the U.S. (Figure 1 shows the global dispersion of automotive tyre suppliers). We have also identified more than two hundred global chemical suppliers and artificial turf manufacturers with possible connections to the US market.

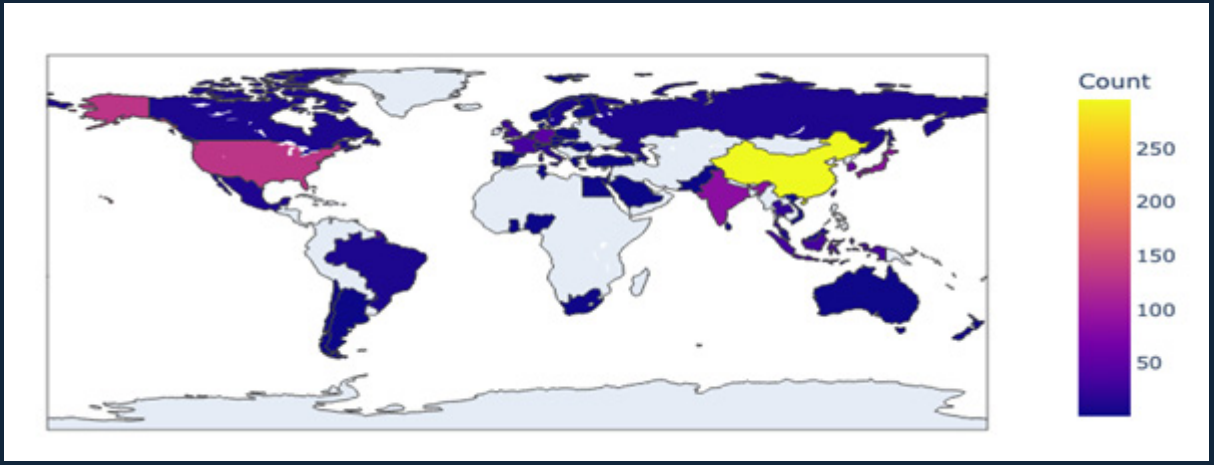


Figure 1. Automotive Tyre Supply Network Geographical Map

## Major Recommendations

We highlight the following policy recommendations for related supply chain regulators and government agencies, policy makers in industry, supply chain actors, and relevant researcher communities.

**Deploy cross-disciplinary working groups to identify and utilise relevant secondary data sources to provide the foundational knowledge necessary to map supply networks and analyse their configurations and relationships for chemicals or materials of concern.**

The project demonstrated the value of utilising appropriate publicly accessible secondary data sources for supply chain mapping studies. These sources provide the basis to identify supply chain actors and their relationships, as well as the supply regions that lack transparency, which require more intense data gathering efforts. It is imperative that the different stakeholders collaborate in accelerating the development of advanced mapping methodologies to address pressing contemporary safety, environmental and social concerns in supply chains.

Relevant government agencies should work with industry, NGOs and research institutes on building data repositories with both generic and specific sources of data that can highlight supply chain actors and their relationships. This will enhance mapping methods accuracy and validity and help advance organisational supply chain mapping capabilities

**Use a multi-level mapping approach to generate actionable policy insights for globally distributed supply networks.**

Industry and policy stakeholders interested in supply chain mapping should utilise a multi-level mapping approach. Well-conducted mapping studies enable the identification of actors with responsibilities, influence and control of supply network operations. The research demonstrated the value of the multi-level mapping hierarchy (Figure 2) previously published by the research team [2], to provide insights at different levels of detail. Specifically,

- At a macro level, mapping and visualisation enables the identificationof the global flow of a material of concern, including the source and destination countries.
- At the supply network level, the identification of key actors and their relationships for a product or sector provides critical information to determine responsibilities, control and influence.
- At the supply chain level, accurate delineation of supply systems used by a specific supply chain actor can enable targeted regulatory actions, including risk prevention and mitigation measures.

Legal responsibilities for supply network operations are informed by each level of mapping, highlighting actors for further scrutiny depending on the legislative environment in the territory under investigation.

**Develop effective supply chain mapping guidance to support and enable compliance with existing and emerging legislation on product safety and chemicals and materials of concern.**

Governments across the globe have made progress in bringing supply chain mapping research into policy decision-making, particularly when facing pandemic-related global commerce challenges. However, the global regulatory landscape requires better approaches for supply chain mapping to support organisations seeking to demonstrate compliance with supply chain regulations and enhance their supply chain resilience. Mapping is a resource-intensive exercise and requires a targeted effort following best practice guidelines.

Developing effective mapping guidance provides greater understanding of material flows across relevant supply networks, the principal actors involved, their responsibilities, and the specific supply chains used by organisations supplying products within their regulated territory. Supply chain regulators need to play the pivotal role in developing supply chain mapping guidance to support organisations in complying with current and emerging national and international supply chain regulations.

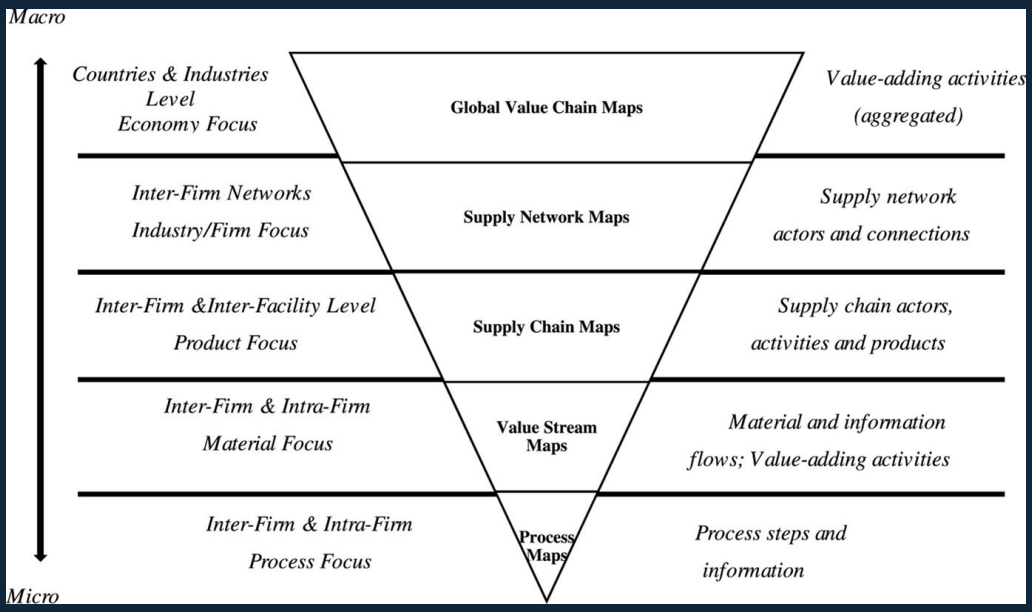


Figure 2. Hierarchy for Supply Systems Mapping, Source (MacCarthy, Ahmed and Demirel, 2022

## Further Reading

[1] California Department of Toxic Substance and Control Safer Consumer Product Program

[2] MacCarthy, B.L., Ahmed, W.A. and Demirel, G., 2022. Mapping the supply chain: Why, what and how?. International Journal of Production Economics, 250, p.108688.

[3] Ahmed, W.A. and MacCarthy, B.L., 2023. Blockchain-enabled supply chain traceability–How wide? How deep?. International Journal of Production Economics, 263, p.108963.

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## About the University of Nottingham

Ranked 18th in the UK by the QS World University Rankings 2023, the University of Nottingham is a founding member of Russell Group of research-intensive universities. With our campuses in China and Malaysia we are part of a global network of education, research and industrial engagement. The University is among the best universities in the UK for research, positioned seventh for research power in REF 2021.

The university's Institute for Policy and Engagement connects Nottingham's world-leading researchers with the public and policymakers to share insight and solve problems. We work with academic experts from across the university who want to create real impact by providing training, advice and expertise. Through these partnerships we will tackle together the most compelling challenges locally, nationally and globally.

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