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The Application of International Agile Methodology Principles in Supply Chain Management for Foreign Economic Activity

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ABSTRACT

BACKGROUND

This study examines the nature and structure of supply chains as integrated systems with clearly defined elements and interconnections. The objective of the research was to determine the specific characteristics of supply chains and the potential for applying Agile methodology principles within them.

MATERIALS AND METHODS

Methodologically, this work is based on an analysis of Agile methodology combined with a comparison of its features against traditional supply chain management approaches.

RESULTS

The findings demonstrate that constant changes in the external environment (particularly demand fluctuations, disruptions in logistics routes, market globalisation, and crisis situations) require the implementation of flexibility, adaptability, responsiveness, and alignment principles. It has been established that supply chains adhering to these principles exhibit greater resilience to external challenges and enable optimal resource management under uncertainty. A comparative analysis of traditional management models and Agile methodology revealed that conventional approaches, focused on stability and cost reduction, lose effectiveness in dynamic environments. In contrast, Agile methodology ensures rapid responsiveness to market changes, optimisation of logistics processes, and enhanced customer-centricity.

CONCLUSION

The study confirmed that adopting flexible management methods allows supply chains to adapt to variable conditions and minimise risks. Furthermore, the results highlighted that integrating complex information systems and digital technologies is a crucial prerequisite for implementing Agile methodology, enabling the formation of effective cross-functional teams, improving management transparency, and ensuring supply chain stability even under high uncertainty. The practical significance of this work lies in formulating recommendations for applying Agile methods and digital solutions to enhance the stability of supply chain operations.

Keywords: Adaptability, Customs authorities, Flexibility, Foreign economic activity, Management, Supply chains

Highlights

- Agile improves flexibility, adaptability, and transparency in supply chains.
- Traditional models lose efficiency in volatile and crisis-driven environments.
- Iterative planning and cross-functional teams enhance supply chain resilience.

- Digital tools are essential for effective Agile-based supply chain management.
- Ukraine's wartime context confirms Agile boosts continuity and risk mitigation.

Introduction

The relevance of research into Agile methodology in supply chain management (SCM) stems from its ability not only to facilitate rapid adaptation to changes but also to enhance companies' resilience to external threats, including wartime risks.¹ Agile methodology is a flexible management approach emphasising iterative progress, continuous feedback, and collaboration, ideal for dynamic and uncertain environments. Scholars are actively analysing its potential, as its core principles – flexibility, iterative planning, and transparency – contribute to the development of effective management systems capable of functioning even under persistent uncertainty.² Although classical approaches have proven effective in stable market conditions, their efficiency significantly declines in highly dynamic and uncertain environments.³ Rigid supply chain structures can hinder rapid adaptation to changes, such as sudden demand fluctuations, supply disruptions, or logistical inefficiencies, underscoring the necessity for more flexible management models capable of operating effectively under constant change.⁴⁻⁶

Researchers have identified certain aspects in an analysis of conceptual approaches to defining the essence of the term “supply chain.” For instance, Prunencko⁷ asserts that a supply chain is an ordered system comprising legal and natural entities (manufacturers, distributors, and other process participants) that carry out logistics operations to transport material flows between logistics systems (in the case of industrial goods) or directly to the end consumer. Krykavskiy,⁸ Smerichevska and Kovalov⁹ emphasise that a supply chain is characterised by the purposeful formation of interrelationships between economic entities, ensuring their integration and cooperation across space and time. This approach is the most contemporary and promising, as it allows supply chains to be examined from the perspective of integration, cooperation, and demand-driven marketing philosophy.

At the same time, scholar Kolodizeva¹⁰ notably highlighted the manifestation of flexibility and dynamism in supply chains concerning horizontal management structures that utilise shared resource pools, among which information resources play a key role. The integration of lean and Agile supply chain strategies was examined by Christopher and Towill,¹¹ who pointed out that Agile approaches are essential in settings where responsiveness and availability are critical, while lean methods work well in cost-driven markets.

Author contribution:

Vadym Borsa – Conceptualization, Methodology, Writing – Original Draft, Supervision; Nataliya Derzhak – Investigation, Data Curation, Writing – Review & Editing; Tetiana Mykytenko – Formal Analysis, Software, Visualization; Tetiana Chorna – Resources, Project Administration, Writing – Review & Editing; Iryna Sahaidak – Data Curation, Methodology, Writing – Review & Editing

Guarantor: Vadym Borsa

Provenance and peer-review:

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Data availability statement:

While the full interview transcripts cannot be publicly shared due to confidentiality agreements with participating organisations, the authors confirm that the data supporting the findings of this study are available in the article, including the information about and full interview guide (Appendix 3) and de-identified excerpts and the codebook (Appendix 4). All shared materials have been anonymised to remove any personally or commercially sensitive information in accordance with institutional data protection and ethical research guidelines. A small anonymised sample of coded excerpts per theme is available upon reasonable request from the corresponding author, with access granted in accordance with data protection regulations and ethical approval

To create supply chains that are both flexible and affordable, they proposed a hybrid model that combines the two paradigms. In a similar vein, Dubey et al.¹² investigated how supply chain agility (SCA) and competitive advantage can be enhanced by big data analytics capability (BDAC). According to their research, organisational flexibility plays a crucial moderating role in the positive relationship between BDAC and SCA, but it has had no discernible effect on the relationship between BDAC and competitive advantage. Both studies stress how crucial responsiveness and flexibility are to contemporary supply chains, especially when dealing with shifting and uncertain market conditions.

Thus, it becomes evident that these systems are conducive to comprehensive transformations, including enhanced flexibility and enterprise competitiveness, as well as improvements in pressing issues of green production. For instance, in the study by Dolatabad et al.,¹³ the implementation of Agile practices in green SCM was evaluated using a fuzzy multi-criteria approach. The results demonstrated that integrating Agile methods into green supply chains enhances their efficiency and resilience, facilitating better responsiveness to market fluctuations and environmental requirements.

Despite the substantial body of scholarly publications dedicated to Agile methodology, numerous questions remain regarding the effective integration of Agile approaches into traditional supply chains. Russia's armed aggression against Ukraine has fundamentally altered logistical realities at both the national and international levels, necessitating the exploration of new management models capable of ensuring supply continuity, minimising losses, and meeting consumer demands under critical conditions. In this context, the adaptation of Agile methodology gains particular significance, as it enables enterprises not only to respond promptly to external challenges but also to enhance their competitiveness through transparency and effective collaboration among all supply chain participants. Consequently, the aim of this study is to identify opportunities for applying Agile methodology principles to improve the efficiency and adaptability of such systems in today's dynamic market environment. Based on this objective, the following research tasks have been formulated:

1. Analyse the potential for implementing Agile methodology principles in SCM within the context of foreign economic activity.
2. Identify key Agile methodology principles that enhance the flexibility and adaptability of supply chains.
3. Develop recommendations for applying Agile methodology to strengthen supply chain resilience amid contemporary crisis challenges.

Materials and Methods**Research Design and Sampling**

This study provides primary data derived from an empirical analysis of the application of Agile methodology

principles in SCM for international trade. A thorough comparison between conventional linear models and Agile methodologies was made possible by the research's use of a systems analysis method to look at the supply chains as dynamic, integrated systems. The State Customs Service of Ukraine's¹⁴ statistical data, academic publications, and case studies of businesses impacted by the external crisis, including wartime conditions, were the main sources of the data.

Purposive sampling was used in the study, and participants were chosen from companies that had implemented Agile methodology and had suffered major supply chain interruptions. The sampling strategy was created to guarantee a wide variety of viewpoints from different industries impacted by the disruptions, such as consulting, logistics, and humanitarian services. Inclusion criteria involved selecting companies engaged in international trade or services where Agile methodologies were applied to mitigate supply chain risks during crises. Exclusion criteria were applied to businesses that had not implemented Agile practices in their operations or had not faced significant external disruptions such as geopolitical crises or trade disruptions. Operational metrics such as flexibility, response times, and adaptability in the face of disruptions were the main focus of data collection.

Operationalisation and Verification of the “Implemented Agile” Criterion

The inclusion criterion “implemented Agile” was operationalised through a twofold verification procedure that used documentation proof and self-reported confirmation during interviews in order to guarantee conceptual clarity and methodological consistency. If an organisation satisfied at least two of the following requirements, it was categorised as “Agile-implemented”:

1. Existence of formal Agile-based practices in logistics or supply management documented in internal policy papers, official websites, or project descriptions;
2. Participation of employees in certified Agile training programmes or institutional workshops;
3. Explicit references by management to iterative planning, cross-functional teams, or short adaptive cycles used for decision-making during crisis conditions.

During the pre-interview and recruitment phases, verification was carried out. Researchers asked for official confirmation through company correspondence or publicly accessible materials. Organisations that offered unambiguous affirmative proof were the only ones kept for analysis.

A total of 15 interviewed organisations met the “Agile-implemented” criterion, which was confirmed through documentation and interviews. Specifically, 11 gave explicit evidence of Agile-based processes, 9 confirmed attendances at certified Agile training, and all 15 mentioned iterative planning or cross-functional decision-making during a crisis. For the four case study

companies, verification relied on public records and official statements confirming Agile practices: logistics projects and partnerships (DiFFreight), transparency reports (Nova Poshta), media interviews (Rozdoum), and humanitarian coordination frameworks (Caritas Ukraine). Each verification step was documented in a case log, which recorded the source and type of evidence reviewed for every organisation to ensure methodological transparency and consistency across cases. An anonymised exemplar of verification evidence is provided in Appendix 1.

To strengthen methodological transparency, a detailed COREQ/SRQR checklist has been provided in Appendix 2, outlining adherence to established standards for qualitative research reporting.

Expert Interviews

To obtain a deeper understanding of how Agile principles are actually implemented in practice, qualitative interviews were also performed with executives, logistics managers, and supply chain coordinators, among other important participants in these supply chains. Because the interviews were semi-structured, they allowed for both in-depth answers and the freedom to discuss surprising discoveries during the discussion.

To ensure a wide range of viewpoints on Agile implementation in dynamic supply chain contexts, the interview sample size consisted of 15 participants. The theoretical saturation principle, which states that after 15 interviews, no new information is emerging, was used to determine the sample size. This number made sure that a range of viewpoints on the application of the Agile approach in various industries and company sizes were recorded. A cross-tabulation of the roles, sectors, and firm sizes is presented in Table 1. Each participant represented a different company. Therefore, experts from 15 companies were interviewed.

This cross-tabulation ensures a balanced representation of both large corporations and smaller organisations by displaying the distribution of roles across various industries and firm sizes. Understanding how Agile methods were applied in various organisational contexts required awareness of the diversity of firm sizes. The study was able to record different methods of implementing Agile in crisis situations by incorporating a broad sectoral range, such as consultancy, logistics, and humanitarian organisations.

Recruitment pathways were strategically chosen to access a range of perspectives within the target sectors. Given Ukraine’s wartime situation, particular recruitment channels focused on those from the industries

most impacted by continuing geopolitical upheavals. Participants were recruited through professional networks, business outreach, and conference connections. People from the supply chain management and logistics industries, as well as technology consulting and humanitarian aid organisations, were directly invited. Professionals from the industries most impacted by disruptions were contacted via email outreach.

Nonresponse was an important consideration in the recruitment process. Despite several follow-up letters and invites, some potential participants declined to take part owing to time restrictions or concerns over confidentiality and the sensitive nature of the ongoing crisis. Four possible participants did not reply to the invitations, indicating a moderate nonresponse rate. However, as saturation was achieved after the fifteenth interview, this had no apparent effect on the sample size.

To investigate the use and effects of the Agile approach in supply chains, a semi-structured interview guide was created. It included open-ended enquiries meant to provide for a range of possible answers. A full interview guide is provided in Appendix 3. Each interview lasted between 45 and 60 minutes, and they were done over a two-month period, from March to May 2024. Every interview was arranged at the participants’ convenience. Interviews were conducted in English, and all participants spoke the language fluently. However, this may have resulted in certain prejudices since Ukrainian and Russian are the two main languages spoken in Ukraine. Interviews conducted only in English might have restricted participation to individuals with higher levels of English proficiency, which might have skewed opinions in favour of those who are more familiar with global corporate processes and have less connection to local linguistic contexts. All of the interviews were audio recorded with the participants’ permission. To guarantee precision in data processing, recordings were verbatim transcribed. Automated transcription software was used to complete the procedure, and then the accuracy and consistency were checked by hand.

A multi-step verification procedure was used to guarantee the quality of the data. A second researcher double-checked the accuracy of the transcriptions. Participants were able to examine their interview transcripts for accuracy or clarification through a member-checking procedure. Additionally, data triangulation was employed, integrating statistical data, case study assessments, and interview insights. The study was conducted with confidentiality. Participants were made aware of

Table 1 | Cross-tabulation of roles by sector, firm size, and location

| Role | Sector | Firm Size | Location | Recruitment Channels |
|--|-------------------------|-----------------------------|----------|--|
| Executive (3 participants: A-C) | Logistics | Large (1000+ employees) | Ukraine | Business networks, email outreach |
| Logistics Manager (4 participants: D-G) | Logistics | Medium (500–1000 employees) | Ukraine | Conferences, professional networks |
| Supply Chain Coordinator (4 participants: H-K) | Supply Chain Management | Small (100–500 employees) | Ukraine | Direct invitation, professional networks |
| Executive (1 participant: L) | Tech Consulting | Small (100–500 employees) | Ukraine | Direct invitation, business networks |
| Logistics Coordinator (3 participants: M-O) | Logistics | Medium (500–1000 employees) | Ukraine | Email outreach, professional networks |

Source: Compiled by the authors.

their freedom to leave at any moment without facing any repercussions. Only aggregated findings were used, and personal identifiers were eliminated. All information was kept in password-protected folders that the research team alone could access.

Evidence of Data Saturation

After 15 semi-structured interviews and an inductive coding process, saturation was reached. Throughout the data collection process, a saturation monitoring memo was kept, documenting the appearance of new codes and themes for each interview. Interviews 14 and 15 corroborated thematic duplication, confirming theoretical saturation, as no new substantial themes emerged after the thirteenth interview (Table 2).

Coding Process

In this study, reflexive thematic analysis was used to examine qualitative data from the primary and secondary sources. There were multiple steps in the coding process. To become acquainted with the data, the interview transcripts were first reviewed several times. The coding process began with open coding, where initial codes were derived directly from the data. As coding progressed, the research team collectively worked to group similar codes into candidate themes. These candidate themes were then reviewed and refined to create final themes that captured the essence of the data. Table 3 illustrates the theme development process, including the relationship between codes, candidate themes, and final themes.

The research team worked together to create the codebook (Appendix 4), making sure that the codes accurately reflected the subtleties of participants' experiences and perceptions. To guarantee uniformity and dependability in coding, coder training was carried out. Every researcher received training on how to apply the coding framework to the data and how to use the codebook. The training strongly emphasised reflexivity, encouraging coders to examine their own potential biases and maintain an open-minded approach towards diverse interpretations of the data.

Disagreements among coders over code definitions and theme classification were settled through many discussions during the theme development process. These conversations made it possible to settle disagreements and guaranteed that the final themes appropriately reflected the information. In the analytical process, each coder had a specific function to play: one was responsible for organising the data and doing preliminary coding, while the other was in charge of honing the codes and facilitating conversations on the development of the themes. The analysis was transparent and consistent because of this cooperative procedure.

The program NVivo was used for data management and coding to make it easier to organise the data and apply the codes. An inductive strategy was used to derive themes, which involved grouping related codes together to identify patterns in the data. Through team conversations, the final themes were honed and examined to ensure that they appropriately reflected the viewpoints of the participants and the study questions. To guarantee the validity and comprehensiveness of the study, researchers consistently reviewed their pre-suppositions and interpretations, maintaining reflexivity throughout the process.

To clearly illustrate the connections between various themes and the ways in which interview data influenced the final conclusions, a thematic map was made (Figure 1).

Triangulation Protocol

Triangulation was used to combine primary data and secondary cases in order to guarantee analytical rigour and improve the reliability of the results. This made it

Table 2 | Evidence of thematic saturation

| Interview No. | New Codes Identified | Cumulative Code Count | Memo Note Summary |
|---------------|----------------------|-----------------------|---|
| 1–5 | 21 | 21 | Initial emergence of core categories (flexibility, cross-functionality, risk mitigation). |
| 6–10 | 6 | 27 | Additional sub-codes related to digital visibility and team autonomy identified. |
| 11–13 | 2 | 29 | No major new codes; repetition of previously identified patterns. |
| 14–15 | 0 | 29 | Full thematic redundancy confirmed. |

Source: Compiled by the authors.

Table 3 | Theme development process

| Codes | Candidate Themes | Final Themes | Exemplar Quotes |
|---------------------------|-----------------------------------|-------------------------|--|
| Flexibility, adaptation | Supply chain responsiveness | Agile adoption | Participant A, Executive: "Agile has been integral in restructuring our logistics strategy during the crisis." Participant D, Logistics Manager: "The shift to Agile helped us adapt quickly to unexpected disruptions in our supply chains." |
| Real-time decision making | Decision-making speed | Flexibility in response | Participant H, Supply Chain Coordinator: "We adapted quickly to changes in logistics routes." Participant B, Executive: "Being flexible with our delivery methods during the crisis allowed us to keep up with customer demand." |
| Cross-functional teams | Collaboration across departments | Cross-functional teams | Participant M, Logistics Coordinator: "Our teams came together to make decisions fast." Participant G, Logistics Manager: "Collaboration across departments was essential for rapid decision-making." |
| Communication efficiency | Information sharing | Iterative planning | Participant L, Executive: "We made changes immediately based on real-time data." Participant J, Supply Chain Coordinator: "Iterative planning helped us continuously reassess and adjust our strategies." |
| Risk mitigation | Crisis response, mitigation plans | Resilience building | Participant A, Executive: "We minimised risks by staying flexible in our approach." Participant F, Logistics Manager: "Agile helped us build a more resilient supply chain that could bounce back quickly from disruptions." |

Source: Compiled by the authors.

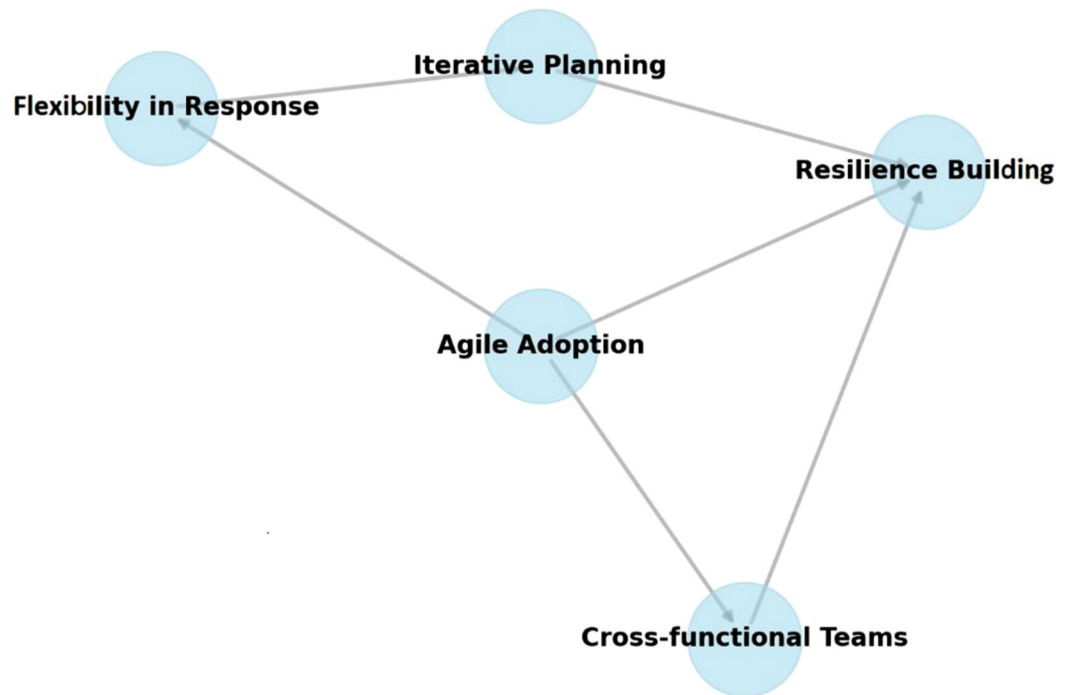


Fig 1 | Thematic map: relations between themes

Source: Compiled by the authors.

possible to have a deeper comprehension of how the Agile approach is actually used in various industries.

The triangulation process was a multi-step procedure. Semi-structured interviews were used to collect primary data, which offered detailed insights into the practical use of Agile principles. The results from the interviews were contextualised and supported by secondary data, such as reports from the State Customs Service of Ukraine¹⁴ and case studies of businesses functioning in crisis situations, such as wartime Ukraine. In order to determine areas of convergence, and the significance of flexibility in crisis response, and divergence, such variations in sectoral uses of Agile principles, data from both sources were examined.

Through this triangulation approach, the study ensured that the findings were not reliant on a single data source, increasing the credibility and generalisability of the results.

Other Methods and Instruments

The analysis instruments used include comparative methods for evaluating the effectiveness of Agile practices against traditional SCM strategies. The comparison was conducted based on key criteria: flexibility, adaptability, transparency, customer-centricity, and communication efficiency. Data triangulation was used to guarantee a solid analysis, fusing qualitative insights from expert interviews and case study evaluations. As a result, generalised characteristics of each approach were formulated, aiding in the identification of their strengths, weaknesses, and potential for integration in real-world supply management scenarios.

Particular attention was paid to defining the key principles of Agile methodology most relevant to SCM.

The methodological approach involved interpreting these principles within the context of international economic activity, thereby clarifying their role in enhancing the competitiveness of enterprises in global markets.

The study applied the method of logical generalisation, which facilitated the formulation of key recommendations for implementing Agile methodology in SCM. The synthesis of research findings enabled the development of practical recommendations for adapting flexible approaches to the specific operational conditions of enterprises engaged in international trade. Furthermore, based on an analysis of current trends in logistics and international economic activity, as well as a thorough examination of statistical data from the State Customs Service of Ukraine¹⁴ regarding the country's foreign economic operations during full-scale war, conclusions were drawn regarding the future development of flexible approaches and their impact on the efficiency of managerial processes.

Primary and Secondary Data

Both primary and secondary sources of data were used in the investigation. Key participants' semi-structured interviews provided the primary data. Case studies of companies that were specifically identified as secondary sources, including DiFFreight, Nova Poshta, Rozdoun, and Caritas Ukraine, provided the secondary data. Although they were maintained separate from primary interview data in all analyses, these secondary cases were used to enhance the findings from the interviews. The company vignettes were developed exclusively from publicly available statements. All quotations were drawn verbatim from verified public

sources, which are cited accordingly in the reference list, and no confidential or unpublished information was included. As the content is based entirely on open data, no informed consent was required, and ethical compliance was ensured through the exclusive use of publicly accessible materials.

Ethical Consideration

The study adhered to ethical guidelines, and the participants were informed about it and its purpose. They provided their consent to the participation.

Results

Classical Supply Chain Management: Challenges in Coordination, Legal Independence, and Flexibility

SCM is one of the pivotal domains of contemporary management, encompassing a wide range of tasks related to the delivery of products from manufacturers to end consumers.¹⁵ It is a process of managing the flow of goods and services from raw materials to final delivery to consumers. The traditional approach to SCM is based on a centralised model aimed at optimising resource utilisation by minimising costs, enhancing logistics efficiency, and improving customer service levels.¹⁶

A crucial prerequisite for forming a supply chain is the presence of a focal company, which plays a leading role in its operation. Participant M, logistics coordinator, said, "As the focal point of our supply chain, we coordinated efforts across multiple partners to maintain production during supply disruptions." Typically, a focal company is the producer of the final goods or services, though large retail networks or logistics providers may also assume this role. Additionally, particular emphasis is placed on coordination and cooperation among all stakeholders, especially between suppliers and customers.^{17,18}

The foundation of classical SCM lies in linear models, which enable effective planning and coordination of activities across the entire supply chain.^{19,20} These models involve sequential processes where each subsequent stage depends on the completion of the preceding one. Among the primary objectives of classical SCM are cost optimisation, achieved through efficient resource utilisation, rational inventory planning, and logistics cost minimisation.²¹ Another critical task is reducing product delivery times to end consumers, which enhances a company's competitiveness and enables it to promptly meet customer demands.²² Ensuring high service quality is also a key priority, as it fosters customer loyalty and contributes to market share growth.²³

Simultaneously, a defining feature of supply chains is the legal independence of their participants, creating a competitive environment both among direct chain members and external market entities.²⁴ "The legal autonomy of our suppliers made it challenging to negotiate quick changes in response to the supply disruption. The lack of cohesion delayed our response time," said Participant J, supply chain coordinator. This highlights how legal independence impacts

crisis management. Moreover, it is important to note that supply chains are prone to conflicts.²⁵ A primary source of conflict stems from divergent goals and priorities among different chain participants. Another significant factor is the disparity in ownership structures among legally independent entities, which may influence strategic decisions and the level of collaboration. Conflicts also arise from imbalances in production capacity, financial resources, and capitalisation among supply chain members. Nevertheless, the classical approach remains foundational for many enterprises operating in relatively stable industries with predictable demand patterns.

Agile Methodology in Contemporary Management: Enhancing Flexibility, Innovation, and Cross-Functional Collaboration

In the context of rapid digital transformation, which demands new approaches to operational management, there arises a necessity to develop management concepts grounded in the principles of Agile methodology.²⁶ This approach is essential for enhancing organisational efficiency because it is based on the principles of equilibrium, stability, information processing, and knowledge-driven decision-making. The managerial paradigm of modern organisations involves the integration of diverse strategic and operational management approaches, emphasising flexibility, innovation, and digital technologies.^{27,28} However, the success of digital tools in supporting Agile processes depended on various aspects. For example, it was difficult for smaller businesses or those in less technologically sophisticated industries to effectively utilise digital technologies, which hindered the smooth integration of collaboration platforms and real-time tracking.

The application of multi-vector management approaches is integral to effective management, reflected in the emergence of a new generation of managers.^{29,30} The training of such professionals is founded on principles of self-organisation, creative thinking development, and strategic vision.³¹ This, in turn, fosters the creation of new software solutions to support managerial processes, which are viewed as complex adaptive systems. Additionally, the importance of cross-functional teams – critical to Agile implementation – must be emphasised. These teams unite specialists from diverse domains, such as procurement, logistics, marketing, and finance, ensuring alignment across departments and enhancing managerial decision-making efficiency. By collaborating on shared objectives, they foster higher accountability and engagement among all participants. At the same time, the degree of departmental integration and organisational culture affected how well cross-functional teams performed in enhancing decision-making and cooperation. It took a lot of work to break down communication barriers and overcome initial reluctance when cross-functional teams were formed in organisations where siloed departments had typically operated independently. For example, Participant F, a logistics manager, said: "Our

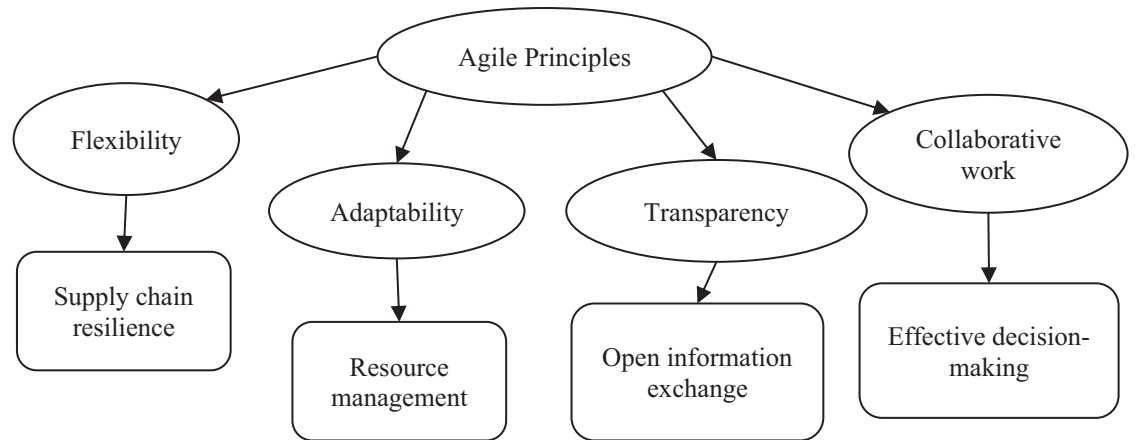


Fig 2 | Agile principles and their connection to specific SCM performance metrics
 Source: Compiled by the authors.

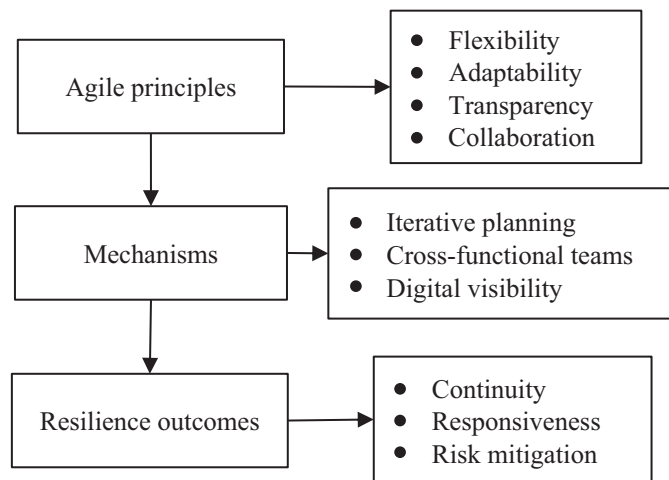


Fig 3 | Conceptual model linking agile principles, mechanisms, and resilience outcomes under crisis
 Source: Compiled by the authors.

cross-functional teams were essential in translating high-level strategy into real-time logistics decisions.”

Agile methodology serves as the theoretical foundation for comprehending the concepts and models of contemporary management, representing an innovative approach that necessitates a methodological framework for interpreting the evolution of management as a complex social and dynamic process.³² The Agile methodology is based on several principles that are critically important for the effective operation of modern enterprises (Figure 2). They include flexibility, adaptability, transparency, and collaborative work. “Agile helped us enhance collaboration between departments. Real-time data sharing enabled faster decision-making, keeping us competitive even during the crisis,” explained one of the interviewed supply chain coordinators, Participant H. Collectively, these principles establish a solid foundation for the implementation of Agile methodology under conditions of high business environment dynamism.

Figure 2 links Agile principles to supply chain management performance measures, emphasising the

necessity of flexibility in responding to disruptions, as demonstrated in organisations adjusting to logistical constraints and market developments. The Agile approach uses iterative planning to improve decision-making, allowing organisations to react quickly to changing situations and efficiently allocate resources. Agile’s resilience-building helps ensure long-term business continuity in difficult environments. These concepts demonstrate the link between Agile methodology and improved supply chain performance metrics, especially in dynamic and unexpected contexts.

Agile Principles and Organisational Resilience: A Dynamic Approach to Crisis Management in Supply Chains

The conceptual framework that links Agile principles to organisational resilience was developed (Figure 3). This framework highlights the importance of basic Agile ideals in helping firms resist and swiftly recover from shocks, in addition to being the cornerstone for increasing operational efficiency. The following flowchart demonstrates the sequential relationship

between these Agile principles, the mechanisms by which they are implemented, and the resilience outcomes that are essential for preserving stability and navigating crises.

The conceptual model in Figure 3 connects Agile principles to resilience results by highlighting important mechanisms, including digital visibility, cross-functional teams, and iterative planning, that collectively promote supply chain continuity, responsiveness, and risk reduction. This model differentiates itself from other well-known frameworks by emphasising how Agile principles directly affect supply chain performance and how they may be dynamically integrated into them during times of crisis. The Agile model gives a more nuanced approach to supply chain resilience under volatility by emphasising the ability to continuously adapt and respond to changing problems, in contrast to traditional resilience models, which place greater emphasis on stability or robustness in the face of disruption.

For instance, well-known frameworks like the resilience-viability link frequently highlight long-term sustainability and the ability to bounce back from shocks. These models emphasise how resilient the supply chain is, recovering from interruptions more slowly but steadily. For instance, participants consistently emphasised that iterative planning enabled “quick reconfiguration of delivery routes under uncertainty” (participant D, a logistics manager), while cross-functional collaboration “reduced delays by decentralising decision-making” (participant M, a logistics coordinator). The emphasis, however, switches to quick reactivity and flexibility in the case of Agile SCM, as shown in Figure 3, where companies quickly and iteratively modify their processes in response to the external environment’s present reality. The idea here is that Agile principles, like cross-functional cooperation and iterative planning, perform better than traditional models in high-uncertainty contexts because they allow for quicker, more efficient reactions to disturbances.

Context-Dependent Resilience: The Role of Agile Principles in Adaptive Supply Chain Management

To better understand the observed disparity in resilience results, it is critical to draw on known viability and resilience models, particularly those proposed by Wieland and Wallenburg³³ and Christopher and Peck.³⁴ These academics argue that resilience is more than simply the ability to survive shocks; it also includes adaptive and absorptive capacities that enable systems to adjust and evolve in response to changing situations. Agile principles, such as iterative adaptation, cross-functional cooperation, and digital visibility, reflect these capabilities by allowing organisations to adjust quickly to external shocks. Ivanov and Dolgui³⁵ also support this view, stating that Agile approaches help to retain the essential functions of socio-technical systems throughout protracted disruptions, ensuring that companies can continue to function while adjusting to new difficulties. The findings of this study are consistent with these theoretical viewpoints,

demonstrating that Agile designs enable rapid reconfiguration and improve short-term resilience.

However, the study reveals that the long-term viability of Agile techniques is dependent on the institutionalisation of collaborative learning practices that go beyond immediate crisis management. In other words, while Agile’s capacity to support quick changes is critical in dynamic and volatile contexts, its actual longevity is dependent on the continuous development of learning mechanisms that permit sustained adaptability. This establishes a fundamental threshold for the research: Agile approaches are best effective in highly dynamic situations with decentralised communication, where flexibility is essential. In contrast, in more stable or hierarchically structured environments, where quick changes are less important, the benefits of Agile fade, and traditional ways may suffice. Thus, the effectiveness of Agile in creating resilience is context-dependent, fluctuating with the level of environmental instability and organisational structure.

The digital visibility was also repeatedly cited as a core enabler of continuity, with one executive, participant A, noting, “Real-time dashboards allowed us to anticipate bottlenecks before they disrupted operations”. The comparative analysis in the Results section also highlights boundary conditions where Agile provides the greatest marginal benefit compared to classical SCM. While classical models focus on stability and cost minimisation, they struggle to adapt to the dynamic and unpredictable environments that characterise today’s supply chains, particularly during crises like those experienced in Ukraine. Agile, in contrast, excels in environments where flexibility, speed, and real-time decision-making are critical. The data show that organisations leveraging Agile principles demonstrated superior resilience, particularly in responding to sudden disruptions and shifting demands (participant D, a logistics manager; participant M, a logistics coordinator).

Agility in Crisis: Enhancing Supply Chain Flexibility and Responsiveness Through Agile Principles

Agile principles are especially helpful in supply chains that are undergoing frequent or unanticipated disruptions, where classic SCM models that depend on strict forecasts and long-term stability may not be sufficient. This is a crucial border condition in this difference. Agile concepts, for example, work well in situations where demand is very variable, transportation infrastructure is constantly challenged (for example, by geopolitical conflicts), or customer tastes change quickly, as is the case in Ukraine during wartime. On the other hand, classical models that emphasise cost optimisation and predictable resource allocation might be better suited in more stable contexts with fewer disturbances since their efficiencies outweigh the need for flexibility.

Agile methods place a high value on flexibility, which aids businesses in handling emergencies and satisfying client needs when conditions are unpredictable. Rigid projections and predetermined plans in a traditional supply chain can lead to bottlenecks in the

event of unforeseen circumstances, making it more difficult for a business to change course. Agile’s iterative planning, on the other hand, enables businesses to modify their strategy in response to new facts, enabling speedier reactions. Rapid adaptation lowers the chance of supply chain failures, allowing companies to keep providing goods and services without suffering major setbacks. Agile also promotes teamwork by dismantling organisational silos and encouraging candid communication, which speeds decision-making even more.

Gligor and Holcomb³⁶ highlight that supply chain agility, which is necessary for businesses to react to disturbances efficiently, is largely dependent on logistics skills. The authors emphasise that supply chain agility is not just a theoretical idea but rather a realistic requirement that depends on particular logistical skills, including operational flexibility, real-time information sharing, and the capacity to quickly adjust to shifting market conditions. This emphasises how crucial it is to incorporate Agile concepts into logistics plans in order to improve responsiveness and preserve business continuity, particularly in times of emergency.

The application of Agile methodology in supply chains enables rapid adaptation to fluctuations in demand and supply, which constitutes one of the principal advantages of this approach. Owing to short delivery cycles, enterprises can promptly respond to shifts in consumer preferences and reduce the risk of excess inventory accumulation.³⁷⁻³⁹ This, in turn, contributes to cost reduction, as the absence of surplus stock lowers expenses related to storage and logistics. For systematic comparison, Table 4 contrasts Agile methodology with classical SCM approaches.

Table 4 shows how Agile and conventional SCM methods differ in flexibility, adaptability, and transparency. Agile’s rapid response to unexpected disruptions like logistical issues or market volatility contrasts with classical models’ rigidity. The table also emphasises Agile’s cross-functional teams, which enable real-time communication and collaborative decision-making across departments, a benefit over hierarchical approaches. In conclusion, Agile iterative planning helps organisations to make immediate, continuing adjustments, boosting transparency and meeting customer needs more efficiently.

Therefore, the implementation of Agile methodology in SCM may be more appropriate for enterprises

operating in highly dynamic industries where rapid adaptation to changes is essential. Conversely, the classical approach remains relevant in stable market conditions, where the priority is cost minimisation and ensuring the predictability of business processes. However, it is impossible to overlook that Russia’s armed aggression against Ukraine has significantly altered the conditions of supply chain operations, creating new management challenges. The war has caused disruptions in logistics, destruction of critical infrastructure, and blockades of key transport routes, forcing businesses to swiftly seek alternative delivery methods.^{40,41} Under such conditions, traditional SCM models have become even less effective, as they are incapable of ensuring rapid adaptation to crisis situations.

Thus, it has become evident that the use of Agile methodology in the Ukrainian context is an outright necessity. One of the key advantages of Agile methodology in crisis situations has been the ability to quickly revise and adjust plans in response to external environmental changes. Instead of relying on fixed long-term strategies, enterprises can use short iterations to regularly assess the current situation and make new decisions. At the same time, active communication among all supply chain participants remains a key factor in effective adaptation. In wartime, ensuring process transparency and timely data exchange between suppliers, carriers, and customers significantly reduces response times to changes. The implementation of digital platforms for monitoring and coordinating logistics operations facilitates more synchronised workflows, minimising the risks of delays and losses.^{42,43} For example, Participant O, a supply chain coordinator, said: “Close communication with suppliers meant we could switch to alternative materials within days.” Another participant L, an executive, stated: “Transparency with both customers and suppliers built trust that compensated for slower routes.”

Enhancing Supply Chain Resilience Through Team Autonomy and Agile Methodology: Insights From the Ukrainian Crisis

Team self-organisation and the expansion of their decision-making authority represent another crucial aspect of Agile methodology, which enables enterprises to operate more autonomously and efficiently. In crisis conditions, where traditional management structures

Table 4 | Comparative characteristics of agile methodology and SCM

| Criteria | Agile Methodology | Classical SCM |
|--------------------------|---|--|
| Flexibility | High adaptability to external changes in market demand, supply, or infrastructure | Limited flexibility, often reliant on long-term forecasts and fixed plans |
| Adaptability | Ability to adjust business processes and strategies in response to new conditions | Focus on stability with slower response to market or logistical shifts |
| Transparency | Real-time visibility of information across teams and stakeholders | Information flow often constrained within silos, with less real-time access |
| Customer-centricity | Clients participate in interim result discussions via product concept iterations | Alignment with consumer demand for goods/services, ensuring end-user delivery and fulfilment of service/product expectations |
| Communication efficiency | Seamless, open communication across all levels and functions in the supply chain | Communication typically hierarchical, with delays in decision-making and response times |

Source: Compiled by the authors.

increasingly lose effectiveness due to the complexity and speed of changes, forming cross-functional teams that independently make on-the-ground decisions significantly enhances system resilience, which encompasses the ability of a supply chain to recover and continue operating despite disruptions. This allows businesses to more quickly devise solutions to overcome logistical barriers, reduce their reliance on centralised management, and ensure flexibility in crisis situations.

Accordingly, Pettit et al.⁴⁴ argue that strengthening supply chain resilience entails giving teams the autonomy to decide for themselves, which is crucial for reacting quickly to interruptions. Their conceptual framework emphasises how crucial it is to support self-organising teams in supply chains so that they can quickly adjust, efficiently manage risks, and continue operating even in the face of adversity. Participant B, an executive, claimed: “Building resilience through flexible processes allowed us to sustain operations even under wartime conditions.” For example, participant M, a logistics coordinator, suggested: “Cross-training staff was our backup plan: if one hub went offline, another team could take over instantly.” This is in line with the Agile methodology’s focus on team autonomy as a crucial component of crisis resilience.

Official statistical data from the State Customs Service of Ukraine¹⁴ demonstrate the dynamics of the country’s foreign trade operations, reflecting the impact of external and internal factors (the COVID-19 pandemic and full-scale war) on supply chains (Table 5).

Data for Table 5 were extracted directly from the official annual reports of the State Customs Service of Ukraine¹⁴. Each report included aggregates of imports, exports, and total trade turnover at the national level, expressed in millions of US dollars. The trade balance was recalculated as exports minus imports, and the numbers were rounded to two decimal places and translated to billions for consistent presentation. To ensure consistency, all data were compared to the relevant tables in the original papers. It should be mentioned that starting with the 2022 report, the Customs Service changed the definition of “trade turnover” to include certain types of humanitarian and temporary imports that were previously excluded. This change accounts for some of the small differences with previous reports, but it has no impact on the overall comparative dynamics shown in the updated table.

Exports and imports (billion USD) refer to the total value of goods and services Ukraine sold to or purchased from other countries, respectively, measured in billion US dollars. Trade Turnover (billion USD) is the sum of both these indicators, reflecting the total volume of trade between Ukraine and its international partners, again in billion US dollars. Balance (billion USD) represents the difference between exports and imports. A negative balance indicates a trade deficit, meaning imports exceeded exports, while a positive balance indicates a trade surplus, with exports exceeding imports. This is also measured in billion US dollars.

In 2019, trade turnover was stable with no major supply chain disruptions. The COVID-19 pandemic in 2020 caused a decline in exports and imports due to quarantine measures, logistical issues, and reduced global demand, highlighting the limitations of the supply management system in rapid crisis adaptation. The full-scale war in 2022 led to a further significant contraction in trade, with critical supply chain disruptions and infrastructure damage hindering adaptation. Although, in 2023, a positive trend can be observed, showing that changes in supply management contributed to the surplus balance.

Leveraging Agile Principles for Resilience: Adaptation and Flexibility in Ukrainian Businesses Amid Crisis

For Ukrainian businesses navigating the intricacies of wartime disruptions, the incorporation of Agile methodologies into logistics operations has proven crucial. One such example is DiFFreight, a Ukrainian logistics company, which partnered with the National Aviation University to provide hands-on training in international logistics.⁴⁵ DiFFreight’s logistics manager claims that the implementation of Agile principles has significantly enhanced the company’s ability to respond to unforeseen disruptions. “Our teams now operate with far greater flexibility,” stated the logistics manager, “we can adapt quickly to new challenges, which has been crucial during the conflict.” This statement demonstrates the useful advantages of Agile approaches by highlighting the enhanced flexibility within the organisation’s logistical architecture. Additionally, the training programme’s emphasis on iterative learning and real-time problem-solving has improved the company’s responsiveness while also assisting future logistics workers in acquiring the skills they need to better adapt to the ongoing war.

In a similar vein, one of Ukraine’s top courier services, Nova Poshta, has shown incredible fortitude in the face of war-related infrastructure difficulties. According to a logistics coordinator from Nova Poshta, “We had to change course fast because the war interfered with our usual routes. We were able to sustain on-time delivery by quickly modifying our logistics structure, concentrating on road transport, and adopting Agile’s iterative methodology.” This illustration demonstrates how Nova Poshta used Agile concepts, like flexibility and quick decision-making, to preserve service continuity in the face of difficulties brought

Table 5 | Dynamics of Ukraine’s foreign trade operations, 2019–2023

| Year | Exports, Billion (USD) | Imports, Billion (USD) | Trade Turnover, Billion (USD) | Balance, Billion (USD) |
|------|------------------------|------------------------|-------------------------------|------------------------|
| 2019 | 50.06 | 60.41 | 110.47 | -10.35 |
| 2020 | 49.20 | 54.23 | 103.43 | -5.03 |
| 2021 | 68.09 | 73.29 | 141.38 | -5.20 |
| 2022 | 44.17 | 59.50 | 103.67 | -15.33 |
| 2023 | 35.66 | 21.93 | 57.59 | 13.73 |

Source: Compiled by the authors.

on by changing conditions.⁴⁶ “Agile allowed us to stay ahead of the disruptions. Instead of waiting for perfect conditions, we acted on the best available data and iterated as we went,” said another Nova Poshta team leader. This emphasis on flexibility enabled the company to continue operations in an unstable environment, reinforcing the value of Agile’s responsiveness in maintaining business continuity during crises.

A cross-case analysis of DiFFreight and Nova Poshta identifies a common theme: both businesses highlighted flexibility and adaptation as essential elements of their success. While Nova Poshta’s agility was based on quick operational changes, such as shifting transport methods, DiFFreight prioritised responsiveness and iterative learning through partnerships and training. Building cross-functional teams and encouraging iterative problem-solving were the main factors in DiFFreight’s agility, which enabled the business to swiftly modify operations in reaction to unanticipated interruptions. However, Nova Poshta showed how Agile’s iterative methodology might be used to swiftly restructure logistics operations in the face of changing external circumstances, especially when infrastructure is damaged.

The Kharkiv-based tech consulting company Rozdoum serves as an example of how Agile approaches can be applied to other business operations in addition to logistics.⁴⁷ “We’ve always been focused on adaptability, but the war accelerated our adoption of Agile practices,” the CEO of Rozdoum said in an interview. “Nearly overnight, we made the switch to entirely remote work, and our team’s capacity for self-organisation enabled us to carry on uninterrupted, completing important projects.” The importance of Agile in preserving company continuity in unstable situations is demonstrated by this move to remote labour and greater decision-making autonomy. Rozdoum’s experience demonstrates how Agile concepts may improve overall business operations and logistics, promoting resilience and ongoing performance in uncertain circumstances. The CEO further remarked, “Embracing Agile, we didn’t just maintain operations; we became more efficient, with teams self-organising and making decisions faster. It’s about quick responses, not just speed, but smart responses.”

Early in the conflict, Rozdoum’s success depended heavily on its capacity for quick, independent decision-making and quick adaptation to changing circumstances. “Our team didn’t wait for top-down instructions,” the CEO said. “They had the authority to decide, try them out, and adjust in response to the outcomes.” Rozdoum was able to handle the crisis better than many of its rivals thanks to its self-organisation and adaptability, which emphasised the value of decentralised decision-making in times of unpredictability and upheaval.

The humanitarian group Caritas Ukraine has successfully addressed the demands brought on by the conflict by implementing Agile principles into its logistics operations.⁴⁸ “Despite the chaos, Agile’s emphasis on iterative planning and cross-team collaboration has

been essential in enabling us to distribute aid efficiently,” said Caritas’ logistics manager. “It enables us to keep our coordination and route planning flexible.” Caritas has been able to continue distributing supplies effectively despite challenging logistical circumstances because of this strategy. The company’s emphasis on iterative delivery and adaptive planning is in line with Agile’s fundamental ideas, enabling quick responsiveness to shifting demands and guaranteeing the efficient and effective distribution of resources. Additionally, the logistics manager stated, “We can swiftly make judgements and modify our plans thanks to Agile principles. Because long-term planning is not an option during a war, our teams concentrate on improving with each new delivery.” Since flexibility and responsiveness are frequently the difference between success and failure in humanitarian work, the capacity to modify logistics operations on the fly has proven crucial.

Several recurring elements emerge from a cross-case study of DiFFreight, Nova Poshta, Rozdoum, and Caritas Ukraine. Firstly, all organisations applied Agile’s concepts of adaptation and flexibility to ensure business continuity. Whether it was implementing remote work, changing logistics frameworks, or modifying the way humanitarian aid was distributed, every organisation used Agile to react to sudden changes in their surroundings. Rozdoum and Caritas implemented Agile throughout their entire organisations, from remote work to crisis-driven decision-making, while DiFFreight and Nova Poshta, both of which are in the logistics industry, concentrated on operational improvements, such as changing transport methods and reorganising teams. Notwithstanding their disparate industries, the businesses relied on Agile to give them the flexibility they needed to continue operating efficiently in the face of constant disruption.

It is evident by comparing these examples that Agile’s iterative nature is essential in various industries. In Rozdoum and Caritas, where operational choices have to be made fast and with no central monitoring, the usage of cross-functional teams and employee empowerment to make decisions swiftly was particularly noticeable. Despite being more logistics-focused, DiFFreight and Nova Poshta both benefited by giving teams the ability to make changes in real time. All four organisations were able to swiftly adjust to rapidly changing situations without the need for drawn-out decision-making cycles because of the iterative method, which places an emphasis on small, frequent modifications and feedback.

This analysis suggests that the current supply management system is not optimal in high-instability conditions. Transitioning to Agile methodology could serve as an effective solution, as this approach ensures greater adaptability through modularity and short planning cycles. The application of Agile methodology enables real-time decision-making, which is particularly crucial in crisis situations.⁴⁹ Implementing this approach alongside modern technologies could significantly enhance the resilience and efficiency of supply chains. Furthermore, developing contingency scenarios and

strengthening international cooperation would serve as additional steps towards ensuring system stability.

Optimising Supply Chain Resilience: The Role of Agile Methodology in Adapting to Crises and Volatility

The integration of Agile methodology into SCM represents a response to increasing stochasticity and emergent system behaviours. Supply chains, which previously relied on linear management models, are now transforming into complex adaptive systems.⁵⁰⁻⁵² They are characterised by a high degree of interdependence among elements and a need to respond to constant changes. Implementing Agile methodology enhances management efficacy through periodic outcome evaluation, strategy adjustment, and operational flexibility. This enables enterprises to respond promptly to external challenges and avoid significant losses. Furthermore, Sheffi⁵³ highlights that building flexibility and adaptability within the system is a key component of supply chain resilience, which goes beyond simply responding to disruptions.

To enhance the empirical focus of the Results section and align the qualitative evidence with the conceptual

model, the following summary Table 6 synthesises the thematic outcomes of the reflexive analysis.

Table 6 highlights the dominant interpretive patterns that emerged across interviews and demonstrates how participants’ experiences collectively illuminate the mechanisms driving supply chain adaptability and resilience. This concise representation serves to connect the qualitative depth of the findings with their theoretical significance, offering readers a structured overview of how Agile principles were manifested in practice.

Table 7 shows a decision matrix that operationalises study boundary conditions to make conceptual findings practical. Practitioners can use the matrix to prioritise Agile, traditional, or hybrid techniques based on environmental volatility and organisational structure.

The matrix operationalises empirical boundary conditions. Agile methods work well in high-volatility, decentralised environments where speed and autonomy are essential. Under low volatility and centralised institutions, classical SCM works well because predictability exceeds flexibility. Intermediate zones are dominated by hybrid models that balance cost and adaptability.

Table 6 | Summary of final themes, indicative codes, and empirical illustrations

| Final Theme | Indicative Codes | Relative Frequency* | Representative Quotations |
|-------------------------------------|--|---------------------|--|
| Agile adoption and flexibility | Iterative planning, rapid reconfiguration, adaptive logistics | High | Participant A, Executive: “Agile was a game-changer for us. It allowed us to pivot quickly and continue operations despite market uncertainty.” Participant D, Logistics Manager: “Weekly re-planning cycles helped us stay aligned with changing transport routes and customer priorities.” |
| Cross-functional collaboration | Team autonomy, interdepartmental coordination, shared accountability | High | Participant F, Logistics Manager: “Our cross-functional teams were essential in translating high-level strategy into real-time logistics decisions.” Participant O, Coordinator: “Marketing and operations finally spoke the same language once Agile ceremonies became part of our routine.” |
| Digital visibility and transparency | Real-time tracking, open communication, data-driven decisions | Moderate | Participant H, Coordinator: “Real-time data sharing enabled faster decision-making, keeping us competitive even during the crisis.” Participant B, Executive: “Digital dashboards gave us full visibility over supplier performance and delays within hours, not days.” |
| Resilience and risk mitigation | Crisis response, redundancy planning, decentralised decisions | Moderate | Participant M, Coordinator: “Cross-training staff was our backup plan: if one hub went offline, another team could take over instantly.” Participant J, Coordinator: “When transport routes were blocked, local teams had authority to reroute shipments immediately without waiting for approval.” |
| Continuous learning and adaptation | Feedback loops, reflective practice, iterative improvement | Moderate | Participant K, Coordinator: “Each iteration taught us something new – we kept refining our logistics flows with every disruption.” Participant L, Executive: “We began documenting lessons from each crisis, turning them into quick-response playbooks for future use.” |

Source: Compiled by the authors.

Table 7 | Decision matrix for selecting optimal supply chain management approach

| Organisational Structure | Highly Centralised | Moderately Decentralised | Highly Decentralised |
|--|---|--|---|
| Volatility Level | | | |
| Low Volatility (stable markets, predictable demand) | Classical SCM – Focus on efficiency, cost optimisation, and standardised procedures. Agile adds little marginal value in stable environments. | Classical-Hybrid – Retain hierarchical control but allow adaptive adjustments in procurement and logistics. | Hybrid – Maintain standard planning cycles but integrate limited Agile iterations for local decision-making. |
| Moderate Volatility (periodic disruptions, fluctuating demand) | Hybrid – Introduce short adaptive cycles within existing control systems. Use cross-functional task forces for crisis response. | Agile-Hybrid – Emphasise iterative planning, transparency, and digital dashboards while maintaining central oversight. | Agile – Prioritise cross-functional collaboration and decentralised autonomy to accelerate responses to change. |
| High Volatility (crisis, war, extreme uncertainty) | Hybrid-Agile – Gradual delegation of authority; central management retains coordination roles only. | Agile – Empower local units and digital visibility; real-time communication and continuous iteration dominate. | Full Agile – Self-organising teams, rapid iteration cycles, data-driven decisions. Ideal under wartime or extreme disruptions, as evidenced by DiffFreight, Nova Poshta, and Caritas Ukraine. |

Source: Compiled by the authors.

Although the Agile methodology has demonstrated efficacy in crisis situations like the ongoing conflict in Ukraine, it is also highly applicable to other non-war crises, including pandemics and natural disasters. In these situations, businesses may quickly adjust to unforeseen disruptions like changes in demand, supply chain interruptions, and resource shortages by utilising Agile's fundamental principles of flexibility, iterative planning, and quick decision-making. Agile's emphasis on real-time data and cross-functional collaboration, for instance, might improve responsiveness to shifting public health standards and logistical issues during a pandemic.

However, implementing Agile in non-conflict situations would require modifications. Rapid, extensive operational changes are frequently necessary in combat settings, but pandemics or natural disasters might call for a greater emphasis on government rules, health and safety procedures, and interagency collaboration. To maintain the efficacy of Agile principles in such circumstances, digital solutions for tracking, real-time communication, and resource allocation would be essential. Furthermore, the sort of crisis may require cross-functional teams to shift their focus, such as coordinating emergency relief after a natural disaster or giving priority to medical supply chains during a pandemic.

The study suggests using Agile methodology to address crisis issues in Ukraine by concentrating on important areas that are essential to the current circumstance. Ukrainian businesses should use iterative planning cycles to promptly adapt to unforeseen circumstances, like demand changes or transportation obstructions. Setting cross-functional teams as a priority will expedite decision-making and foster cooperation. Digital platforms for information sharing and real-time tracking will also improve responsiveness and transparency by bringing stakeholders together. Lastly, to respond to infrastructure failures, businesses should create backup plans that incorporate Agile principles, enabling flexible resource allocation and alternate routing. The purpose of these suggestions is to improve supply chain continuity and resilience in the face of persistent instability.

Discussion

The application of Agile methodology in SCM has proven effective in promoting flexibility, adaptability, and rapid decision-making in the face of volatility. This aligns with the work of Korucuk et al.⁵⁴ who identified the critical success factors of implementing Agile methodology in logistics. The authors emphasised the need to develop risk mitigation strategies for supply management under uncertain conditions. Particular focus was placed on the methodology's ability to ensure adaptability in volatile market conditions and reduce risks associated with supply unpredictability and fluctuating demand. The authors noted that applying an iterative approach to planning and forming cross-functional teams enhanced the efficiency of logistics processes through rapid decision-making

and flexible restructuring of operational models. The results of the present study reinforce these findings, demonstrating that businesses operating under crisis conditions, such as wartime, found Agile's flexibility crucial for overcoming logistical hurdles and adapting to sudden supply chain disruptions.

Similarly, Sadikoglu and Demirkesen⁵⁵ focused on examining the impact of Agile approaches to SCM in dynamic market conditions. The authors highlighted that iterative planning was a key element of successful Agile implementation, enabling timely responses to changes and adjustments in business processes. The study's findings also confirmed that adopting Agile methodology could enhance transparency in managerial processes and improve communication systems among suppliers, manufacturers, and consumers. These conclusions are supported by the current data, which indicated that many participants listed enhanced communication and group decision-making as two major advantages of using Agile principles. "Agile transformed how we communicate internally and with our suppliers, making our decision-making faster and more efficient," said Participant E, logistics manager, for example. These results support Sadikoglu and Demirkesen's contention that, by encouraging openness and interdepartmental cooperation, Agile can strengthen managerial procedures and relationships throughout the supply chain.

Furthermore, the work of Fesobi et al.⁵⁶ highlighted the role of Agile in reducing supply cycle times and resolving logistical issues promptly. The study noted that supply chain flexibility was achieved by reducing supply cycles and resolving logistical issues promptly through the active involvement of all stakeholders. In this study, participants A and B noted that Agile's iterative processes allowed them to reduce delays, lower costs, and improve customer service quality. This reflects the findings of Fesobi et al., confirming that Agile can significantly enhance the efficiency of supply chains, especially in volatile market conditions.

The present study highlights the critical role of Agile principles in optimising supply chains, especially in response to growing complexity and instability in global markets. The findings align with several key studies that emphasise the need for flexibility, digital technologies, and real-time decision-making to improve supply chain performance. For example, the study by Voronkova et al.⁵⁷ focused on the limitations of traditional SCM models, which are increasingly seen as rigid and inadequate for handling the volatility of modern markets. The findings of this study resonate with those of the researchers, yet it further emphasised the specifics of Ukraine's foreign economic activity, necessitating additional adaptation strategies using Agile methodology for enterprises operating in highly unstable environments. This highlights the scientific novelty of the study, which is orientated towards identifying solutions for managing supply chains under extreme conditions.

Focusing on the peculiarities of Agile methodology implementation in global supply chains, Alzoubi et al.⁵⁸

analysed the transformational processes in multinational corporations facing heightened uncertainty and risks. The researchers stressed that ensuring end-to-end transparency is particularly critical, as it facilitates effective risk management. This viewpoint is supported by the current study's findings, which show that Agile methodology improves flexibility by giving people the means to be more responsive and manage risks. However, by analysing the unique issues brought on by outside political and economic forces, including military conflicts, which interrupt supply chains and call for more flexible solutions, the current study builds on the previous work of the researchers.

The study by Ahmed and Huma⁵⁹ was dedicated to analysing changes in the productivity of enterprises that had already implemented flexible management methods. The work examined indicators such as reduced lead times, decreased logistics costs, and improved customer satisfaction levels. The researchers also emphasised the importance of adapting Agile methodology to the specificities of various industrial sectors. The findings demonstrated that the implementation of Agile methodology enabled enterprises to significantly enhance their competitiveness. This finding is corroborated by recent research, which demonstrates that companies who adopted Agile practices saw comparable increases in productivity and flexibility. The new analysis further emphasises how crucial sector-specific Agile adjustments were in helping Ukraine-based companies deal with the difficulties of doing business in a very unpredictable climate.

Thus, despite the alignment with existing scholarly works, the findings of this study complement the existing body of research by proposing approaches that open prospects for further practical investigations, particularly in the development of flexible management systems adapted to real-world business conditions amid heightened risks and instability. Consequently, the obtained results hold not only theoretical but also practical significance for enterprises operating in today's dynamic environment.

Conclusions

The findings of the conducted research demonstrate the significant potential of applying Agile methodology principles in SCM, particularly under conditions of a dynamic external environment and high uncertainty. The analysis performed within this study not only confirmed the effectiveness of Agile methodology in enhancing the flexibility, adaptability, and transparency of managerial processes but also revealed its additional benefits in the context of Ukraine's foreign economic activity amid military aggression. The research focused on crisis management aspects that complicate the application of classical logistics models and necessitate the development of new response strategies.

Among the key limitations of this study is its theoretical nature, which restricts the ability to assess the real-world efficacy of Agile methodology implementation. Additionally, the findings may not be as broadly applicable due to the small sample size of 15

participants and the exclusion of viewpoints from other industries due to the focus on the logistics and supply chain sectors. In Ukraine, where English ability is not universal, the use of English-language interviews may create bias and might omit perspectives from people who are less fluent in the language. The study's reliance on secondary case data, including company case studies and reports from the Ukrainian State Customs Service, may also introduce contextual biases, limiting the findings' generalisability to other regions or nations with distinct sociopolitical or economic circumstances. When evaluating the study's findings' applicability in non-Ukrainian contexts, several aspects should be taken into account.

Given this, further research should be orientated towards the practical application of Agile methodology in corporate operations, enabling an evaluation of actual changes in their performance metrics. Particularly valuable are studies comparing company performance before and after the adoption of Agile approaches, as this would allow for a more detailed assessment of their impact on operational and strategic outcomes. Such an approach would help identify additional opportunities and potential risks associated with the transformation of management systems. Furthermore, it is advisable to conduct case studies of individual enterprises operating in high-risk environments, such as active combat zones or regions with unstable economic conditions. This would yield new insights into the specifics of implementing Agile methodology under extreme circumstances and help define additional adaptation strategies.

Overall, this study has established a robust theoretical foundation for future applied research and opened new perspectives for further development of the topic. The application of its proposed recommendations could enhance the efficiency of SCM in dynamic business environments and serve as a basis for developing novel managerial approaches that address contemporary challenges.

References

- 1 Bathaei A, Awang SR, Štreimikienė D, Ahmad T. Agility sustainable supply chain in automobile industry. *Technol Econ Dev Econ.* 2025;31(2):619–638. <https://doi.org/10.3846/tede.2025.23231>
- 2 Alakaş EÖ, Bölük AA, Karadoğan D. Resilient logistics in strategic management: Going beyond low cost and sustainability. *Bus Strateg Dev.* 2025;8(3):e70197. <https://doi.org/10.1002/bsd2.70197>
- 3 Bastl M, Ceruti C, Mena C, Skipworth HD. The interplay of agile capabilities in crisis response. *Int J Oper Prod Manag.* 2025;45(8):1481–1509. <https://doi.org/10.1108/IJOPM-05-2024-0426>
- 4 Richey RG, Roath AS, Adams FG, Wieland A. A responsiveness view of logistics and supply chain management. *J Bus Logist.* 2022;43(1):62–91. <https://doi.org/10.1111/jbl.12290>
- 5 Kerimkulov S, Teleuova S, Tazhenova G. Measuring chaotic and cyclic fluctuations of Cass Freight Index: Expenditures. *Act Probl Econ.* 2015;17(9):434–445.
- 6 Bisenovna KA, Ashatuly SA, Beibutovna LZ, Yesilbayuly KS, Zagievnna AA, Galymbekovna MZ, Oralkhanuly OB. Improving the efficiency of food supplies for a trading company based on an artificial neural network. *Int J Elect Comp Eng.* 2024;14(4):4407–4417. <http://doi.org/10.11591/ijece.v14i4.pp4407-4417>

- 7 Prunenکو DO. Supply chain management. Kharkiv: O.M. Beketov KhNUMG; 2016.
- 8 Krykavskiy EV. Logistics and supply chain management: Textbook. Lviv: Lviv Polytechnic Publishing House; 2020.
- 9 Smerichevska SV, Kovalov AV. Mechanism for ensuring effective partnership interaction in cluster organizational structures. *Econ Bull Zaporizhzhia State Eng Acad.* 2017;6–1(12):50–54.
- 10 Kolodizeva TO. Supply chain management: A textbook. Kharkiv: S. Kuznets KhNEU; 2016.
- 11 Christopher M, Towill D. An integrated model for the design of agile supply chains. *Int J Phys Distrib Logist Manag.* 2001;31(4):235–246. <https://doi.org/10.1108/09600030110394914>
- 12 Dubey R, Gunasekaran A, Childe SJ. Big data analytics capability in supply chain agility: The moderating effect of organizational flexibility. *Manag Decis.* 2019;57(8):2092–2112. <https://doi.org/10.1108/MD-01-2018-0119>
- 13 Dolatabad MJ, Azhdarifard M, Acwin Dwijendra NK, Ali Sharhan Al-Sudani AQ. Evaluating agile practices in green supply chain management using a fuzzy multicriteria approach. *Discret Dyn Nat Soc.* 2022;2022(1):4290848. <https://doi.org/10.1155/2022/4290848>
- 14 State Customs Service of Ukraine. Statistics and registers. 2024. <https://customs.gov.ua/en/statistika-ta-reiestri>
- 15 Hugos M. Essentials of supply chain management. Hoboken: John Wiley & Sons; 2018. <https://doi.org/10.1002/9781119464495>
- 16 Altekar RV. Supply chain management: Concepts and cases. Delhi: PHI Learning; 2023.
- 17 Wankmüller C, Reiner G. Coordination, cooperation and collaboration in relief supply chain management. *J Bus Econ.* 2020;90:239–276. <https://doi.org/10.1007/s11573-019-00945-2>
- 18 Calignano F, Mercurio V. An overview of the impact of additive manufacturing on supply chain, reshoring, and sustainability. *Clean Logist Supply Chain.* 2023;7:100103. <https://doi.org/10.1016/j.clscn.2023.100103>
- 19 Rushton A, Croucher P, Baker P. The handbook of logistics and distribution management: Understanding the supply chain. London: Kogan Page Publishers; 2014.
- 20 Xu X, Kim HS, You SS, Lee SD. Active management strategy for supply chain system using nonlinear control synthesis. *Int J Dyn Control.* 2022;10(6):1981–1995. <https://doi.org/10.1007/s40435-021-00901-5>
- 21 Zheng X, Chen Y. Optimization of inventory cost control for SMEs in supply chain transformation: A case study and discussion. *Econ Manag.* 2024;27(1):87–107. <https://doi.org/10.15240/tul/001/2024-5-002>
- 22 Jaboob AS, Awain AMB, Ali KAM, Mohammed AM. Introduction to operation and supply chain management for entrepreneurship. In: Kankaew K, Nakpathom P, Chnitphattana A, Pitchayadejanant K, Kunnapadeelert S, (ed.). *Applying Business Intelligence and Innovation to Entrepreneurship.* Hershey: IGI Global Scientific Publishing; 2024. p. 52–80. <http://doi.org/10.4018/979-8-3693-1846-1.ch004>
- 23 Foster ST, Gardner JW. Managing quality: Integrating the supply chain. Hoboken: John Wiley & Sons; 2022.
- 24 Men F, Yaqub RMS, Yan R, Irfan M, Haider A. The impact of top management support, perceived justice, supplier management, and sustainable supply chain management on moderating the role of supply chain agility. *Front Environ Sci.* 2022;10:1006029. <https://doi.org/10.3389/fenvs.2022.1006029>
- 25 Mageto J. Big data analytics in sustainable supply chain management: A focus on manufacturing supply chains. *Sustainability.* 2021;13(13):7101. <https://doi.org/10.3390/su13137101>
- 26 Vaia G, Arkhipova D, DeLone W. Digital governance mechanisms and principles that enable agile responses in dynamic competitive environments. *Eur J Inf Syst.* 2022;31(6):662–680. <https://doi.org/10.1080/0960085X.2022.2078743>
- 27 Piera MA, Buil R, Ginters E. State space analysis for model plausibility validation in multi-agent system simulation of urban policies. *J Simulation.* 2016;10(3):216–226. <https://doi.org/10.1057/jos.2014.42>
- 28 Yermolenko R, Falko A, Gogota O, Onishchuk Yu, Aushev V. Application of machine learning methods in neutrino experiments. *J Phys Stud.* 2024;28(3):3001. <https://doi.org/10.30970/jps.28.3001>
- 29 Yudina S, Razumova H, Lysa O, Oskoma O, Zakharchenko V. Optimizing financial management and administration in infrastructure projects for economic recovery. *Int J Account Econ Stud.* 2025;12(2):337–346. <https://doi.org/10.14419/bk6pnf50>
- 30 Mstskiv H, Zhydovska N, Petryshyn L, Tomashevskii Yu, Skhidnytska H. The impact of digitalisation on business efficiency and competitiveness. *Econ Develop.* 2025;24(1):70–83. <https://doi.org/10.63341/econ/1.2025.70>
- 31 Yurinetz ZV. Innovative strategies in the system of increasing the competitiveness of the Ukrainian economy. Lviv: Ivan Franko National University of Lviv; 2016.
- 32 What is the Agile Manifesto? Agile Alliance; 2025. <https://www.agilealliance.org/agile101/the-agile-manifesto/>
- 33 Christopher M, Peck H. Building the resilient supply chain. *Int J Logist Manag.* 2004;15(2):1–13. <https://doi.org/10.1108/09574090410700275>
- 34 Wieland A, Wallenburg CM. The influence of relational competencies on supply chain resilience: A relational view. *Int J Phys Distrib Logist Manag.* 2013;43(4):300–320. <https://doi.org/10.1108/IJPDLM-08-2012-0243>
- 35 Ivanov D, Dolgui A. Viability of intertwined supply networks: Extending the supply chain resilience angles toward survivability. A position paper motivated by COVID-19 outbreak. *Int J Prod Res.* 2020;58(10):2904–2915. <https://doi.org/10.1080/00207543.2020.1750727>
- 36 Gligor DM, Holcomb MC. Understanding the role of logistics capabilities in achieving supply chain agility: a systematic literature review. *Supply Chain Manag Int J.* 2012;17(4):438–453. <https://doi.org/10.1108/13598541211246594>
- 37 Lutsenko I, Dmytriiiev I, Avanesova N, Semenushyna I, Rozhenko Z, Danileiko O. A method to form control over queuing systems taking into consideration the probabilistic character of demand. *East Eur J Enter Tech.* 2019;13(97):28–36. <https://doi.org/10.15587/1729-4061.2019.157201>
- 38 An J, Mikhaylov AYU, Yousif NBA. Financial and investment model for social security and sustainable economic growth. *Finance Theory Pract.* 2024;28(5):133–145.
- 39 Porkodi S, Ahmad A, Tabash BKH. Employee experience management and its critical impact on the sustainable development of an enterprise – A systematic literature survey with meta-analysis. *J Sustain Sci Manag.* 2024;19(4):201–235. <http://doi.org/10.46754/jssm.2024.04.015>
- 40 Ketners K. Adaptation of state security to modern military operations and terrorist risks in the world. *Space Cult India.* 2025;13(1):1–5. <https://doi.org/10.20896/e3p2jm77>
- 41 Vysotska I, Holovach T, Vysotskyi V, Nahirna OV, Korchymskyi V. Economic and legal aspects of the functioning of the IT sphere in the conditions of war. *Soc Leg Stud.* 2024;7(2):119–129.
- 42 Bulatov N, Uvaliyeva A, Kassymzhanova K, Izteleuova M, Saukenova I. Intelligent systems for managing and monitoring the collection, sorting, and transportation of solid waste for processing. *Evergr.* 2024;11(2):938–948.
- 43 Hasanova J, Najafova K. Digitization, automation problems and solutions in small business on the example of Azerbaijan. *WSEAS Transact Bus Econ.* 2025;22:1358–1369. <https://doi.org/10.37394/23207.2025.22.110>
- 44 Pettit TJ, Fiksel J, Croxton KL. Ensuring supply chain resilience: Development of a conceptual framework. *J Bus Logist.* 2010;31(1):1–21. <https://doi.org/10.1002/j.2158-1592.2010.tb00125.x>
- 45 Internship in a logistics company: stories of KAI students at DiFFreight. DiFFreight; 2025. <https://diffreight.com/novyny/praktika-v-logistichnij-kompaniyi-istoriyi-studentiv-nau-v-diffreight>
- 46 Nova Poshta Today. Nova Poshta; 2025. <https://novaposhta.ua/more/novapost-today/>
- 47 Russell A. How Kharkiv's tech start-ups became the ultimate test of business resilience. *Financial Times*; 2024. <https://www.ft.com/content/248c4ac0-2e20-4900-bb21-625c0e260b66>
- 48 War in Ukraine: Where to get help. Caritas Ukraine; 2025. <https://caritas.ua/>
- 49 Al-Ababneh HA, Tsiapa A, Rudyk N, Kapyrulya M, Yatsukh R. Modelling the risks of the exporter's company in times of crisis. *Theoret Pract Res Econ Field.* 2025;16(1):142–153. [https://doi.org/10.14505/tpref.v16.1\(33\).12](https://doi.org/10.14505/tpref.v16.1(33).12)
- 50 Jakubik P, Kerimkhulle S, Teleuova S. How to anticipate recession via transport indices. *Ekon Casop.* 2017;65(10):972–990.

- <https://www.sav.sk/journals/uploads/1204140610%2017%20Jakubik%20a%20kol.%20+%20RS.pdf>
- 51 Işık C, Yan J, Ongan S. Energy intensity, supply chain digitization, technological progress bias in China's industrial sectors. *Energ Econ*. 2025;145:108442. <https://doi.org/10.1016/j.eneco.2025.108442>
- 52 Rasulov R. Optimization of direct supply chains in the restaurant industry: Addressing key challenges through technological innovation. *Econ Develop*. 2024;23(3):93–103. <https://doi.org/10.57111/econ/3.2024.93>
- 53 Sheffi Y. *The Power of Resilience: How the Best Companies Manage the Unexpected*. Cambridge: MIT Press; 2015. <https://doi.org/10.7551/mitpress/9780262029797.001.0001>
- 54 Korucuk S, Tirkolaee EB, Aytekin A, Karabasevic D, Karamaşa Ç. Agile supply chain management based on critical success factors and most ideal risk reduction strategy in the era of industry 4.0: Application to plastic industry. *Oper Manag Res*. 2023;16(4):1698–1719. <https://doi.org/10.1007/s12063-023-00360-5>
- 55 Sadikoglu E, Demirkesen S. Agile supply chain management. In: Sarkis J, (ed.). *The Palgrave Handbook of Supply Chain Management*. Cham: Palgrave Macmillan; 2024. p. 363–387. https://doi.org/10.1007/978-3-031-19884-7_21
- 56 Fesobi BO, Fesobi MA, Ogungbeje O. Implementing agile supply chain strategy for improved response to market volatility: A systematic literature review. *South Florida J Dev*. 2024;5(12):e4838. <https://doi.org/10.46932/sfjdv5n12-057>
- 57 Voronkova VG, Azhazha MA, Nikitenko VO. Concepts and models of modern management: A scientific and methodological manual for applicants for the degree of Doctor of Philosophy in the field of knowledge 071 "Management and Administration" specialty 073 "Management". Zaporizhzhia: Zaporizhzhia National University; 2022.
- 58 Alzoubi HM, Elrehail H, Hanaysha JR, Al-Gasaymeh A, Al-Adaileh R. The role of supply chain integration and Agile practices in improving lead time during the COVID-19 crisis. *Int J Serv Sci Manag Eng Technol*. 2022;13(1):1–11. <https://doi.org/10.4018/IJSSMET.290348>
- 59 Ahmed W, Huma S. Impact of lean and agile strategies on supply chain risk management. *Total Qual Manag Bus Excell*. 2021;32(1–2):33–56. <https://doi.org/10.1080/14783363.2018.1529558>

Appendix

Appendix 1 | Verification evidence example (anonymised)

| Evidence Type | Source Document/Statement | Verification Summary | Outcome |
|---------------------------|---|---|---|
| Internal policy reference | Excerpt from internal logistics policy: "Operational planning will follow iterative Agile sprints of two weeks with retrospective evaluation by cross-departmental teams." | Confirms formal integration of Agile-based iterative cycles in logistics management. | ✔ Meets Criterion 1 – Documented Agile practice |
| Training record | HR training certificate (anonymised): "Employee completed Certified Agile Practitioner Program, Kyiv, 2023." | Verifies completion of formal Agile training by key staff. | ✔ Meets Criterion 2 – Certified Agile training |
| Managerial statement | Interview extract (Participant E, Logistics Manager): "We use short adaptive cycles to adjust delivery routes weekly; every change is reviewed by the cross-functional planning board." | Confirms self-reported use of iterative planning and team-based decisions in crisis response. | ✔ Meets Criterion 3 – Iterative adaptive cycles implemented |
| Cross-validation | Correspondence excerpt (email confirmation from organisation): "All supply chain processes follow Agile routines with weekly stand-ups and continuous improvement tracking." | Aligns with both documentary and verbal evidence of Agile practice. | ✔ Verified as "Agile-Implemented" |

Source: Compiled by the authors.

Appendix 2 | COREQ/SRQR checklist

| Section | Item | COREQ/SRQR Criterion | Implementation in the Present Study |
|---------------------------------|-------|---|--|
| Research team and reflexivity | 1–5 | Researcher credentials, experience, and relationship with participants | Researchers held advanced degrees in management and logistics; prior experience in Agile and SCM ensured contextual expertise. No prior relationships with participants existed. Reflexivity and bias minimisation were ensured through coder training and team discussions. |
| Study design | 6–13 | Theoretical framework, participant selection, setting, data collection | A qualitative, interpretive design underpinned by reflexive thematic analysis. Purposive sampling targeted 15 participants across logistics, consulting, and humanitarian sectors. Recruitment occurred via professional networks, email outreach, and conferences. |
| Data collection | 14–21 | Interview guide, saturation, recording, field notes | Semi-structured interviews (45-60 min) conducted online (March-May 2024). The interview guide (Appendix 3) structured all sessions. Data saturation was confirmed at 15 interviews. All sessions were audio-recorded, transcribed verbatim, and checked manually. |
| Data analysis | 22–26 | Coding process, reliability, use of software, theme derivation | Inductive reflexive thematic analysis in NVivo. Double-coding, team consensus, and reflexivity memos ensured analytic rigour. Themes were derived iteratively, with evidence of saturation provided (Table 2). The codebook is available in Appendix 4. |
| Findings/ Reporting | 27–32 | Presentation of quotations, linkage to interpretation, credibility checks | Participant quotations (Tables 3 and 6) illustrate themes. Member-checking validated transcripts; triangulation across interview, case, and statistical data enhanced validity. The thematic map (Figure 1) and conceptual model (Figure 3) illustrate the analytic structure. |
| Ethics and trustworthiness | 33–36 | Ethics approval, consent, confidentiality, reflexivity | Informed consent obtained. The data is anonymised and stored securely. Ethical principles were followed per institutional standards. Researchers maintained reflexivity journals. |
| Transferability and limitations | 37–39 | Contextualisation, saturation limits, bias acknowledgement | Findings are discussed within the Ukrainian wartime logistics context; limitations are addressed in the Conclusion section regarding sample size, linguistic bias, and generalisability. |
| Transparency statement | 40 | Availability of supplementary data and materials | A full interview guide (Appendix 3) and codebook (Appendix 4) are included. Thematic map and conceptual model are visually represent analytic pathways. |

Source: Compiled by the authors.

Appendix 3. Full Interview Guide Demographics

1. Role in the company:
 - What is your current position?
 - How long have you been working in this role?
2. Company information:
 - What sector does your company operate in (e.g., logistics, consulting, manufacturing)?
 - What is the size of your company (e.g., small, medium, large)?
 - What geographical markets does your company serve?

- What specific Agile methodologies (e.g., Scrum, Kanban, Lean) did your company adopt?
 - How did you communicate the need for Agile practices within your team or across the organization?
2. Integration into Supply Chain Management
 - How were Agile principles integrated into your supply chain processes? Were certain areas (e.g., procurement, logistics, customer service) prioritized?
 - Were there specific teams responsible for implementing Agile in your supply chain, or was it a company-wide initiative?
 - What were the main challenges during the initial implementation phase?

Section 1: Agile Adoption and Implementation

1. Initial Adoption of Agile
 - Can you describe how your company first adopted Agile practices in supply chain management? What was the driving force behind this decision?

Section 2: Crisis Response and Flexibility

3. Adapting to Disruptions
 - Can you provide examples of disruptions (e.g., geopolitical conflict, natural disasters, demand

fluctuations) that your supply chain faced? How did Agile principles help your company respond to these disruptions?

- How did Agile allow your company to adapt to sudden changes in supply or demand during the crisis?

4. Flexibility in Response

- In what ways did Agile practices enable more flexibility in your supply chain operations?
- Were there specific tools, techniques, or processes used to enhance flexibility (e.g., iterative planning, real-time decision-making)?
- How did Agile help your team react to unexpected logistical challenges?

5. Cross-functional Collaboration

- How did Agile influence collaboration across different departments (e.g., procurement, logistics, marketing)?
- Can you describe an instance where cross-functional teams worked together to resolve a supply chain issue?
- How did Agile practices enhance communication and decision-making across these teams?

Section 3: Role of Technology and Digital Tools

6. Digital Tools and Agile

- How did your company leverage digital tools to support Agile practices in the supply chain? (e.g., tracking systems, collaboration platforms, real-time data sharing)
- How important were these tools in enhancing visibility and responsiveness in your supply chain?

7. Technology Integration

- Were there any challenges in integrating digital technologies with Agile methodologies?
- Can you provide an example of how digital tools helped your company adapt to a specific disruption or crisis?

Section 4: Resilience Building and Risk Management

8. Resilience Building

- How did Agile principles contribute to building resilience in your supply chain?

- Can you provide an example where Agile helped your supply chain continue operations despite external challenges?

9. Risk Mitigation

- How did Agile practices help you manage and mitigate risks in your supply chain during crises?
- Can you provide an example of a risk that was mitigated because of Agile's iterative planning or flexibility?

Section 5: Organizational Culture and Continuous Improvement

10. Agile Culture

- How did Agile practices influence the overall culture of your organization, particularly in terms of flexibility, decision-making, and collaboration?
- Was there any resistance from employees or leadership when transitioning to Agile? How was this managed?

11. Continuous Improvement

- How does your organization ensure continuous improvement using Agile practices?
- Can you share an example where your team identified areas for improvement and implemented changes based on Agile principles?

Section 6: Impact and Future of Agile in Supply Chains

12. Effectiveness of Agile Practices

- Based on your experience, how effective do you believe Agile practices have been in improving supply chain operations, particularly during crises?
- Were there any unintended consequences or challenges in applying Agile practices?

13. Future of Agile in Your Supply Chain

- How do you foresee the future application of Agile in your supply chain? Do you plan to expand or refine Agile practices in the future?
- Are there specific areas of your supply chain where you would like to see further Agile integration?

Appendix 4 | Codebook excerpt

| Theme | Description | Example Quotes |
|-------------------------|---|---|
| Agile adoption | The deliberate introduction of Agile methodology to restructure decision-making and logistics. Boundary: includes accounts of initiation, adaptation, and resistance during adoption. | Participant A, Executive: "Agile has been integral in restructuring our logistics strategy during the crisis." Participant E, Logistics Manager: "The shift to Agile helped us adapt quickly to unexpected disruptions in our supply chains." Participant N, Logistics Coordinator: "We adopted Agile principles to streamline decision-making, which significantly improved response times." Participant J, Supply Chain Coordinator: "Some departments resisted Agile at first: it felt chaotic compared to our old routines." |
| Flexibility in response | Adjustments in processes and logistics triggered by external shocks such as war, supply blockades, or demand surges. Boundary: operational adaptations, not long-term strategy. | Participant C, Executive: "We had to adjust our delivery methods to accommodate sudden logistical constraints." Participant D, Logistics Manager: "Flexibility became key when we switched from air to road transport during the war." Participant I, Supply Chain Coordinator: "Not every team welcomed sudden changes: some preferred predictability over speed." |
| Cross-functional teams | Collaboration among departments that had previously worked in silos. Boundary: interdepartmental cooperation only, excluding routine teamwork. | Participant F, Logistics Manager: "Our cross-functional teams were essential in quickly implementing Agile practices." Participant O, Logistics Coordinator: "By integrating marketing and operations teams, we were able to make faster, more informed decisions." Participant K, Supply Chain Coordinator: "Collaboration between procurement and logistics was a game-changer in handling the disruptions." Participant M, Logistics Coordinator: "At times, differing departmental goals slowed us down before alignment was reached." |
| Iterative planning | Short planning and feedback cycles replacing long-term forecasts. Boundary: structured adaptation cycles, not ad hoc changes. | Participant G, Logistics Manager: "We adopted iterative planning to make quicker adjustments to supply routes as the crisis evolved." Participant L, Executive: "Rather than relying on long-term forecasts, we shifted to short cycles, re-evaluating every few weeks." Participant D, Logistics Manager: "Iterative planning enabled us to react swiftly to changes, ensuring our operations stayed aligned." Participant H, Supply Chain Coordinator: "Sometimes iterations conflicted with existing reporting cycles, creating temporary confusion." |
| Resilience building | Systemic capacity to absorb, adapt, and recover from shocks. Boundary: long-term structural or cultural strengthening. | Participant B, Executive: "Building resilience through flexible processes allowed us to sustain operations even under wartime conditions." Participant M, Logistics Coordinator: "We focused on enhancing our system's resilience by ensuring all teams were cross-trained and adaptable." Participant G, Logistics Manager: "Repeated crises taught us endurance." Participant C, Executive: "Constant adaptation was exhausting; maintaining resilience required emotional support as well." |
| Risk management | Identification and mitigation of operational vulnerabilities. Boundary: preventive and corrective measures addressing uncertainty. | Participant J, Supply Chain Coordinator: "We developed contingency plans to minimise risks, ensuring that we could quickly recover from disruptions." Participant D, Logistics Manager: "Risk management has become a key priority; we implemented real-time monitoring systems to spot issues before they escalate." Participant K, Supply Chain Coordinator: "Despite monitoring, supplier failure still caught us off guard: complete control isn't possible." |
| Customer-centricity | Responsiveness to changing customer needs under crisis conditions. Boundary: direct link to customer feedback or satisfaction. | Participant I, Supply Chain Coordinator: "We focused on customer feedback and adjusted our delivery models to meet their changing expectations during the crisis." Participant G, Logistics Manager: "Keeping the customer at the centre of our decisions helped us maintain trust and ensure business continuity." Participant N, Logistics Coordinator: "Customer focus sometimes clashed with cost-saving imperatives." |
| Digital tools | Deployment of technology to sustain Agile principles. Boundary: digitalisation directly linked to responsiveness and transparency. | Participant H, Supply Chain Coordinator: "Digital platforms allowed us to track shipments in real time, which helped us make better decisions faster." Participant L, Executive: "The use of digital tools for real-time data sharing improved our responsiveness to supply chain challenges during the crisis." Participant F, Logistics Manager: "Digital overload was a challenge, too many tools diluted focus." |
| Self-organisation | Empowerment of teams to act autonomously without centralised control. Boundary: decision-making delegated to teams. | Participant N, Logistics Coordinator: "We empowered our teams to make decisions on the ground, which accelerated our response time to changing conditions." Participant K, Supply Chain Coordinator: "Self-organisation enabled us to be more agile, as teams could address issues as they arose without waiting for approval." Participant M, Logistics Coordinator: "Some supervisors struggled to relinquish control, slowing the process." |
| Transparency | Open communication across internal and external partners. Boundary: structured sharing of information, not informal updates. | Participant O, Logistics Coordinator: "Having transparent communication with suppliers and customers allowed us to act swiftly and align our strategies." Participant F, Logistics Manager: "Transparency in decision-making kept everyone aligned, reducing the time it took to implement changes." Participant A, Executive: "Total transparency sometimes revealed internal conflicts that had to be managed carefully." |
| Leadership support | Senior leadership's role in enabling or constraining Agile transformation. Boundary: top-level endorsement, strategic vision, or resistance. | Participant B, Executive: "Without visible support from leadership, Agile would have died early." Participant E, Logistics Manager: "Our CEO's involvement gave legitimacy to change." Participant N, Logistics Coordinator: "Some senior managers still preferred rigid control structures." |

(Continued)

Appendix 4 | Continued

| Theme | Description | Example Quotes |
|------------------------------------|--|---|
| Employee resistance and adaptation | Staff reactions ranging from scepticism to eventual acceptance of Agile practices. Boundary: emotional and behavioural adaptation at the individual level. | Participant J, Supply Chain Coordinator: "People were uncomfortable with losing clear command chains." Participant M, Logistics Coordinator: "Initial resistance faded once employees saw results." Participant F, Logistics Manager: "Agile demanded a mindset shift that not everyone managed." |
| Ethical and social responsibility | Organisational awareness of social impact and ethical behaviour in crisis logistics. Boundary: references to responsibility towards employees, partners, or society. | Participant K, Supply Chain Coordinator: "We couldn't prioritise efficiency over safety of drivers." Participant I, Supply Chain Coordinator: "Fair contracts with small suppliers mattered despite pressure." Participant C, Executive: "Agility must never compromise ethical standards." |

Source: Compiled by the authors.