MIDLANDS ENGINE

Observatory

# MIDLANDS ENGINE SUPPLY RESEARCH REPORT
# FOOD SUPPLY CHAINS

MARCH 2021

**FINAL REPORT**

# ACURSC – ANTI-COVID-19 CAPABILITIES UNDERPINNING RESILIENT SUPPLY CHAINS FRAMEWORK:
## evidence from the food supply chain in the Midlands Engine pan region

## BACKGROUND

This report is based on a 'deep dive' study into the Midlands Engine food supply chain, undertaken from November 2020 and April 2021 by the Lincoln International Business School at the University of Lincoln, and funded by the Midlands Engine, The Midlands Engine Observatory and the University of Lincoln. The aim of the project is to identify the main resilience capability factors which protected the food supply chain in the Midlands from severe disruption during the COVID-19 pandemic. Based on a thoroughly researched framework of resilience capabilities in supply chains, as well as insights from practitioners and experts in the food sector in the Midlands, we present an original framework named ACURSC, which encapsulates the main capabilities underpinning resilient supply chains in the region.

## ACKNOWLEDGEMENTS

This report was jointly produced by Professor Charbel Jose Chiappetta Jabbour, Dr. David Twigg, Liz Price, Professor Martin Hingley, and Martin Collison (Lincoln International Business School, University of Lincoln).

We thank the Midlands Engine Observatory, and particularly Professor Andrew Leyshon and Professor Delma Dwight, for providing funding and guidance during the development of this research. We thank LIAT and NCFM – University of Lincoln, and Collison Associates for their help in securing contacts with potential participants of this study. We thank Christopher Wardle-Cousins for the support with the final version of this report.

This document should be cited as follows: Chiappetta Jabbour, C.J., Twigg, D., Price, L., Hingley, M., Collison, M. (2021). ACURSC (Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains) Framework: evidence from the food supply chain in the UK Midlands, April 2021, available at the University of Lincoln Repository: https://eprints.lincoln.ac.uk/

CRediT author statement: all authors contributed to the manuscript equally, considering conforming research contribution suggested by CRediT.

**ACURSC – Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains Framework: evidence from the food supply chain in the UK Midlands Engine pan region**

## *60 SECOND OVERVIEW*

The UK food supply chain was able to cope with the pressures put on it by the COVID-19 pandemic, and its consequences, which included the dramatic contraction of the 'food to go' sector (also known as 'grab-and-go' food, including, for example: packaged, microwavable foods, sandwiches) and food services (as pubs, bars and restaurants shut down), and an acute increase in food stockpiling by households. This study provides insights into capability factors underpinning the resilience of the food supply chain during the pandemic in the Midlands Engine pan region.

The main research findings are derived from a qualitative study that was comprised of 20 interviews with a variety of stakeholders and professionals from organizations in the food supply chain located in both the West and East Midlands. The research findings helped build an original portfolio of resilience capability factors, called the ACURSC (Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains) Framework.

The central resilience capabilities of ACURSC are:

- **Organization**, defined as human resource structures, policies, skills and culture.
- **Anticipation**, which means the ability to identify potential future disruptive events or situations.
- **Adaptability**, meaning the organizational ability to modify operations in response to challenges or opportunities.
- **Flexibility in order fulfilment**, which means quickly changing outputs or the mode of delivering outputs.
- **Flexibility in sourcing**, with the ability to quickly change production inputs and raw materials.

These five capability factors were shown to create synergy with secondary capabilities, such as collaboration and financial strength. It also emerged that the most resilient firms had distinctive characteristics, which acted as enablers and facilitators, such as proactivity, entrepreneurship, and adoption of best practices. ACURSC can be both a policy and a benchmarking tool used to trigger discussions and concrete initiatives around how the Midlands food supply chain could become more resilient. In this context, an original package of strategic insights and potential policy implications for the advancement of Midlands food supply chain is presented.

**ACURSC – Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains Framework: evidence from the food supply chain in the UK Midlands Engine pan region**

## EXECUTIVE SUMMARY

## 1. THE PROBLEM

The COVID-19 pandemic created new pressures for food supply chains globally. For example, the International Monetary Fund's Global Uncertainty Index rose to an historic peak due to the pandemic and remains at a high level. While the food supply chain in the wider Midlands Engine region avoided major disruptions and food shortages during the pandemic, the capability factors underpinning this supply chain resilience have so far been little explored. By understanding and systematizing the main supply chain capabilities which are capable of engendering resilience in the food sector, it will be possible to learn lessons, share best practice, and further strengthen food supply chains both in the Midlands Engine and across the UK as a whole in preparation for future challenges and opportunities.

The main question addressed by this project is: *what is the portfolio of supply chain resilience capabilities adopted by members of the food supply chain in the Midlands that allowed food production and distribution chains to remain resilient during the COVID-19 pandemic in the UK?*

## 2. OUR APPROACH

The objective of this research was to discover the portfolio of supply chain resilience capability factors adopted by firms in the Midlands food sector to remain resilient during the COVID-19 pandemic. This portfolio of resilience capabilities is herein called 'ACURSC': Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains.

A qualitative study based on interviews with 20 food supply chain professionals and experts in the sector from the Midlands region was undertaken between November 2020 and April 2021. Drawing on a portfolio of the 14 most frequently cited capability factors (Pettit et al., 2014), interview scripts were designed to support discussion with both supply chain professionals and experts in the food sector across the Midlands Engine. The key topics covered were: (a) how these professionals defined supply chain resilience during the pandemic; (b) the main initiatives taken and examples of how they sustained the resilience of the supply chain during the pandemic; and (c) capability gaps, future developments, and expectations from food policy.

## 3. OUR FINDINGS

### 3.1 IDENTIFYING A SET OF CRUCIAL RESILIENCE CAPABILITIES

An analysis of the interviews produced a ranking of the main resilience capabilities cited by the research participants during the interviews (Figure 1).


**Figure 1: World cloud of the main resilience capabilities according to selected experts**

The top five resilience factors are:

- **Organization:** organizational innovation with a strong emphasis on agile and pragmatic Human Resource Management.
- **Anticipation:** preparations for a 'no-deal Brexit', adoption of best practices regarding business continuity planning, risk assessment and the supply chain's global exposure.
- **Adaptability:** necessary due to dynamic trading and changes in the food market, requiring readiness for an 'every day is Christmas Day' order of demand.
- **Flexibility in Order Fulfilment:** rapid shift from 'food to go' and 'food services' to dominant retailers and new markets, such as direct on-line sales to customers.
- **Flexibility in Sourcing:** identification of alternative pre-approved, pre-audited new regional suppliers for each input to cope with further global disruptions, focus on essential production inputs, reduced mix of products and regional availability of inputs rather than cost reduction.

## 3.2 ACURSC FRAMEWORK

The most significant output of this research is the ACURSC portfolio of resilience capability factors (Figure 2). Five capabilities were central in underpinning the resilience of firms in food supply chains during the pandemic, which supported and created synergy with other resilience capabilities, such as capacity, financial strength, dispersion, visibility and collaboration. The most resilient firms possessed particular enabling and facilitating characteristics:

- Understanding new customers' expectations.
- Implementation of management best practices; and firm's size-related resources.
- Proactivity during the early stage of the first wave of the pandemic.

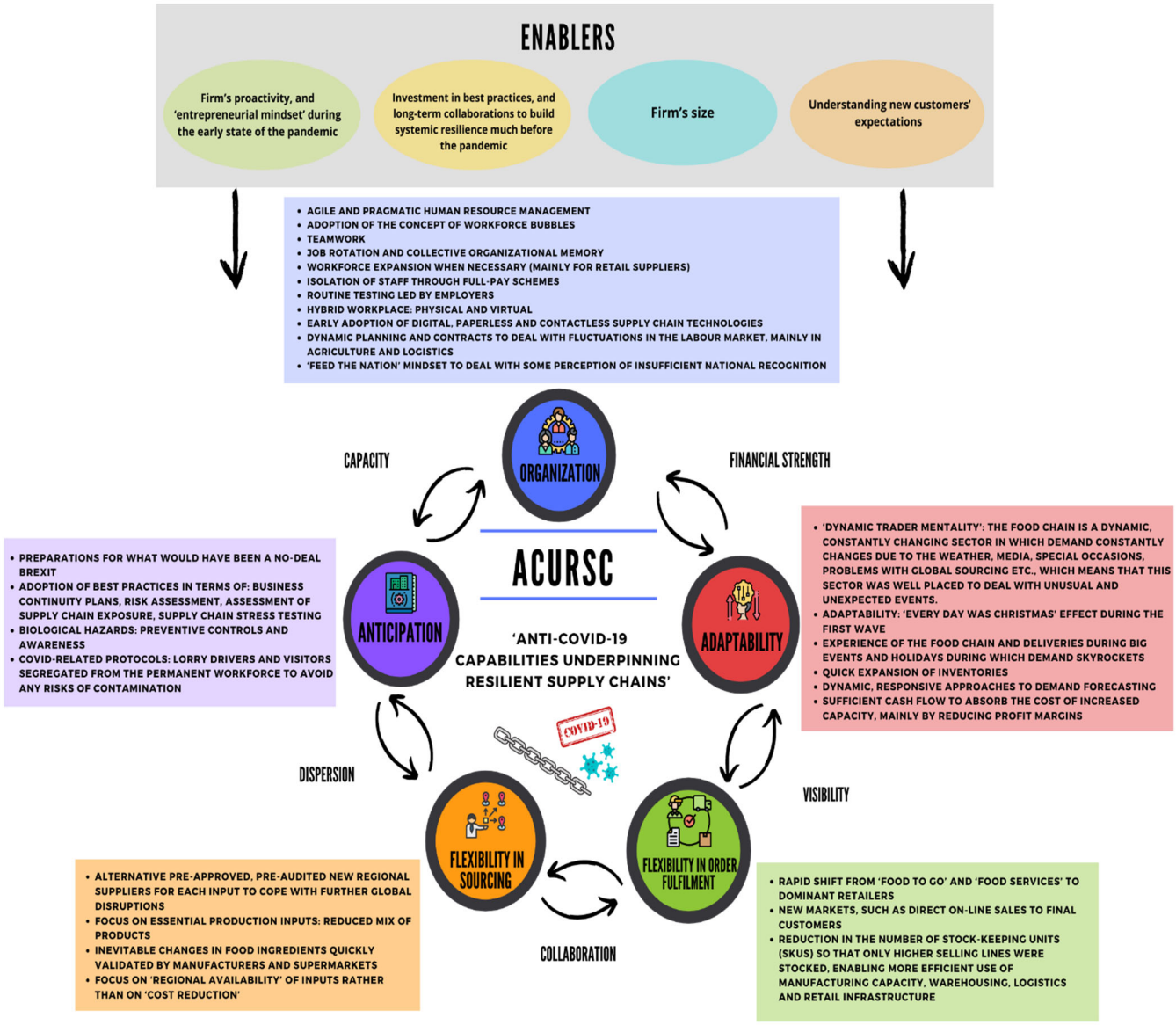


**Figure 2: ACURSC – Full Version**

### 3.3 ON THE HORIZON

ACURSC can be useful as a benchmarking and policy tool to support food supply chains in the Midlands Engine in the face of the opportunities and adaptations required by post-pandemic trends and challenges. These include:

- Digital transformation of supply chains, through appropriate digital infrastructure, and understanding of new digitally-enabled consumer habits.
- Net-zero supply chains and green recovery.
- An understanding of relevant factors affecting the competitiveness of the food chain for a post-Brexit Britain: labor and infrastructure to help a digitally enabled net zero recovery post-COVID-19.

## 4. HOW TO BUILD CAPACITY

Study participants were asked to reflect on how public policy could support the Midlands Engine food supply chain when faced with emergent challenges and opportunities. The most frequent answers were:

- Access to and an ability to learn from supply chain management best practice, including topics such as: demand forecasting during disruptive events; business continuity, and; stress testing of supply chains.
- Access to case studies of successful and resilient supply chains.
- Learning how industries beyond the food sector have adapted and maintained resilience.
- Knowledge about how to address resilience capabilities asymmetries which may arise among members of a supply chain, for instance, when a focal company in a supply chain has a more robust business continuity plan that smaller members of the chain.
- Support and training for organizations in the food chain to build up comprehensive business continuity plans that incorporate possible 'black swan events' and incident recovery. In this context, supply chain risk assessment could monitor updates regarding: Public Health England Guidance on High Consequence Infectious Diseases (HCID); Lessons from cross-government exercise to test the UK response to pandemics, such as 'Exercise Cygnus' which was a cross-government exercise to stress test the national response to a critical influenza pandemic. The exercise took place over 3 days in October 2016 and involved more than 950 people; Global Risks Report, World Economic Forum; and the 10 Global Health Issues, World Health Organization.
- Discussion forums, workshops, and mechanisms to allow stakeholder engagement on critical elements which could affect the resilience of food supply chains in the Midlands Engine pan region, for example, road capacity, logistics services, warehouses, labor, agriculture capacity, manufacturing, and trends in retail.[1]

[1] An important limitation to note is that research results cannot necessarily be generalized for the UK as a whole, as participants were asked to focus on UK Midlands while providing insights during the interviews. In this research the terms resilience capabilities and resilience factors were used in an interchangeable way. This research focuses on how firms kept their resilience during the pandemic, however, future studies can explore fewer positive examples, or cases in the UK Midlands of firms that might not have been able to cope with the pandemic.

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**ACURSC – Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains Framework: evidence from the food supply chain in the Midlands Engine pan region**

## FULL REPORT

## 1. THE PROBLEM

The COVID-19 pandemic has decisively drawn attention to the critical role of supply chains in key sectors. This includes the food sector in the Midlands Engine pan region. Before COVID-19, it was possible to imagine that pandemics were a purely medical consideration, and they were not foreseen as an issue of importance to supply chains in general. This perception has changed dramatically, and the issue of how to develop resilient supply chains is now considered a key element for the national security, productivity and prosperity of the UK, particularly as it looks towards economic recovery from COVID-19. For example, 94% of US Fortune 1000 companies have had their supply chains disrupted during the pandemic[2]. In another example, from the UK, it was reported that in January 2021 'the percentage of businesses currently trading in the accommodation and food service activities industry has fallen to 34%, the lowest recorded value since comparable estimates began'[3]. The running aground in March 2021 of the Ever Given container ship which blocked the Suez Canal emphasized further the relevance of pursuing more resilient supply chains. There is an immediate need to examine existing business frameworks in light of COVID-19, and to adapt them to incorporate lessons for pandemic resilient supply chains. COVID-19 has been an extreme test of supply chain resilience, due to the fact that the global uncertainty achieved a record high during 2020, according to the World Uncertainty Index[4] (Figure 3).

[2] 94% of the Fortune 1000 are seeing coronavirus supply chain disruptions: Report https://fortune.com/2020/02/21/fortune-1000-coronavirus-china-supply-chain-impact/

[3] Business insights and impact on the UK economy: 28 January 2021. Source: https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/bulletins/businessinsightsandimpactontheukeconomy/28january2021

[4] 'The WUI is computed by counting the percent of word "uncertain" (or its variant) in the Economist Intelligence Unit country reports. The WUI is then rescaled by multiplying by 1,000,000. A higher number means higher uncertainty and vice versa. For example, an index of 200 corresponds to the word uncertainty accounting for 0.02 percent of all words, which—given the EIU reports are on average about 10,000 words long—means about 2 words per report'. Source: https://worlduncertaintyindex.com/ Access: April 2021

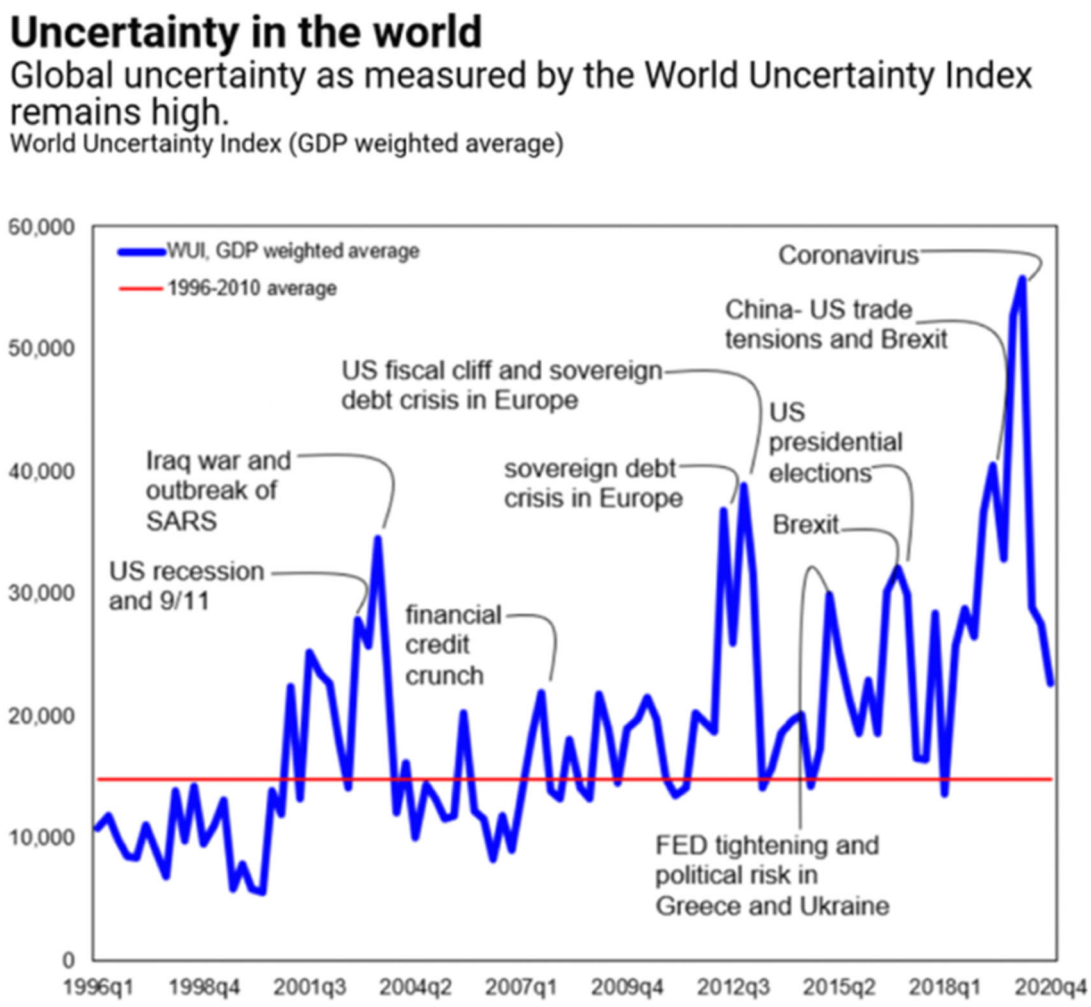


**Figure 3 – World Uncertainty Index peaked during the COVID-19 pandemic**

**Source: Ahir et al. (2021)**

When their supply chains are disrupted, organizations from all sectors are no longer capable of fulfilling their missions, serving society, and generating profit, causing economic, social and environmental damage, and potentially diminishing the wellbeing of the population in the long term (Lopes de Sousa Jabbour et al., 2020).

Although there has been some recent discussion around how firms have adapted their business models and supply chains to cope with the COVID-19 pandemic (for example: Elavarasana & Pugazhendhi 2020; EY 2020), little attention has been paid to date to the food supply chains of the Midlands Engine during the pandemic-triggered lockdowns. Nevertheless, the Midlands pan region is a key region to ensure food security of the UK. There is, therefore, a considerable research opportunity to understand the portfolio of

capabilities adopted by food supply chain members and stakeholders in the Midlands to build up resilience in their chains during the COVID-19 pandemic.

Resilient supply chains are supply chains those that are capable of returning to their original state in the face of disruption, or to move to a newly adapted and a more stable state after suffering a shock (Christopher & Peck, 2004). One of the most widely accepted – and cited – frameworks for understanding the capability factors that engender resilience in supply chains was developed by Pettit et al. (2010). They define the capabilities of more resilient supply chains as 'attributes that enable an enterprise to anticipate and overcome disruptions' (Pettit et al. 2010, p.6). In this context, the higher the supply chain's capabilities, the lower its vulnerabilities. Their framework contains 14 capability factors underpinning resilient supply chains:

(i) flexibility in sourcing;
(ii) flexibility in order fulfilment;
(iii) capacity;
(iv) efficiency;
(v) visibility;
(vi) adaptability;
(vii) anticipation;
(viii) recovery;
(ix) dispersion;
(x) collaboration;
(xi) organization;
(xii) market position;
(xiii) security;
(xiv) financial strength.

During the COVID-19 pandemic, Pettit et al. (2010)'s work acquired particular relevance and was included in a special selection of highly influential scientific articles on 'resilience and supply chains' published by the *Journal of Business Logistics*[5]

[5] Journal of Business Logistics, Research on Supply Chains in Crisis: https://onlinelibrary.wiley.com/doi/toc/10.1111/(ISSN)2158-1592.research-on-supply-chains-in-crisis

Using the Pettit et al. (2010) framework as a context for the experience of supply chain practitioners, experts, and stakeholders in the Midlands Engine pan region currently dealing with the disruptions created by the COVID-19 pandemic and subsequent lockdowns (2020-2021), this project presents an original and exploratory framework: ACURSC (Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains). This framework encapsulates key capabilities for resilient supply chains in the food sector and will also be of benefit to other sectors' supply chains.

The research question (RQ) underlying this proposal is:
*RQ: What is the portfolio of supply chain resilience capabilities adopted by selected food supply chain members to keep their food production and distribution chains resilient during the COVID-19 pandemic in the Midlands, UK?*

Consequently, the research objectives (RO) of this proposal are:

- RO1: To compare the Pettit et al. (2010) framework of 14 capability factors for resilient supply chains with primary data/evidence collected through in-depth interviews with Midlands' food supply chain stakeholders.
- RO2: To systematize findings of this research regarding the key capabilities identified into the ACURSC Framework: Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains.
- RO3: To promote our research findings regarding ACURSC to key stakeholders, both within the sector and regionally within the economic community, particularly, through the extensive network underpinning Midlands Engine.

Table 1, extracted from Pettit et al. (2010), details these 14 resilience capability factors.

**Table 1: Resilience capabilities in supply chain management**

**Source: Pettit et al. (2010)**

| Capability Factor | Definition | Sub-Factors |
|---|---|---|
| **Flexibility in sourcing** | Ability to quickly change inputs or the mode of receiving inputs | Part commonality, Modular product design, Multiple uses, Supplier contract flexibility, Multiple sources |
| **Flexibility in order fulfillment** | Ability to quickly change outputs or the mode of delivering outputs | Alternate distribution channels, Risk pooling/sharing, Multi-sourcing, Delayed commitment, Production postponement, Inventory management, Re-routing of requirements |
| **Capacity** | Availability of assets to enable sustained production levels | Reserve capacity, Redundancy, Backup energy sources and communications |
| **Efficiency** | Capability to produce outputs with minimum resource requirements | Waste elimination, Labor productivity, Asset utilization, Product variability reduction, Failure prevention |
| **Visibility** | Knowledge of the status of operating assets and the environment | Business intelligence gathering, Information technology, Products, Assets and People visibility, Information exchange |
| **Adaptability** | Ability to modify operations in response to challenges or opportunities | Fast re-routing of requirements, Lead time reduction, Strategic gaming and simulation, Seizing advantage from disruptions, Alternative technology development, Learning from experience |
| **Anticipation** | Ability to discern potential future events or situations | Monitoring early warning signals, Forecasting, Deviation and Near-miss analysis, Contingency planning, Preparedness, Risk management, Business continuity planning, Recognition of opportunities |
| **Recovery** | Ability to return to normal operational state rapidly | Crisis management, Resource mobilization, Communications strategy, Consequence mitigation |
| **Dispersion** | Broad distribution or decentralization of assets | Distributed decision-making, Distributed capacity and assets, Decentralization of key resources, Location-specific empowerment, Dispersion of markets |
| **Collaboration** | Ability to work effectively with other entities for mutual benefit | Collaborative forecasting, Customer management, Communications, Postponement of orders, Product life cycle management, Risk sharing with partners |
| **Organization** | Human resource structures, policies, skills and culture | Learning, Accountability and Empowerment, Teamwork, Creative problem solving, Cross-training, Substitute leadership, Culture of caring |
| **Market position** | Status of a company or its products in specific markets | Product differentiation, Customer loyalty/retention Market share, Brand equity, Customer relationships, Customer communications |
| **Security** | Defense against deliberate intrusion or attack | Layered defenses, Access restrictions, Employee involvement, Collaboration with governments, Cyber-security, Personnel security |
| **Financial strength** | Capacity to absorb fluctuations in cash flow | Insurance, Portfolio diversification, Financial reserves and liquidity, Price margin |

However, while the work of Pettit et al. (2010) and their 14 capabilities form the backbone of this research, it is also necessary to investigate further relevant evidence from previous research on resilience in the supply chains of firms based in the Midlands Engine. To map

the literature and collect insights from previously published research outputs on resilience of supply chains with a focus on the Midlands, a systematic review was conducted through the SCOPUS database. The main findings from this systematic review are in Appendix *A*.

The research question to be answered by this project can be justified based on both its originality (no similar research was found in the SCOPUS database) and relevance, because the resilience capabilities underpinning food supply chains during the pandemic is a topic which has attracted significant attention and preoccupation from society. The systematic review revealed that the topic of which capability factors supported the resilience of the food sector during pandemics has to date not been properly considered by either academics or practitioners, and that the research findings produced by ACURSC are original and capable of adding useful insights to policy makers and stakeholders of the food supply chain in the Midlands Engine pan region.

## 2. OUR APPROACH

The objective of this research is to discover the portfolio of supply chain resilience capabilities adopted by firms in the Midlands Engine food sector (agriculture, food processing and distribution) to remain resilient during the COVID-19 pandemic. This portfolio of resilience capabilities is herein called ACURSC: Anti-COVID-19 Capabilities Underpinning Resilient Supply Chains.

In the UK, the food supply chain employs approximately 4.3 million people, and generates over £120 billion of added value for the economy each year, according to the UK Food & Drink Federation, and the Midlands pan region concentrates a substantial proportion of food processors and supply chain companies (Food & Drink Federation, 2020). The Midlands pan region in 2014 had around 118,000 jobs in food and drink manufacturing, and estimated 2,400 enterprise units, including over 1,500 food manufacturing firms; over 300 beverages manufacturers, and over 450 firms engaged in packaging manufacturing or packaging activities (Midlands Engine SIA, 2016). The region benefits from a number of Food Enterprise Zones (FEZs), providing training and capacity building for members of the food sector (Midlands Engine Opportunities in Agri-food, 2018).
With support from Midlands Engine, a qualitative study based on interviews with 20 food supply chain professionals and experts from the food sector in the Midlands region was conducted from November 2020 to March 2021.

Following recommendations from the Midlands Engine Observatory:

- All participants were asked to provide insights and comments, as much as possible, to cover the broader Midlands Engine pan region;
- Participants from both the West and East Midlands were invited to participate;
- A plurality of insights from different supply chain actors, and stakeholders in the food sector were engaged.

The sample of interviewees was identified via several means, such as:

- Invitations to engage with the research distributed through Midlands Engine to representatives of Local Enterprise Partnerships (LEPs)

- Invitation to engage with the research distributed via LinkedIn, through: (a) West Midlands Business LinkedIn Network; and (b) East Midlands Procurement and Supply Chain Professionals
- University of Lincoln and this research team's contacts within the food sector, including support from Lincoln International Business School, Lincoln Institute for Agri-Food Technology, and National Centre for Food Manufacturing

At the end of each interview, the interviewer probed for potential further respondents, following a snowball sampling approach appropriate to qualitative interviews. The quantity of interviews – 20 participants – is in accordance with both the original project proposal and the concept of saturation of data in qualitative interviews, which recommends that researchers stop conducting new interviews once convergence and a dominant line of evidence emerges in the interviews already conducted.

Drawing on the portfolio of 14 highly cited capability factors (Pettit et al., 2010), interview scripts were designed to support the interviews conducted with both supply chain professionals and experts in the food sector in the Midlands. Some of the main topics discussed were: (a) how these experts and practitioners defined supply chain resilience during the pandemic; (b) key initiatives and examples of how they sustained the resilience of the supply chain during the pandemic; (c) capability gaps, future developments, and expectations from industrial policy. An invitation to take part in the research was sent out to all contacts (Appendix B). The full versions of the interview scripts are in Appendix C and Appendix D.

The data collected provided an understanding of how food sector firms are performing along the range of 14 capabilities factors, the current challenges faced, and what kind of policy interventions would be welcomed by food supply chains in the region. All findings are systematized in the ACURSC framework.

Following research ethics guidelines, as shared with interviewees, the data was analyzed in an anonymized and aggregated way, without individual identifiers or names. Each interview generally lasted between 30 and 50 minutes, and a notebook was used to record the data. When possible, two members of the research team conducted the online interviews together.

The profile of the 20 participants is displayed below, respecting anonymity (Table 2). It is important to highlight that the adoption of a stratified sampling (for example, covering the totality of local economic partnerships) was not an objective of this research. Another limitation is that research results cannot be generalized to the entire UK, as participants restricted their focus and insights during the interviews to the Midlands Engine.

One group of interview participants had job roles which allowed them to be in direct contact with supply chain management issues during the pandemic. Examples included: head of operations, operations manager, and supply planning manager. A second group of participants contained stakeholders with an understanding of the dynamics of the food sector, and the challenges and opportunities faced by the Midlands region during the pandemic. Examples of profiles of participants of this group include: experts in local economic development in which the food sector plays an important role, and award-winning food sector experts. Video calls were used to gather data to follow the WHO (World Health Organization - Ethical standards for research during public health emergencies - COVID-19) guidelines for research methodology during the pandemic.

**Table 2 – Profile of participants of the interviews**

| Participant | Profile |
|---|---|
| A | Professional from a Medium Sized Food Manufacturer |
| B | Professional from a Food Supply Chain and Logistics company |
| C | Professional from a Large Food Manufacturer |
| D | Professional from a Large Food Manufacturer |
| E | Professional from a Food Supply Chain and Logistics company |
| F | Professional from a Fruit Supply Chain Producer |
| G | Professional from a Fruit Manufacturer |
| H | Professional from a Seafood Producer |
| I | Professional from a Fruit Supply Chain Producer |
| J | Professional from a Large Food Manufacturer |
| K | Expert Stakeholder from the Fresh produce sector |
| L | Expert Stakeholder from the Food sector |
| M | Expert Stakeholder from the Food Supply Chain |
| N | Expert Stakeholder in Regional Economic Development (includes food sector) |
| O | Expert Stakeholder from the fresh produce sector |
| P | Expert Stakeholder from the Food Supply Chain |
| Q | Expert Stakeholder in Food Supply Chain Innovation |
| R | Expert Stakeholder from the Food Supply Chain |
| S | Professional from a Medium Sized Food Manufacturer |
| T | Expert Stakeholder from the Food Sector |

Appendix E contains a detailed explanation on how data was analyzed. All interviews were transcribed on the same day as the interview. We used a qualitative data analysis computer software package (NVIVO, QSR International), and thus the transcription of each interview was inserted into the software. 14 analysis codes were created, one code for each resilience capability according to Pettit et al. (2010).

# 3. RESEARCH FINDINGS

## *3.1 IDENTIFYING A SET OF CRUCIAL RESILIENCE CAPABILITIES*

Based on our analysis of the content from the interviews, it was possible to rank the main resilience capability factors identified by the research participants during the interviews.

The top five resilience capabilities are:

- Organization: organizational innovation with a strong emphasis on agile and pragmatic Human Resource Management.
- Anticipation: preparations for what could have been a no-deal Brexit, adoption of best practices regarding business continuity planning, risk assessment and the supply chain's global exposure.
- Adaptability: necessary due to dynamic trading and changes in the food market, requiring readiness for the unexpected.
- Flexibility in Order Fulfilment: rapid shift from 'food to go' and 'food services' to dominant retailers and new markets, such as direct on-line sales to customers.
- Flexibility in Sourcing: identification of alternative pre-approved, pre-audited new regional suppliers for each input to cope with further global disruptions, focus on essential production inputs, reduced mix of products and regional availability of inputs rather than cost reduction.

A word cloud (Figure 4) makes it easier to visualize the dominant capabilities underpinning more resilient food chains during the COVID-19 pandemic in the Midlands, according to the perspectives of the selected participants.


**Figure 4 – Word cloud of the most frequent capabilities**

By mining the content of statements made by the participants in a more detailed way and going beyond Petit et al.'s labels of capabilities, the organization of staff was the single most relevant factor capable of ensuring the resilience of supply chains during the pandemic (see word cloud in Figure 5):


**Figure 5 – Word cloud of the most frequent words in participants' statements**

For each of the five key resilience capabilities identified in this research, several initiatives taken by organizations in the food chain were identified, as listed below. The planning and implementation of these initiatives were led, generally, by firms themselves.

### *3.2 ORGANIZATION CAPABILITY*

Defined as human resource structures, policies, skills and culture, the main initiatives taken by firms in the food chain, mentioned by the participants, and interpreted by the research team are presented in the figure below (Figure 6).

**ORGANIZATION**

- **Agile and Pragmatic Human Resource Management**
- **Adoption of the concept of 'workforce bubbles': staffs are organized in teams, and allocated to the shifts**
- **Teamwork**
- **Job Rotation and Collective Organizational Memory**
- **Workforce expansion when necessary (mainly for retail suppliers)**
- **Isolation of staff through full-pay schemes**
- **Routine testing led by employers**
- **Hybrid Workplace: Physical and Virtual**
- **Early adoption of digital, paperless and contactless supply chain technologies**

**Figure 6 – Understanding the resilience capability 'organization' in the context of the food supply chain in the Midlands**

Selected comments from interviews on 'organization' include:

- 'We saw the human dimension is still critical' (Participant P)
- 'Teamwork, job rotation and multi-tasking are here to stay' (Participant A)

- ‘The sector took a very responsible position […] paying staff who had to isolate for 14 days on full pay’ (Participant K)
- ‘Many [larger] food companies purchased fast COVID-19 testing kits at considerable cost to enable rapid onsite testing’ (Participant T)
- ‘[Our HR had] a big focus on mental health, because many businesses have staff who have lost family members’ (Participant M)

### *3.3 ANTICIPATION CAPABILITY*

Anticipation means the ability to identify potential future disruptive events or situations. It was found the anticipated actions and readiness to respond in a crisis were put in practice through a number of initiatives (Figure 7). In this research, it was clear that anticipation was underpinned by the entrepreneurial culture of firms, which when faced with an unexpected, Black Swan event, such as COVID-19, responded immediately. This kind of company did not necessarily wait for government to develop a continuity plan, but used their experience of constantly having to change production or delivery schedules due to changes in supply, demand, to pivot their business products or processes.

**ANTICIPATION**

- **Preparations for what would have been a no-deal Brexit**
- **Adoption of best practices in terms of: Business Continuity Plans, Risk Assessment, Assessment of Supply Chain Exposure, Supply Chain Stress Testing**
- **Biological Hazards: Preventive Controls and Awareness**
- **Covid-related protocols: lorry drivers and visitors segregated from the permanent workforce to avoid any risks of contamination**

**Figure 7 – Understanding the resilience capability ‘anticipation’ in the context of the food supply chain in the Midlands**

Selected comments from interviews include:

- ‘Lucky that we had been preparing for Brexit’ (Participant F)
- ‘We should have had better disaster recovery processes in place’ (Participant E)
- ‘[Resilience] it depends on each firm’s capability and context to assess risks and how to manage risks’ (Participant O)

### *3.4 ADAPTABILITY CAPABILITY*

Adaptability means the organizational ability to modify operations in response to challenges or opportunities, and in the context of the COVID-19 pandemic, the food supply chain in the Midlands adapted through the initiatives identified in Figure 8.

**ADAPTABILITY**

- **‘Dynamic Trader Mentality’: the food chain is a dynamic, constantly changing sector in which demand constantly changes due to the weather, media, special occasions, problems with global sourcing etc., which means that this sector was well placed to deal with unusual and unexpected events**
- **Adaptability: ‘every day was Christmas’ effect during the first wave.**
- **Experience of the food chain and deliveries during big events and holidays during which demand skyrockets**
- **Quick expansion of inventories**
- **Dynamic, responsive approaches to demand forecasting**
- **Sufficient cash flow to absorb the cost of increased capacity, mainly by reducing profit margins**

**Figure 8 – Understanding the resilience capability ‘adaptability’ in the context of the food supply chain in the Midlands**

Selected comments from interviews include:

- ‘We have a small company mindset […] decisions made very quickly […] no bureaucracy’ (Participant B)

- ‘There are examples of ‘adapters’ who made changes which would normally take them a year in a few weeks’ (Participant L)
- ‘They adapted because they were entrepreneurial and had the resources’ (Participant N)

### *3.5 FLEXIBILITY IN ORDER FULFILMENT CAPABILITY*

Flexibility in Order Fulfilment signifies being able to quickly changing outputs or the mode of delivering outputs, such as the initiatives highlighted by the interviewees of this research (Figure 9).

**FLEXIBILITY IN ORDER FULFILMENT**

- **Rapid shift from ‘food to go’ and ‘food services’ to dominant retailers**
- **New markets, such as direct on-line sales to final customers**
- **Reduction in the number of Stock-Keeping Units (SKUs) so that only higher selling lines were stocked, enabling more efficient use of manufacturing capacity, warehousing, logistics and retail infrastructure**

**Figure 9 – Understanding the resilience capability ‘flexibility in order fulfilment’ in the context of the food supply chain in the Midlands Engine**

Selected comments from interviews include:

- ‘It [demand for food during the first wave of the pandemic] was like Christmas every day’ (Participant M)
- ‘Usual demand for SMEs vanished’ (Participant H)

### *3.6 FLEXIBILITY IN SOURCING CAPABILITY*

Being flexible in sourcing is the organizational ability to quickly change production inputs and raw materials, to keep the supply chain alive (Figure 10).

**FLEXIBILITY IN SOURCING**

- **Alternative pre-approved, pre-audited new regional suppliers for each input to cope with further global disruptions.**
- **Focus on essential production inputs: reduced mix of products.**
- **Inevitable changes in food ingredients quickly validated by manufacturers and supermarkets.**
- **Focus on 'regional availability' of inputs rather than on 'cost reduction'.**

**Figure 10 – Understanding the resilience capability 'flexibility in sourcing' in the context of the food supply chain in the Midlands Engine**

Selected comments from interviews on flexibility in sourcing are:

- 'We have 3 suppliers for each [item], with contracts ready to be implemented' (Participant C)
- 'We replaced an ingredient from Asia with an alternative from Spain' (Participant J)
- 'A diverse supply chain is what delivers real resilience' (Participant Q)

It is possible to suggest that the following 'secondary' resilience factors create synergy with the five 'central' resilience capabilities mentioned above. The additional secondary capabilities are:

- Capacity to increase stocked items and ramp up production.
- Financial strength to absorb the costs of 'COVID-19 adaptation', related to acquisition of PPE, social distancing, testing, and logistics.
- Dispersion, such as the privileged position of the Midlands in hosting a number of warehouses, and the fact that the most resilient firms were based on different sites across the Midlands and the UK.

- Visibility, by sharing information with other members of the supply chain through new technologies.
- Collaboration to learn how to better adapt in such a short period of time.

### *3.7 ACURSC FRAMEWORK*

The most important output of this research is the ACURSC portfolio of resilience capabilities. It also emerged that the most resilient firms possessed the following particular characteristics, enablers and facilitators:

- Understanding new customers' expectations
- Implementation of management best practices for the firm's size
- Proactivity during the early stage of the first wave of the pandemic

There are two versions of the ACURSC framework; the first diagram is a simplified version (Figure 11), while the second is more comprehensive (Figure 12).

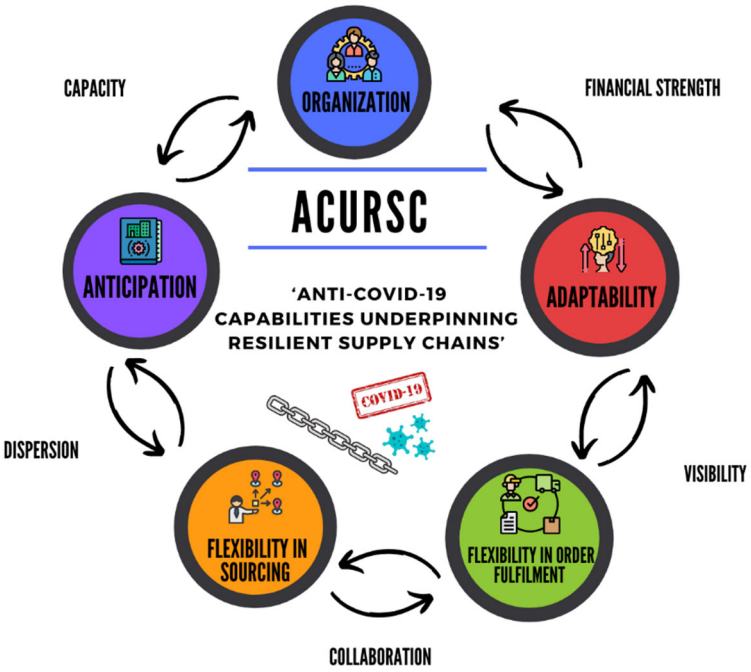


**Figure 11 – ACURSC framework: simplified version**

It also emerged that the most resilient firms had certain particular characteristics, enablers and facilitators; many of the most resilient firms displayed the following characteristics:

- Managerial proactivity and 'entrepreneurial mindset', mainly during the early weeks of the COVID-19 waves in the UK, in which they were often 'first mover'.
- Had invested in supply chain management best practices and long-term partnerships long before the start of the pandemic
- Firm size mattered; the bigger the company, the more equipped and resource-capable they were to deal with the cost of adaptation to COVID-19.
- Understood new customers' expectations and calculated which of the changes were likely to be durable.

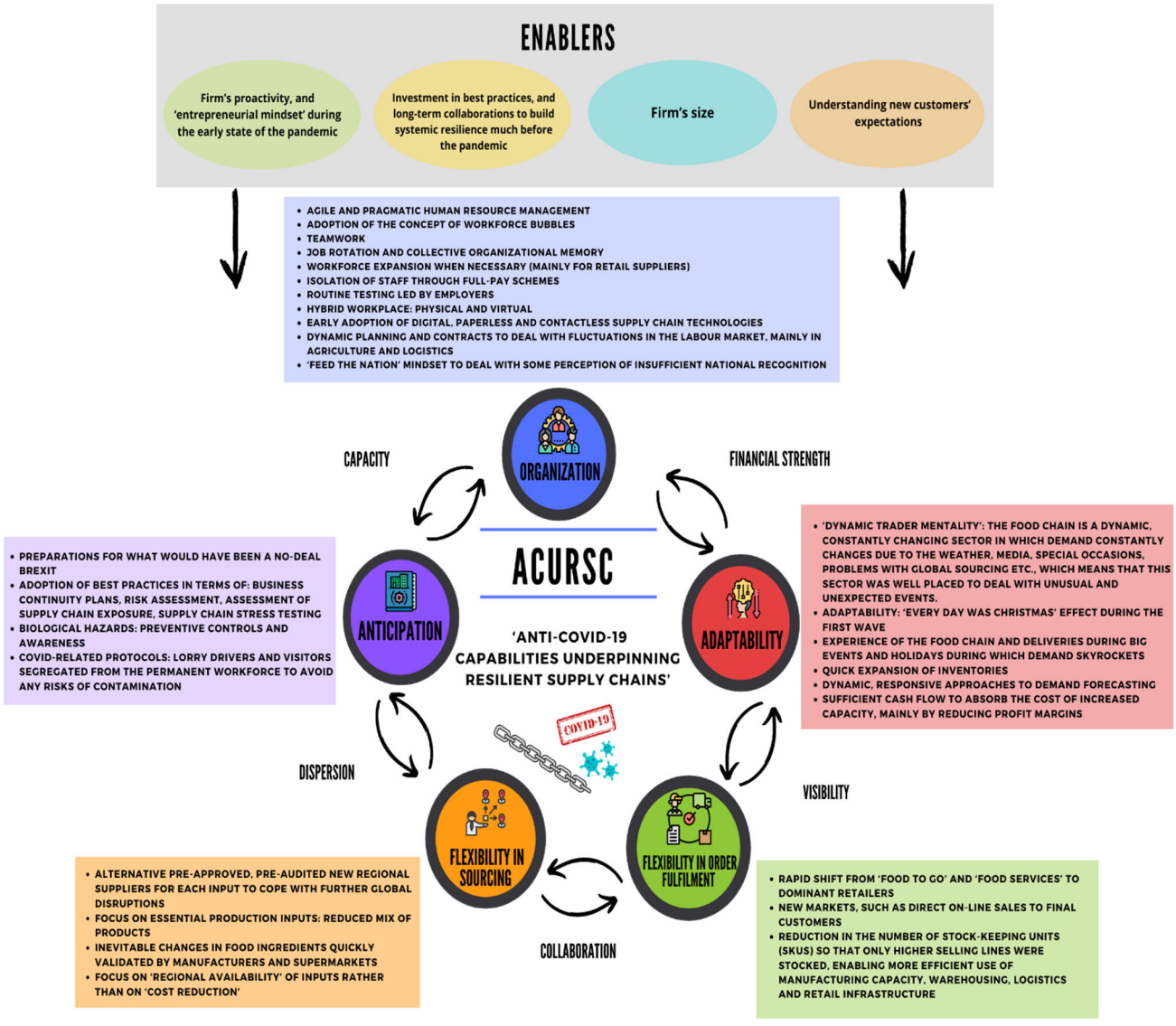


**Figure 12 – ACURSC framework: complete version**

### *3.8 ON THE HORIZON*

Finally, it is believed that ACURSC can be useful as a benchmarking and policy tool to support the food supply chains in the Midland Engine navigate through the opportunities and adaptations required in the wake of the pandemic identified by the research participants:

- Digital transformation of supply chains, through appropriate digital infrastructure, and consumer habits.
- Net-zero supply chains and green recovery.
- An understanding of relevant factors affecting the competitiveness of the food chain for a post-Brexit Britain: labor and infrastructure to help a digitally enabled net zero recovery post-COVID-19.

## *4. RECOMMENDATIONS ON BUILDING CAPACITY*

Participants of this study were asked on how policy could better support Midlands Engine food supply chains to be equipped to tackle emergent challenges and opportunities. The ACURSC framework generated a variety of suggestions and insights which may be useful for enhancing the resilience and performance of the food supply chain in the Midlands Engine pan region.

Table 3 presents strategic suggestions and insights for policy and transformational impact based on the main research findings and ACURSC.

**Table 3 – Research insights and potential implications for policy**

| Research Insights | Suggestions and Insights |
|---|---|
| **Global challenges tend to require a specific set of resilience capabilities** | ACURSC is a contingency based framework. Each major disruption, black swan event, or global challenge tend to require a specific set of resilience capabilities. The experience of COVID-19 has emphasized the need to retain a focus on potentially critical events, incorporating them into future discussions around the resilience of the food chain in the Midlands. Key sources could include, for example:<br>- Public Health England Guidance on High Consequence Infectious Diseases (HCID) (Public Health England, 2021)<br>- Lessons from cross-government exercise to test the UK response to pandemics, such as 'Exercise Cygnus' which was a cross-government exercise to stress test the national response to a critical influenza pandemic. The exercise took place over 3 days in October 2016 and involved more than 950 people (Gov UK Pandemic Preparedness, 2016)<br>- Global Risks Report, World Economic Forum<br>- The 10 Global Health Issues, World Health Organization |
| **Firms' proactivity and 'entrepreneurial mindset'** | Entrepreneurialism helped many food companies respond very quickly to the pandemic, re-orientating their product range, route to market and business processes. We suggest supporting firms in assessing their level of entrepreneurial orientation (see Covin & Wales, 2012; Van Ness et al., 2020 for more information), and to support entrepreneurial development through:<br>• Training programs to develop the skills and knowledge needed, such as the recently announced 'help to grow scheme' which will provide training to around 130,000 small and medium sized businesses<br>• Sharing best practices between firms and stakeholders in the food chain |

| | |
|---|---|
| **Best practices, and long-term collaboration for systemic resilience** | Collaboration between supply chain partners (such as supermarkets working with food processors) was a key enabler of resilience as the response needed coordinated action by all stages of the supply chain. Collaboration can also help firms at other times (i.e. in the absence of major disruptions) to access additional resources and expertise. To help deliver this in anticipation of future events, it would be important to:<br>• Help firms access a wide range of supply chain management best practices on the benefits of, and models for, collaboration<br>• Develop programs to foster long term collaboration in the food chain, and in particular for SMEs, by providing advice, training and grants to stimulate collaboration/or how to apply for grants |
| **Firm Size: Support to SMEs** | SMEs face particular challenges in responding to disruptions as they, in general, have less management capacity and resources. They do, however, have advantages in terms of freedom to operate, with small flexible management teams. Interventions here could include:<br>• Support provided to smaller firms in assessing the risks they face and prepare for what could be unexpected 'black swan' events at a range of spatial scales<br>• Developing, in advance, guidelines on how the public sector can best support smaller firms in the event of a major disruption in the food supply chain |
| **Understanding new consumer behavior and society trends** | Many smaller food companies struggle to find the time or financial resources to commission market research or analyze market trends, restricting their growth. SMEs in the food chain can be helped to focus on growth markets by:<br>• Running group-based training courses to look at market trends<br>• Offering one to one business advisory support and peer to peer events to help food SMEs to reflect on trends in the food sector<br>• Better understanding food demand trends through using big data captured by retail loyalty cards, and online food shopping, for instance, the project 'Who Buys My Food' (UEA, 2018) |

Table 4 presents suggestions and insights on challenges and opportunities of the food supply chain in the Midlands pan region identified by this research.

**Table 4 – Research insights on future challenges and opportunities**

| Challenges | Suggestions and Insights |
|---|---|
| **Future challenges and opportunities: growth in demand** | The pandemic, in conjunction with Brexit, has increased the demand for UK sourced food. This is an economic opportunity which should be embraced through proactive policies that would encourage investment in regional inputs to food production supply chains. |
| **Future challenges and opportunities: net zero** | Focal companies in the food chain, consumers and government policy are accelerating the transition towards a net zero food sector, and not all firms in the food chain are equipped with adequate resources, tools, and knowledge on how to achieve net zero, which means that:<br>• Capacity building is needed in business support training and awareness raising<br>• Incentives are needed to help supply chains adopt Net Zero models of food chain delivery |
| **Future challenges and opportunities: digital reinvention** | Major players in the food chain (focal companies, third part logistics firms) are leading the transition to a digitally-enabled food chain as consumers choose to shop remotely.<br>In this context, it is important to discuss the meaning of digital reinvention of each firm in the food supply chain and support firms in overcoming a possible 'digital asymmetry' in the food chain, which happens when the level of digital development among firms in a chain vary. Key areas to target include:<br>• To provide training on digital trends in supply chain and logistics, such as dark warehouses (automated warehouses). During the pandemic, firms in the region were forced to develop, by themselves, B2C strategies, instead of relying exclusively on B2B<br>• Training and grant support and/or advice to help food SMEs develop an online presence (suggestion: digital transition vouchers) |
| **Future challenges and opportunities: infrastructure** | It relates to understanding how to secure that the Midlands will keep its important role in 'feeding the nation' through excellence in infra-structure, from roads to distribution centers. The demand for supply chain efficiency is driving reconfiguration and the Midlands cannot assume its role as the nation's food logistics and production base is assured. We suggest further attention to:<br>• Identification of issues and opportunities with the road network in the Midlands based on the perspective of key stakeholders of the food sector, such as logistic providers, drivers. Topics of interest can be: satisfaction with maintenance of roads, value for money, availability of information on delays and traffic congestion |

| | |
|---|---|
| | • Roads and rail infrastructure which is efficient and equipped to support the transition to low carbon food chains<br>• Links to ports and Freeports to facilitate global food trade |
| **Future challenges and opportunities: workforce to keep feeding the nation** | Labor supply was one of the largest challenges faced by food chain companies during Covid. Attracting additional workforce for a growing sector is a key strategic challenge. To address this the sector will need to develop initiatives to diversify the workforce in terms of age, gender, and support the growth of higher paid, higher skilled jobs in the industry. Key actions include:<br>• Promotion of food sector careers, in particular stressing the diversity of careers and the growth in high tech, high skilled roles in trade, engineering and technology<br>• Supporting the adoption of automation and technology to create high paid careers |

Finally, Table 5 presents additional suggestions on how stakeholders in the Midlands food supply chain could work together to enhance resilience in the food chain through attention to the five ACURSC central capability factors.

**Table 5 – Research insights on how to leverage resilience in the food sector through attention to the five ACURSC central capability factors**

| Capability Factor | Suggestions and Insights |
|---|---|
| **Capability: Organization** | To work with firms in the food supply chain to build capacity in managing the adaptability of human resources during a variety of critical scenarios based on wide range of global risks. For example, by engaging the food supply chain in future exercises to test the UK response to pandemics, such as 'Exercise Cygnus' and understanding the consequences of such a crisis on the organization of the workforce. |
| **Capability: Anticipation** | To scope out major unexpected disruptions that could impact the food sector based on global risks and including these risks in sectoral assessments and business continuity plan training, while drawing on collaborations and networks to help map risks and build future resilience to such risks. |
| **Capability: Adaptability** | To foster discussion of best practices and protocols on how to quickly adapt to major disruptions, including learning from other important sectors in the Midlands Engine pan region (such as automotive and life sciences, for example) |

| | |
|---|---|
| **Capability: Flexibility in Sourcing** | Most food companies changed their sourcing policies due to COVID-19, with many switching to regional suppliers due to greater resilience. The possibilities of local substitutions could be explored through training and business support:<br>• Food companies should be encouraged to develop contingency plans for ingredients and other inputs<br>• Business support agencies can help companies to identify gaps and potential opportunities regarding the availability of regional suppliers |
| **Capability: Flexibility in Order Fulfilment** | To assess the magnitude of usual and alternative distribution channels of food based on a wide range of global risks. |

It is believed that ACURSC can be both a policy and a benchmarking tool used to trigger discussions and concrete initiatives around how the Midlands food supply chain could become more resilient.

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## APPENDIX A

To understand key insights in the literature on the resilience of supply chains in firms based in the Midlands Engine pan region, we conducted searches using the SCOPUS database (Elsevier) between 15 December 2020 and 10 January 2021 for relevant key research outputs. We started by exclusively searching for works related to resilience in food supply chains in the UK Midlands, but this search proved to be too narrow, and did not return any valid outcomes.

Consequently, *a broader search* was conducted using the search terms “supply chain”, “resilience”, and “Midlands” (Figure A.1), without any specifications regarding industry sector. This search produced just one result (Oxborrow & Brindley, 2012). This research argued that apparel SMEs in supply chains in the Midlands focus on three key factors to maintain competitiveness: innovation, relationships, and cultural aspects in supply chain management (Oxborrow & Brindley, 2012). This paper also found that SMEs in Midlands-based apparel supply chains tend to have more capacity for handling upstream supply chain relations, rather than downstream ones (Oxborrow & Brindley, 2012).

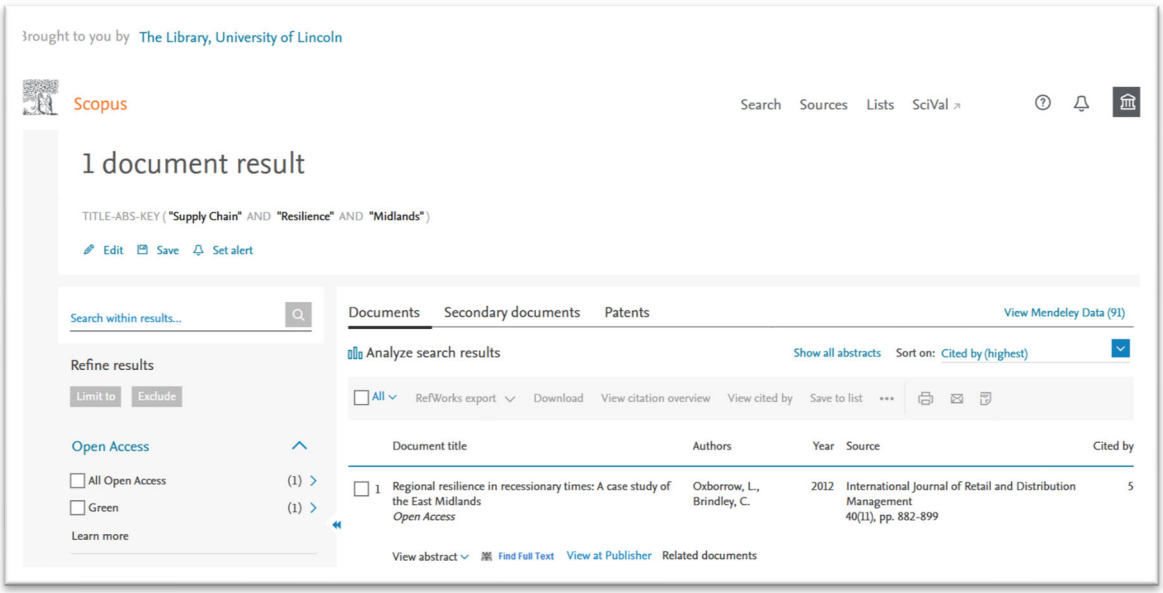


**Figure A.1– First search of SCOPUS database**

**Source: Authors**

In a second round (Figure A.2) of searching on the SCOPUS database, we used the search terms “supply chain”, “Midlands”, and “UK”. We did not specify research outputs related to the food sector because, as mentioned previously, this did not return any valid results. This

time, a total of 29 potentially useful research outputs were suggested by SCOPUS. However, once the research team working on this project had read these 29 papers, it was decided to remove a number of these results due to a clear lack of alignment with the area of management research. Examples of papers which were excluded from this research include Ilbery, Maye & Little (2012), whose research results do not have any apparent direct relation to supply chain management, although they do mention the term “supply chain” in their text. Another paper which was not included in this research was Balaman, Wright, Scott & Matopoulos (2018), which proposes a model to quantify waste and bioenergy demands in the West Midlands, with a focus beyond the scope of this research project.

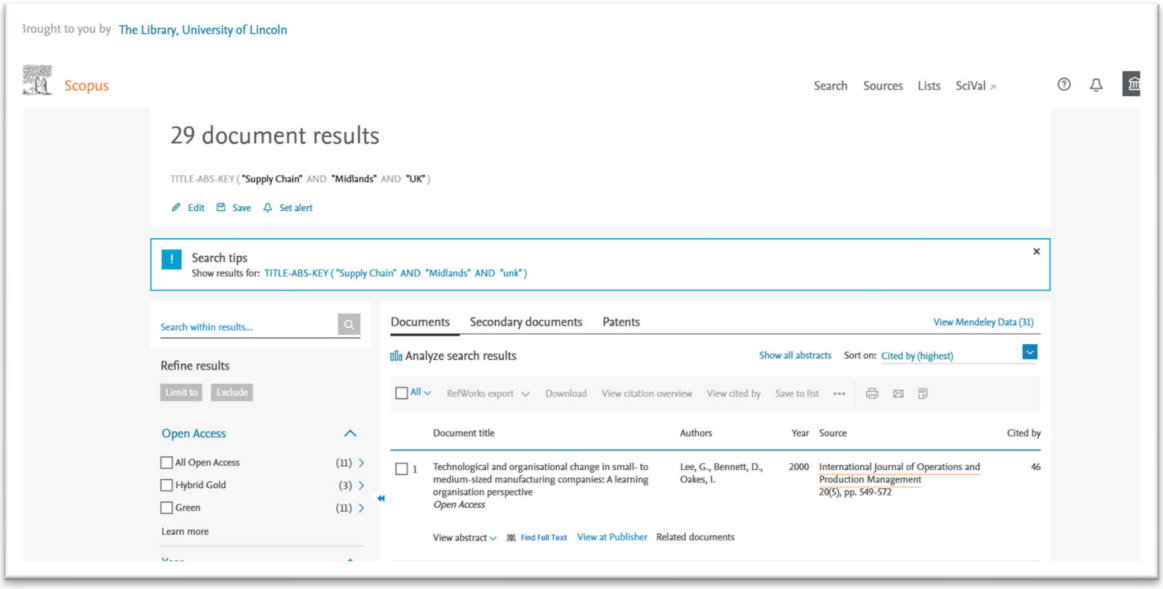


**Figure A.2 – Second search of SCOPUS database**

**Source: Authors**

From the systematic literature review conducted the first conclusion was that Pettit et al. (2010)’s portfolio of resilience capabilities has, so far, not being used to understand the resilience of Midlands food supply chain during the COVID-19 pandemic. Other key insights emerge from three main research streams:

- Insights on the complexity of emerging food supply chain dynamics in the Midlands (for example: Hingley, Lindgreen, Beverland, 2010)
- Lessons from research on SMEs and the Midlands’ automotive supply chain (for example: Lee, Bennett & Oakes, 2000; Dey, Yang, Malesios & Evangelinos, 2019)
- Ideas about the role of emerging IT developments, and other variables which affect the competitiveness of Midlands supply chains (such as: Simba, 2013)

While searching the SCOPUS database returned only a few works which simultaneously had a focus on ‘resilience’, ‘food supply chains’, and ‘Midlands’, it was possible to identify insights not only from the food sector, but also from other sectors, such as the automotive industry, as well as to gain insights from the challenges faced by Midlands SMEs in operating in supply chains.

Regarding insights from the food sector in the Midlands, Hingley, Lindgreen & Beverland (2010) found that diversification of the food chain in the Midlands was taking place through the emergence of ethnic food consumption. However, that trend faced challenges, such as the importance for food manufacturers of securing access, availability and information regarding fresh produce from wholesalers linked to international and globalised food supply chains. Adding to this, Beer, Hingley & Lindgreen (2016) conclude that actors in culturally diverse food supply chains need to develop an understanding of each other’s demands, and thus that collaboration in the supply chain is key to competitiveness.

Mainstream research on supply chain management in the Midlands focuses on either the automotive sector or SMEs, or both. In this context, Tilson (1999) affirms that studying the automotive sector in the Midlands is important because many trends in the automotive sector tend to be transferable to other sectors which are important to the Midlands, such as food and drink, domestic appliances, etc. In this context, one of the major transformations in how supply chains are managed in the Midlands was triggered by the adoption of management practices such as lean manufacturing and agile production (Qamar & Hall 2018). In this context, Qamar, Hall & Collinson (2018) affirm that Midlands firms implementing agile production methods were found to be more flexible in their relations with supply chains in comparison with firms implementing lean production methods.

Remaining with the automotive sector, the pressure faced by component suppliers – generally SMEs – was highlighted in the literature. For example, Lee, Bennett & Oakes (2000) found that Midlands-based component suppliers were facing pressures from major players in their supply chains – i.e. automotive manufacturers. These pressures included increasing emphasis on innovation and continuous improvement. However, Okamuro (1997), after investigating Midlands-based automotive firms, found that an important transformation in supply chains in the Midlands centered around the management of business relationships

with suppliers, which was considered an important source of competitiveness. This author believed that this change – towards a consideration that relationships with suppliers are relevant – was probably triggered by the transplantation of Japanese manufacturing philosophies to the UK, through UK sites of Japanese auto manufacturers. Finally, Dey, Yang, Malesios, De & Evangelinos (2019) highlight that the economic performance of SMEs operating in Midlands-based supply chains tends to be correlated with environmental and operational performance, and, therefore, discussions surrounding green issues in supply chains' decision-making processes are likely to be considered.

The existing literature on supply chain management in the Midlands points to the relevance of IT developments as both key to competitiveness and a real challenge, particularly for SMEs. Research suggests that information technology developments among firms in the Midlands can improve information flows and promote lean management (Homer & Thompson, 2001). Hayward, Todd & Reynolds (2006) suggest that SMEs in the Midlands can be vulnerable to the rapid development of technologies across supply chains, which can impact their competitiveness. They found that collaboration among firms was key to developing high value solutions in a collective fashion, while at the same time reducing risks by diversifying their presence in different markets.

Other variables were pointed out in terms of research concerning resilience in supply chains in the Midlands. For example, McKinnon (1991) affirms that warehousing in the UK tends to be concentrated in the Midlands and South East of England, which can benefit firms and supply chains in the Midlands, due to the proximity between the two regions. However, resilience in the supply chains of Midlands-based firms can be affected by specific factors, such as the availability of affordable energy (Mulhall & Bryson, 2014) and the ways in which major natural events and disruptions can affect transportation and logistics for supply chains operating in the Midlands (Jaroszweski, Hooper, Baker, Chapman & Quinn, 2015), which requires contingency plans. Finally, prior research has highlighted that the Midlands is a science hub, which facilitates the generation of social capital and the involvement of Midlands-based firms in global value chains, which are knowledge-intensive (Simba, 2013), and in this context, science parks and industrial hubs work in favor of firms in the Midlands (Simba, 2013).

## APPENDIX B

An invitation to take part in the research was sent out to all contacts (Figure B.1).

Dear,

On behalf of Midlands Engine Observatory, we are conducting a project to understand how the Midlands food supply chain was able to respond to COVID-19. The report will help government agencies, e.g. Councils and LEPs, to understand how their support for food companies can be strengthened.

We would like to invite you to be part of our work and are looking for supply chain professionals based in the Midlands to be briefly interviewed (20-30 minute online interview).

The identity of participants will remain anonymous. If you are interested in being part of this exciting project, please contact Prof Charbel J Chiappetta Jabbour through cchiappettajabbour@lincoln.ac.uk by 5th February 2021.

Thank you and best regards

Charbel J Chiappetta Jabbour, University of Lincoln

E-mail: cchiappettajabbour@lincoln.ac.uk

Webpage: https://staff.lincoln.ac.uk/559e4437-ac6c-46e3-8c1b-cab7ec8d2196

**Figure B.1 – Invitation to be part of the interviews of this research**

**Source: Authors**

## APPENDIX C

Interview Script – Firm's Level

1. How do you understand the term 'resilience of food supply chains'? What are the main capabilities of resilient food chains in your opinion? *Some examples of capabilities are: (a) flexibility; (b) collaboration; (c) financial strength.*
2. Please give 2-3 examples on when the capabilities were vital to keep your supply chain resilient during the pandemic?
3. Do you see any resilience gaps in your supply chain?
4. What are the challenges faced by your firm to achieve resilience in downstream supply chain? Any examples from the pandemic? What about upstream supply chain?
5. Do you have any comments on how policy makers and the government could act to help food supply chains to be more resilient in the Midlands? Please what would be your suggestion?

## APPENDIX D

Interview Script – Stakeholders of the Food Supply Chain

1. How do you understand the term 'resilience of food supply chains'? What are the main capabilities of resilient food chains in your opinion? Some examples of capabilities are: (a) flexibility; (b) collaboration; (c) financial strength.
2. Please give 2-3 examples on when the capabilities were vital to keep resilient food supply chains in the Midlands during the pandemic?
3. What are the challenges to achieve resilience in downstream supply chain? Any examples with focus on the Midlands?
4. What are the challenges to achieve resilience in upstream supply chain? Any Midlands based examples?
5. Do you have any comments on how policy makers and the government could act to help food supply chains to be more resilient in the Midlands? Please what would be your suggestion?

## APPENDIX E

To analyze the data, all interviews were transcribed into MSWord on the same day the interview was conducted through video call. We used NVIVO (NVivo version 20.4.0.4), a qualitative data analysis computer software package (QSR International). The transcription of each interview was inserted into NVIVO. 14 analysis codes were created, one code for each resilience capability according to Pettit et al. (2010). The figures below show screens from the software and coding process (Figures E.1 and E.2).

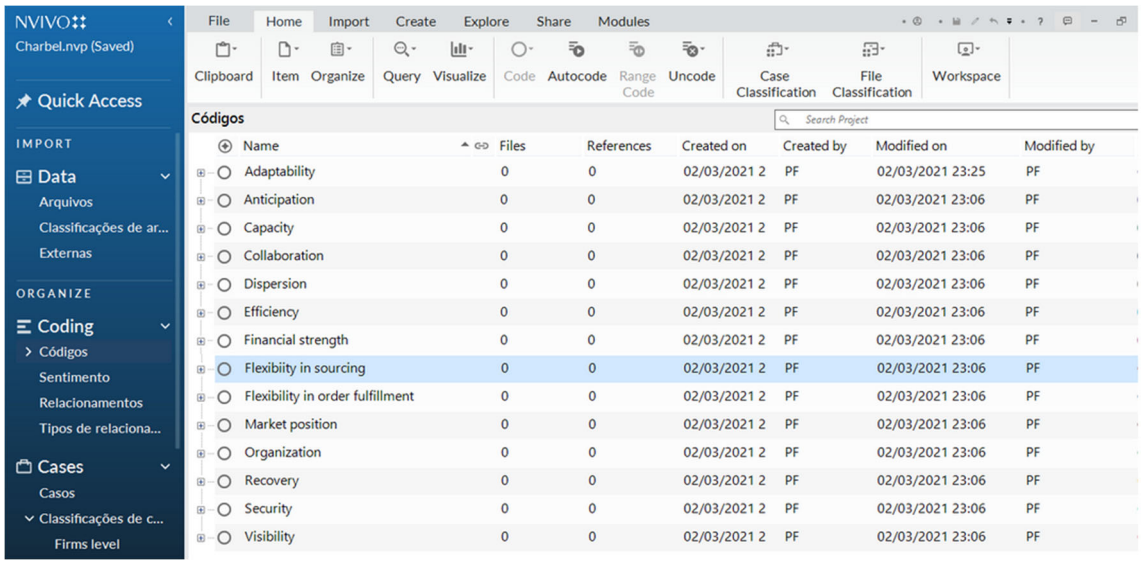


**Figure E.1 – Example 1 of Data processing through NVIVO based on Pettit et al. (2010)**

These codes were used to systematize the main findings, by generating:

- Word clouds
- Frequency (%) of the key resilience capabilities to support the development of the ACURSC framework.

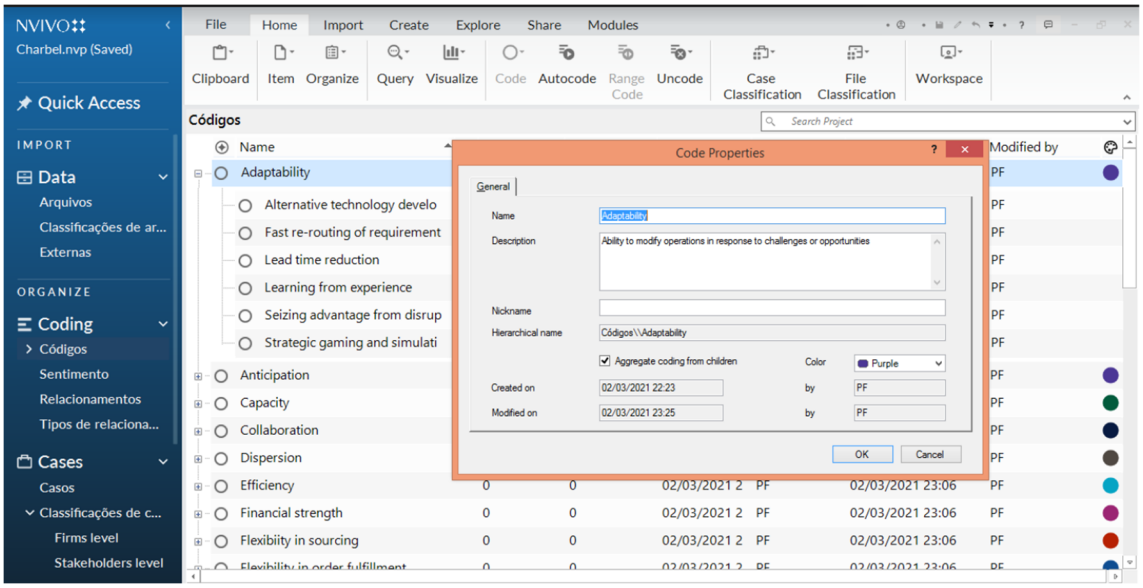


**Figure E.2 – Example 1 of Data processing through NVIVO based on Pettit et al. (2010)**

Once the coding procedure was complete, it was possible to systematize the main insights from the interviews in a more structured fashion.


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