



Evaluating supply chains from a resilience and cost perspective: A scoping literature review and future research directions

Presentation for 2023 EurOMA Conference

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Industrial Resilience Research Group



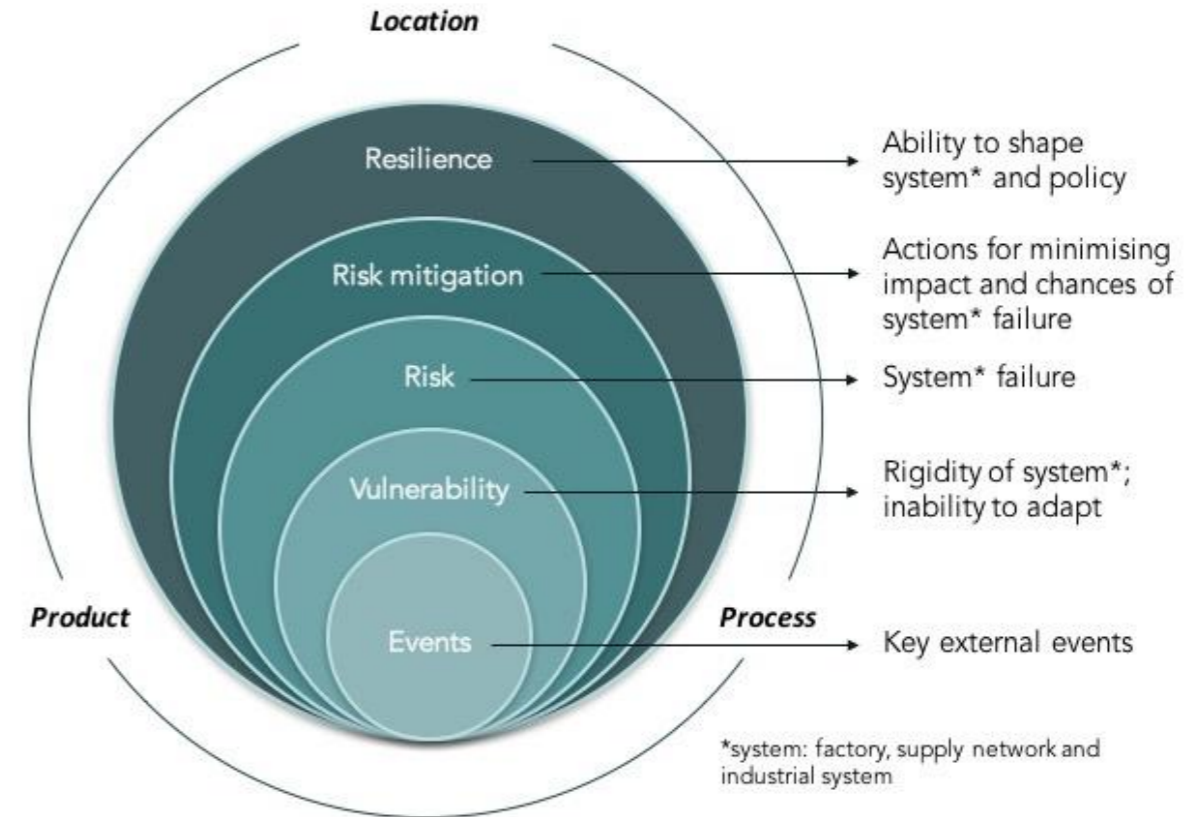
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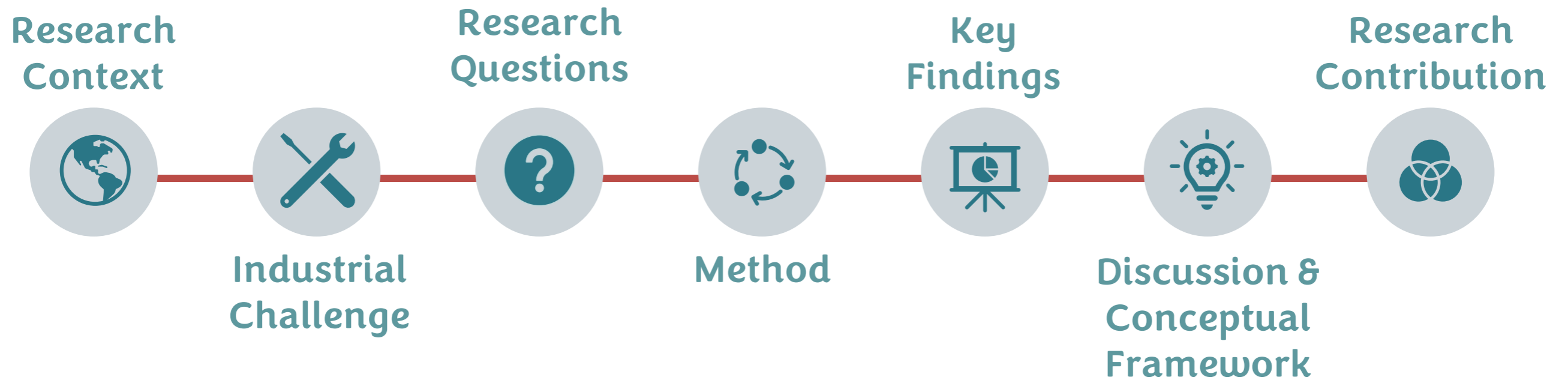
Industrial Resilience Research Group

How global manufacturing can become more resilient at the factory, supply network and industrial system levels?

- **Factory Level:** Managing risk in plant investment projects across multiple sectors, funded by EPSRC.
- **Supply Network Level:** Climate change impact on global supply chains, funded by EPSRC-GCRF and Three Guineas Trust
- **Industrial System Level:** Example project: Sustainability of UK-India industry systems, funded by UKIERI.
- **Digital Architecture for Industrial Resilience:** Building sustainability and product safety resilience in the global food system, funded by EPSRC-DTP-Nestlé.



Agenda





Context

Our Global Food System

nature

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COMMENT | 08 May 2019

Fix the broken food system in three steps

Build a global network for mapping, modelling and managing agriculture, biodiversity, trade and nutrition, argue Guido Schmidt-Traub, Michael Obersteiner and Aline Mosnier.

[Guido Schmidt-Traub](#) [Michael Obersteiner & Aline Mosnier](#)

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(Schmidt-Traub et al., 2019)

The Guardian
News website of the year

Food price rises around the world are result of 'broken' system, say experts

Surge of about 20% this year due to system that concentrates power and profits in hands of few companies



Strawberries pickers inside a polytunnel. Photograph: Andrew Fox/Alamy

Food price rises around the world are the result of a "broken" food system that is failing the poor and concentrating power and profits in the hands of a few, food experts have said.

(Harvey, 2022)



Context Opportunities

(World Economic Forum, 2018)



Nutrigenetics for personalized nutrition

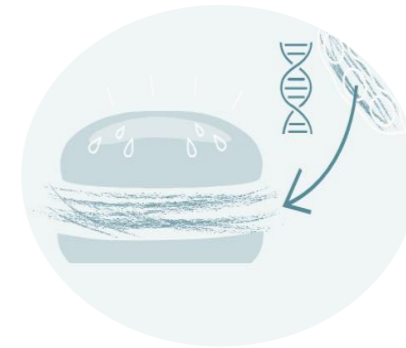


IoT for real-time supply chain traceability



Food sensing technologies

Precision agriculture for water use optimization



Alternative proteins



Mobile service delivery

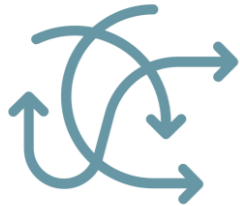


Off-grid renewable energy generation and storage



Industrial Challenge

Complex



Inefficient



Supply Chains?

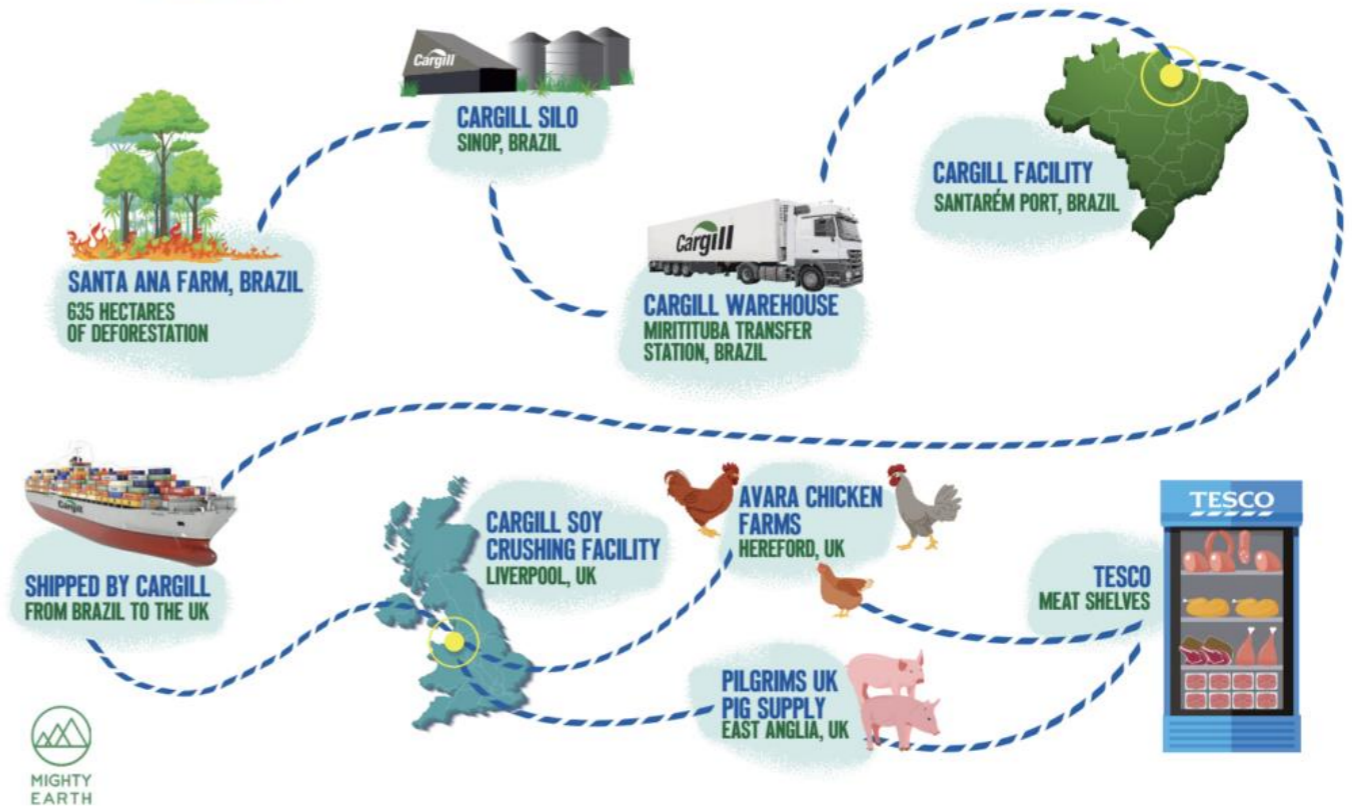
Vulnerable



Lack traceability



HOW TESCO'S SUPPLY CHAIN FUELS DEFORESTATION



The mapped journey of Tesco's soy supply risk of deforestation contamination, from the Amazon to Tesco in the UK.



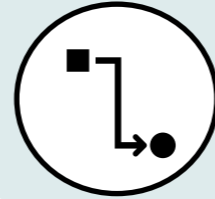
Industrial Challenge



Resilience?

Developing resilience in food supply chains is not only an operational requirement but also a social responsibility.

Companies focus on traditional **lean** initiatives



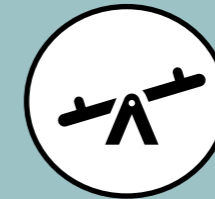
Supply chain resilience is perceived as a **'luxury'**



Companies choose to be **reactive** rather than proactive



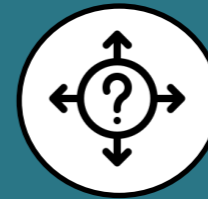
Companies consider they cannot **afford** resilience



The **relationship** between resilience and cost of resilience is not understood



It is unclear how to evaluate the **level** of supply chain resilience



(Maslarić et al., 2013)



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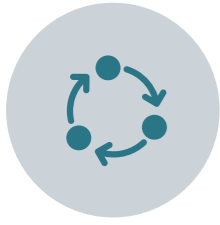
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Research Questions

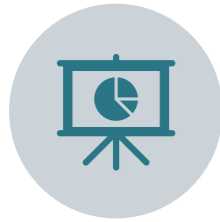
How do companies manage the trade-offs between resilience and costs in the context of food supply chains?

- A** How do companies assess their level of supply chain resilience?
- B** What cost structures are associated with developing resilience?
- C** How do companies balance supply chain resilience and cost?



Method

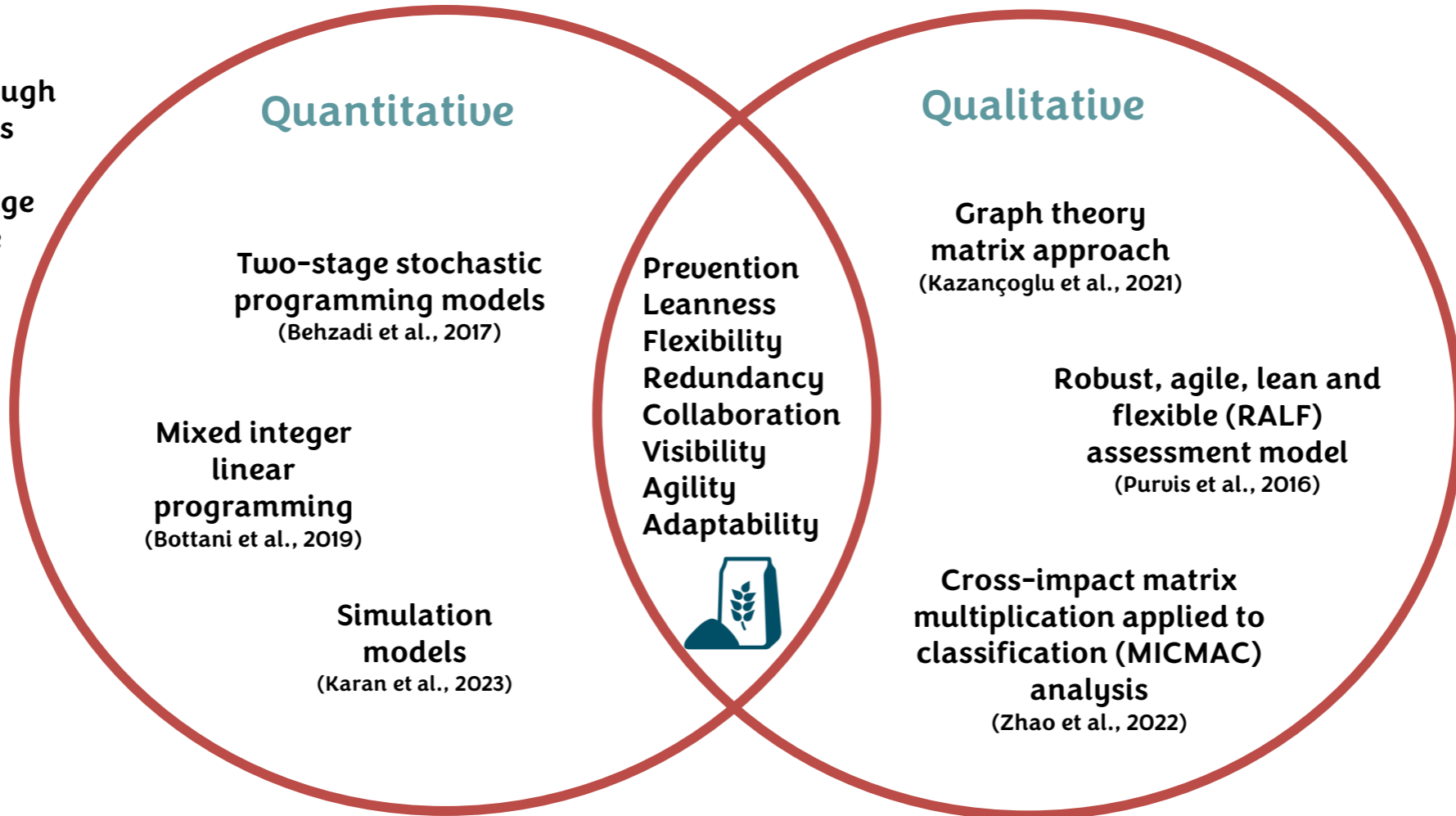
Scoping Literature Review	
Database	Web of Science
Search field	'Article Topic' category (title, abstract and keywords).
Search string	(resilience OR resilient) AND supply AND chain* AND (((food OR agri*) AND (manage* OR design* OR assess* OR evaluat*)) OR cost)
Filters	Publication time: Last 10 years Document type: Articles and Review Article in English
Screening	<ol style="list-style-type: none">1. Title screenings - to identify duplicates and select articles for further review.2. Abstract screenings - to carefully examine the content of each article and validate its eligibility (e.g., purpose, findings, and/or implications), along with their relevance to the research questions.
Selection	<ul style="list-style-type: none">• 477 articles retrieved in total• 439 articles excluded (outside of scope, duplicates, no new approaches to the problem)• 38 articles selected for final review



Key Findings

A Resilience Assessment Methods

Resilience is assessed through performance indicators, as these give industry actors verifiable metrics to manage supply chain performance



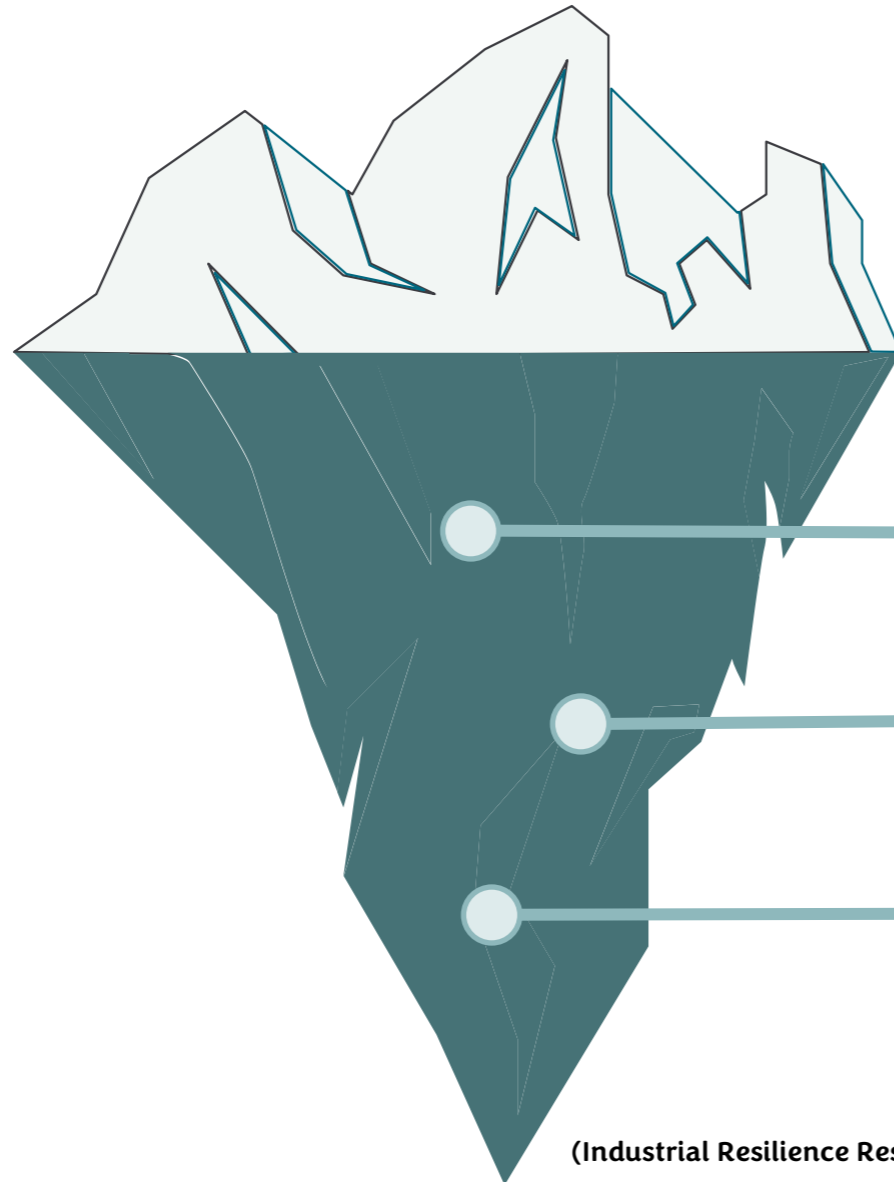
Investigate resilience capability factors and resilience framework building as a starting point to assess resilience





Key Findings

B Resilience Cost Structures



Economic → Operational Costs
Investments

Reactive → System's ability to continue providing food when a disruption occurs

Visible → Easy to identify and measure, and/or included in the purchase price of goods. (Stone and Rahimifard, 2018)

Environmental Costs

Social Costs

Hidden Economic Costs



Key Findings

C Trade-offs between Resilience and Cost

Resilience Capabilities	Authors	Economic									Social	Environment
		Operation Costs					Investments					
		Sourcing	Manufacturing	Inventory	Transport	Capital	Infrastructure	Technology	R&D	Compliance		
Prevention	Behzadi et al. (2017)	-	-	-	-	↑	↑	↑	-	↑	↓	-
Leanness	Karan et al. (2023)	↓	↓	↓	↓	↑	-	↑	↑	-	-	-
Flexibility	Aboah et al. (2018)	↑	↑	↑	↑	↑	↑	↑	-	-	↓	-
Redundancy	Behzadi et al. (2017)	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Visibility	Purvis et al. (2016)	↓	↓	↓	↓	↑	↑	↑	-	↓	↓	-
Collaboration	Purvis et al. (2016)	↓	↓	↓	↓	↑	↑	↑	↑	↓	↓	-
Agility	Do et al. (2021)	↑	↑	↑	↑	↑	↑	↑	↑	↑	-	-
Adaptability	Sá et al. (2019)	↑	-	↑	-	↑	↑	↑	↑	-	↓	↑

(Industrial Resilience Research Group., 2023)

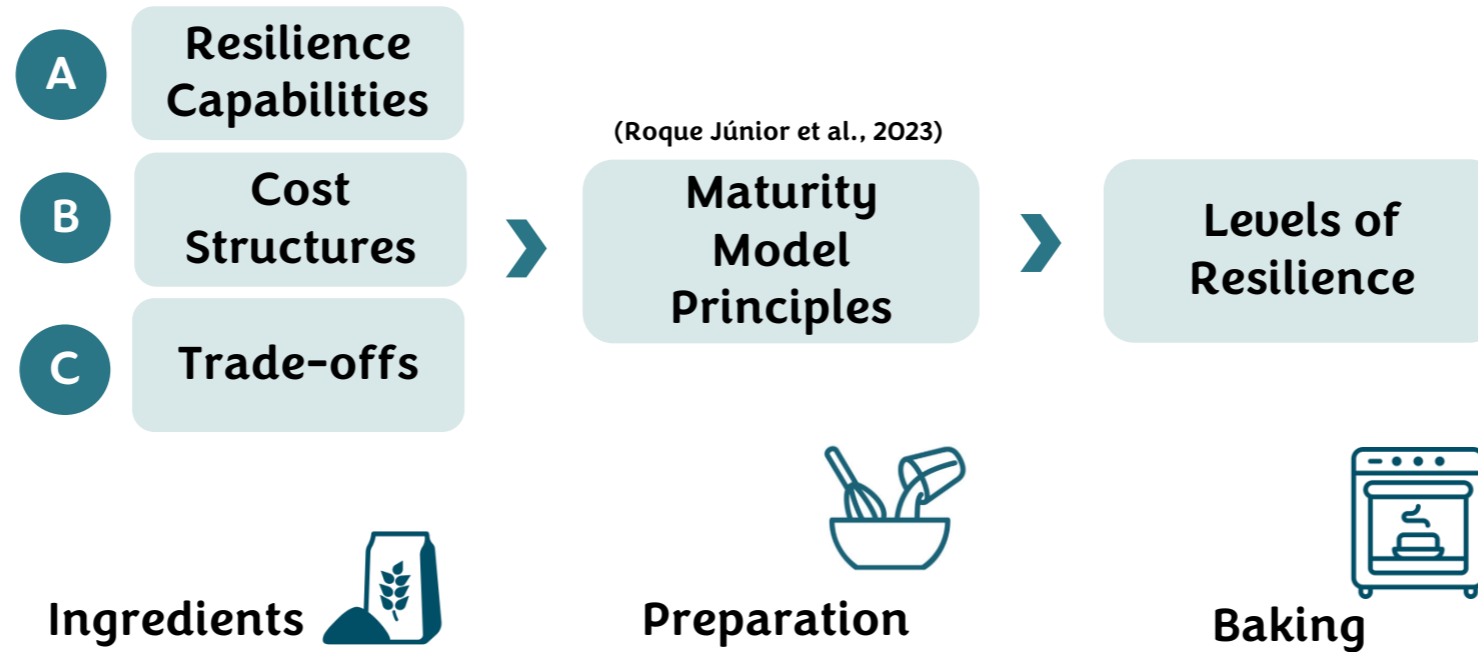




Discussion



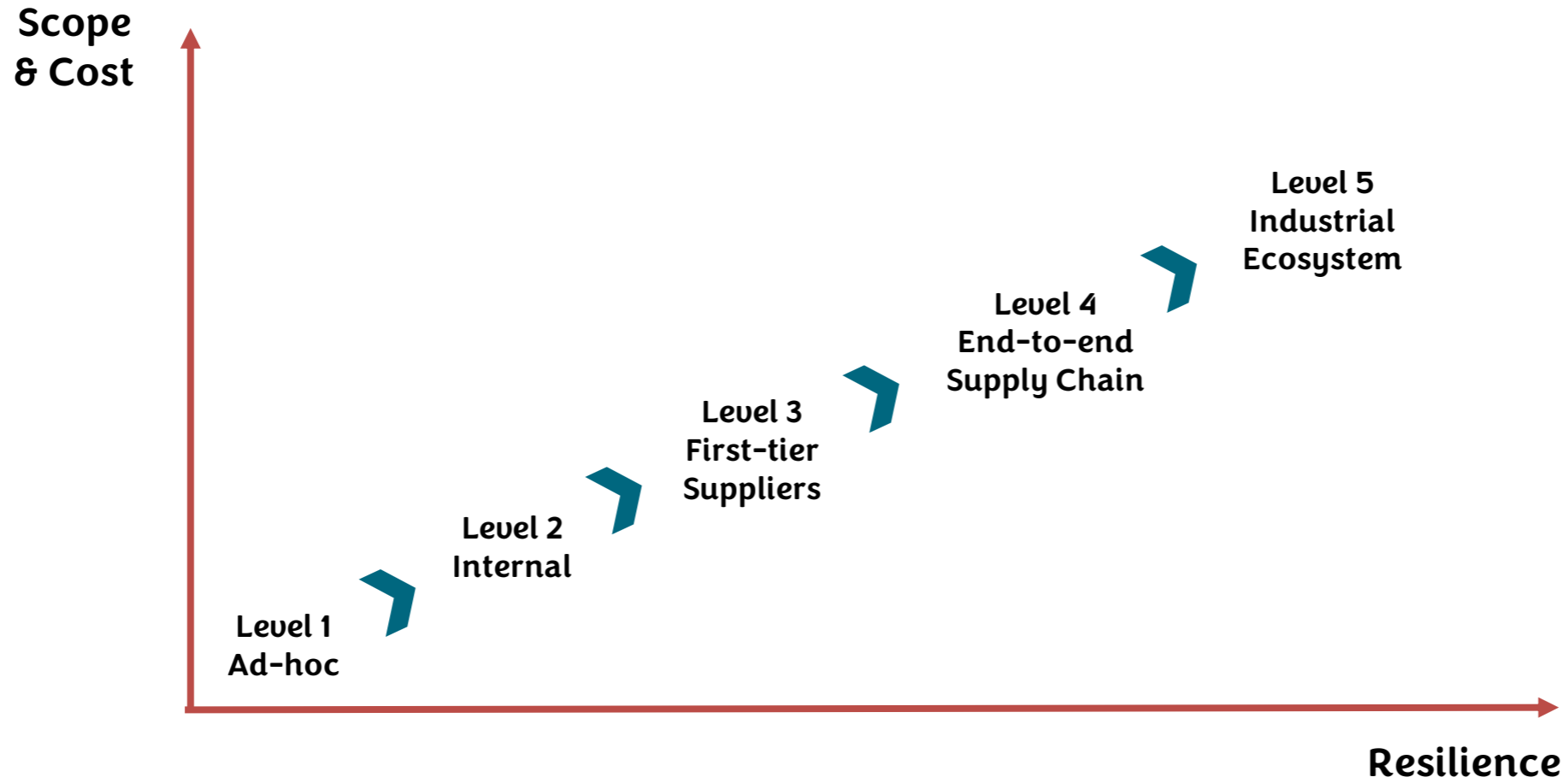
It is still unclear for practitioners how much resilience capability their supply chain has and needs and whether or not they can afford it.



Developing Supply Chain Resilience



Discussion





Conceptual Framework

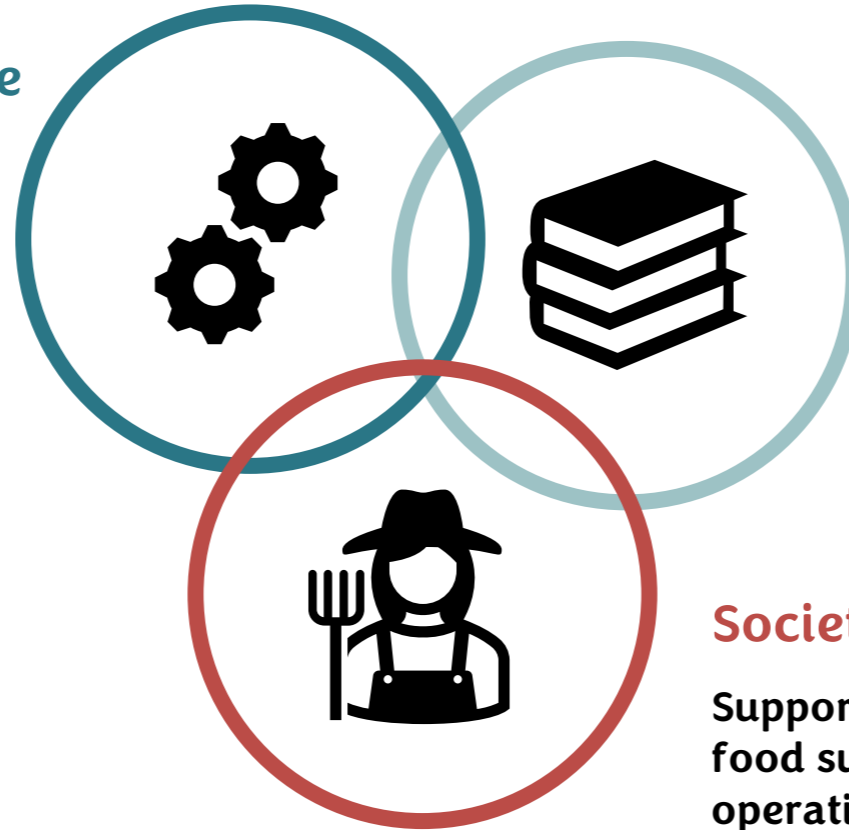
Levels of Resilience	Level 1 Ad-hoc	Level 2 Internal	Level 3 First-tier Suppliers	Level 4 End-to-end Supply Chain	Level 5 Industrial Ecosystem
Resilience Capabilities					
1 Prevention	Monitoring, risk management, contingency planning, quality management and market development strategies.				
2) Leanness	Operational (e.g., lead time and product variability reduction) and resource efficiency (e.g., human, financial and natural) strategies.				
3) Flexibility	Flexibility in sourcing (e.g., supply structure and location), production (e.g., product re-design) and order fulfilment (e.g., alternative customers and channels).				
4) Redundancy	Robustness (e.g., back-up warehouse) and diversity (e.g., alternative landscapes and resources) strategies.				
5) Visibility	Information sharing strategies (e.g., digital technologies and climate information).				
6) Collaboration	Cohesion (e.g., collaborative forecasting, brand sharing) and trust strategies (e.g., joint decision-making)				
7) Agility	Responsiveness (e.g., resource mobilisation), rapidity (e.g., more working hours) and velocity (e.g., silent product rollover) strategies.				
8) Adaptability	Self-organisation (e.g., innovation culture) and co-learning strategies.				
Resilience Costs					
1) Economic	Operational (sourcing, manufacturing, inventory, transportation, and capital costs) and investments (infrastructure, technology, R&D and compliance costs).				
2) Social	Such as the involvement and development of employees and communities.				
3) Environmental	Such as the use of natural resources.				



Research Contribution

Practice

Provide a decision-making approach to assess the level of supply chain resilience.

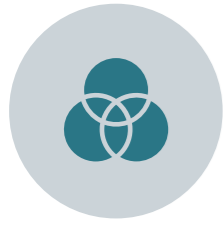


Theory

Expand supply chain resilience theory by studying the relationship between supply chain resilience and cost.

Society

Support the development of resilience in food supply chains, which is not only an operational requirement but also a social responsibility.



Key Takeaways

A

How do companies assess their level of supply chain resilience?



B

What cost structures are associated with developing resilience?



C

How do companies balance supply chain resilience and cost?

Levels of Resilience	Level 1 Ad-hoc	Level 2 Internal	Level 3 First-tier Suppliers	Level 4 End-to-end Supply Chain	Level 5 Industrial Ecosystem
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What is next? This research lays the ground for empirical studies. The framework could guide actors towards proper validation methods, such as stress-testing through System Dynamics modelling.

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Thank you.

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