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Data Analytics Capabilities and Supply Chain Resilience among Finnish SMEs: A Qualitative Study

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Abstract
This study analyzes how data analytics capabilities build supply chain resilience for Finnish Small and Medium-sized Enterprises (SMEs). While data analytics is considered an enabler for large enterprise resilience, there is a limited body of research on how resource limited SMEs encounter and exploit these capabilities in practice, particularly in Finland. A qualitative approach using an interpretivist philosophy and exploratory research design, was employed for this research. The method used consisted of six semi structured interviews with supply chain analytics, business intelligence, logistics, procurement and operations experts working for Finnish SMEs. Analysis was undertaken on interview data using a six-step process for themed analysis which gave rise to a set of ten interconnected theme: analytics adoption; supply chain visibility; resilience building; data based decision making; business continuity; implementation challenges; organizational capabilities; human capital; enabling technological capabilities and a set of practical suggestions. It is found that data analytics improve SME resilience through increased visibility and faster more informed decision making and in organizational flexibility to adapt during disruptive events. However, there are some important barriers such as the cost of implementation; lack of personnel capable of combining both an analytics and a supply chain focus; and data quality. There is high motivation towards Leadership Engagement, employee training and IT Infrastructure to foster successful analytics application in an enterprise. The research sheds practical lights on how Finnish SMEs build resilience with the support of data analytics, and provides practical recommendations on a phase approach to implementation, staff development, and ongoing future research investigating external knowledge in support of the digitalization for SMEs.

Keywords: *Data analytics capabilities, supply chain resilience, Finnish SME's*

Introduction

Background of the Study

In recent years, global supply chains are increasingly susceptible to disruptions emanating from pandemic outbreaks, geopolitical tensions, extreme weather events and fluctuating customer demands (Belhadi, Kamble, Subramanian, Singh and Venkatesh, 2024). Enterprises of all sizes need to rethink supply chain strategies – planning, monitoring, and decision making – in response to these uncertain conditions in their supplier, production, and distribution networks. Data analytics has become a core

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capacity that many organizations use to analyse and process mass amounts of operational data to identify risk signals proactively and support quick and data-driven decision-making processes across their supply chains (Iftikhar, Ali, Arslan and Tarba, 2024; Jiang, Feng and Wong, 2025). SMEs occupy a unique position in this landscape as they often lack the human, technical, and financial resources of many large, multinational organizations, despite being an integrated part of the wider supply ecosystem, either as producers, suppliers, distributors, or service providers (Khurana, Dutta and Ghura, 2022).

In Finland, SMEs have a particularly central economic role and are exposed to many of the same forces creating supply chain instability (Hafeez, Shahzad and De Silva, 2025). Learning what kind of data analytics capabilities Finnish SMEs possess and deploy to foster their resilience against these forces would therefore be of both academic and practical importance. Even though academic studies are accumulating regarding the role of data analytics in building resilience at large firms, little research exists on how Finnish SMEs indeed employ these capacities (Durst, Foli and Edvardsson, 2022; Eriksson, Heikkilä and Nummela, 2022; Kala Kamdjoug, 2023). This research attempts to address this gap by investigating the qualitative account of practitioners in these companies on how and why they leverage data analytics tools for enhancing supply chain resilience.

Problem Statement

While it has been argued that data analytics provides "strong impetus towards supply chain resilience," it seems that much of the research evidence collected thus far has come from either large enterprises or based on survey type research where data analytics capability is operationalised as one measurable construction rather than how the capabilities are lived and developed by practitioners in practice within resource constrained entities such as SMEs. Finnish SMEs are situated in a special environment characterized by its small domestic market, geographical proximity to large international suppliers, high labour costs, and reliance on digital infrastructure, thus the adoption and deployment of the capability takes on a unique character, and recommendations based on large enterprise research do not lend themselves well in the SME world without qualitative insights into how practitioners experienced and used them. So, this study seeks to address the question how and by what organizational and environmental factors a firm's data analytics capabilities are practiced by Finnish SMEs to support supply chain resilience.

Research Gap

The body of research on big data analytics and supply chain resilience has grown exponentially over recent years, with a number of large scale quantitative research studies demonstrating statistical relationships between analytics capability and resilience outcomes (Jiang, Feng and Huang, 2024; Jiang, Feng and Wong, 2025) in manufacturing and retail firms. However, the existing literature typically presents resilience as an aggregate performance outcome, with little discussion on the individual organisational processes, obstacles and facilitating conditions underpinning the

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statistical relationship. Research into supply chain resilience in the SMEs' sector of the economy remains somewhat limited, especially at a national level of enquiry, and relatively scarce within the Finnish operating environment, despite SMEs being a fundamental part of Finland's economy. Furthermore, there is relatively little of the literature which addresses the phenomenon from a quality based, practitioner focused research perspective to understand supply chain professionals' perceptions of use of data analytics and supply chain resilience. This paper thus seeks to provide an in-depth qualitative and practitioner-led account of data analytics capabilities and supply chain resilience within Finnish SME's.

Scope of the Study

The paper considers Finnish small and medium-sized enterprises in manufacturing, logistics and supply chain focused industries. It draws from six experts in managerial and analytical roles as supply chain analytics, business intelligence, logistics, procurement and operations manager. This paper explores and describe how these experts utilize data analytics capabilities in relation to supply chain resilience (which is not interpreted or measured in terms of performance metrics) not large multinational firms or generalizes to statistical population of Finnish SMEs. This research explores for generating thick context dependent insight; academic discussion and practitioners' decision.

Research Questions

RQ1: To what extent can the data analytics capabilities explain the degree of supply chain resilience among Finnish SMEs.

RQ2: What challenges and enabling factors affect the employment of data analytics to build supply chain resilience in Finnish SMEs?

Research Objectives

RO1: To examine how data analytics capabilities can strengthen supply chain resilience in Finnish SMEs.

RO2: To assess the enabling factors and challenges to implement the use of data analytics for improving supply chain resilience among Finnish SMEs.

Literature Review

The Concept of Data Analytics Capabilities

Data analytics capability refers to the ability of a firm to procure, combine, analyze and use data for decision-making through information (Iftikhar, Ali, Arslan and Tarba, 2024). While an array of definitions of data analytics capability exists in literature, these often highlight the interplay between IT infrastructure, personnel abilities, and organisational structure, which a singular tool or software system can hardly suffice (Wamba et al., 2020). Organizations with sophisticated data analytics capabilities readily use their existing operational data gathered from various sources like, for instance, enterprise resource planning (ERP) systems, Point of Sales (POS) systems, and supplier databases to gain useful knowledge for developing, e.g., forecasts,

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dashboards, and supporting tools of decision making, which can aid both operational and strategic processes. Within the context of supply chains, the importance of data analytics capability may be viewed as how well the firms are equipped to sense changes in customer-defined requirements, monitor suppliers and logistics activities, and discover early signals of impending operational disruptions. Dynamic capability theory frames data analytics capability as an operational enabler of organisational sensing, seizing, and reconfiguring routines, thereby enabling the firm to thrive in dynamic environments (Lin, Wu and Luo, 2025).

Supply Chain Resilience: Definitions and Dimensions

Supply Chain resilience refers to the firm's ability to prepare, cope, manage, respond to, recover from disruptive incidents, and withstand stress and pressure while functioning during all circumstances (Ivanov and Dolgui, 2020). Resilience can be viewed as two complementary sets, i.e., proactive and reactive: Proactive resilience is linked with the capability of the firm to prepare and manage possible upcoming disturbances whereas reactive resilience is related to managing such disturbances once they actually occur (Jiang, Feng and Wong, 2025). A few concepts that have often co-occurred with resilience in literature are supply chain visibility (the visibility aspect refers to the ability of supply chain partners to monitor the flow and status of products and related information within their respective organisations and across other organisations in the supply chain), supply chain flexibility (the ability to alter the operations swiftly and smoothly in response to market and industry dynamics), and supply chain agility (the response time of the organisation under crisis or disruption).
Belhadi, Kamble, Jabbour, Gunasekaran, Ndubisi and Venkatesh (2021) discovered that it would be prudent to treat resilience not only as an organisational trait but also as a capability which firms build up with time via investments, learning, and adaptation in an environment marked by turbulence, a perspective particularly relevant to small and medium-sized enterprises (SMEs) lacking sufficient financial, technical or human resources.

Data Analytics and Supply Chain Visibility

Most studies connect the deployment of data analytics capability to significant enhancements in the visibility across their supply chains. Visibility is cited frequently as a mediate through which data analytics capabilities provide resilience-associated effects (Jiang, Feng and Wong, 2025). Supply chain performance can be actively enhanced by utilising, as an illustration of real time dashboard applications, integrated reporting systems and prediction based forecasting instruments that inform decision makers of the state of their inventories, logistics, suppliers' operational efficiencies, thereby limiting disruptions that go unnoticed until damage is done to the company's operational performance. According to Shamout (2024), supply chain analytics made positive contributions to response to disruption, business resilience and restoration capability during the pandemic across the organisation. Specifically, visibility mediated the positive relationship between supply chain analytics adoption and supply chain resilience (Jiang, Feng and Wong, 2025), but, at the individual level; vision (an element

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of resilience) is mediated by awareness and action planning for SME leaders. For smaller companies, supply chains visibility will become easier to achieve with more affordable and integrated IT tools.

Digital Technologies and SME Supply Chain Management

Research of digital transformation always point out limitations regarding money, workforce competences, and partnership with suppliers as typical constraints that SMEs faces in their adoption of digital technologies (Khurana, Dutta and Ghura, 2022; Durst, Foli and Edvardsson, 2022).

Recently Hafeez et al. (2025) investigate how innovation mediators can help Finnish SMEs at the Ostrobothnia region to create the capabilities for developing their firms through digital transformation strategies and use those innovations to achieve operational and economic competitive advantages in turbulent environment. Another research conducted by Eriksson, Heikkilä, and Nummela (2022) demonstrates that there is a connection between innovative adoption and the application of the dynamic perspective in Finnish SME business models for internationalisation activities aiming at resilience and competitiveness. The previous observations suggest that to understand the dynamics of SMEs' data analytics in their supply chains, more attention needs to be paid to factors which play a decisive role beyond organisational borders like in government bodies programmes, network collaboration, and various external organisations that provide relevant assistance, information and support to smaller companies.

Challenges of Data Analytics Adoption in SMEs

Although the advantages of using data analytics to foster resilience in supply chain operations are apparent, numerous barriers exist that prevent a large proportion of SMEs from effectively adopting such capabilities.

For example, many SMEs operate without adequately integrated software, are hesitant to use cloud-based tools due to concerns over security and data management, lack capital for investments in sophisticated data analytics software and infrastructure, and possess limited analytical and technical skills within their workforce to adequately utilise these advanced systems and interpret the outcomes.

Kala Kamdjoug (2023) also highlights the lack of supply chain professionals possessing both a sufficiently wide range of analytical capabilities and sophisticated supply chain domain experience to exploit these fully, adding that SMEs have insufficient, or dated data quality management processes, in addition to lacking sufficient capability to unite existing dispersed and legacy systems which were not developed to enable complex analytics. In fact, Isensee et al. (2023) pointed out the importance of organizational culture and leadership commitment in the successful implantation and adoption of data-analytics related organisational practices in SMEs an area where SMEs should also put an effort if expecting technological solutions to make real differences for their operational activities.

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Theoretical Framework

This research is underpinned by dynamic capability theory, which suggests that organisations possess resources that they leverage to develop superior capabilities that allow them to compete over time (Teece, Pisano & Shuen, 1997; Ganotakis, Angelidou, Saridakis, Piperopoulos and Dindial, 2023). The application in this paper argues that data analytics capabilities function as both a sensing and seize mechanism that enable SMEs to detect changes and opportunities within their external environment, and then proactively reorganize their sourcing, logistics and other operational activities in response to seize such opportunities and adapt to changes.

Research Methodology

Research Design

This study employs a qualitative, exploratory research design under an interpretivist philosophy. An interpretivist philosophy was chosen as the purpose of this research is not to measure pre-defined concepts in a numerical manner and test hypotheses, but to investigate and understand, from a subjective perspective how supply chain professionals working in Finnish SMEs experience and make sense of data analytics capabilities concerning supply chain resilience. Qualitative methods allow for the exploration of the rich context, nuances, and organizational intricacies that survey-based techniques sometimes cannot reveal, and thus enable the researcher to explore not only what is happening but how and why.

Research Approach

An inductive research approach was chosen for this study. This involves looking for emerging themes and patterns from the interview data, rather than an initial identification of themes through existing theory or a predetermined coding framework. This approach reflects much of prior qualitative work carried out within both supply chain and management related research, and was carried out using the six phased thematic analysis approach described in Nowell, Norris, White and Moules (2017) which guided the analysis undertaken and reported on in dta analysis section. An inductive, thematic approach was selected over the other forms of qualitative research such as grounded theory or narrative analysis due to the aim of the research to highlight emerging practices and challenges that are perceived to be consistent across a small, purposively selected sample of individuals, rather than to develop an entirely new substantive theory.

Data Collection

This primary data was collected through six semi-structured interviews that were conducted with supply chain analytics, business intelligence, logistics, procurement, and operations specialists working in Finnish SMEs. Semi-structured interviews were deemed most appropriate for this research as they allow for a consistent set of initial questions to be posed to participants while maintaining the flexibility to investigate topics of interest and respond to participant's views in more depth. Participants are allowed the liberty to explain their perceptions and feelings of issues in their own words.

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In interviews participants were asked to consider the following: current practices; how it affects supply chain visibility and resilience; organizational issues and barriers in adopting the practice; and enabling capabilities and resources assisting its use. All interviews were given with participant's consent and kept anonymous throughout the research by using the identifiers R1 to R6 for each participant interviewed.

Sampling Technique and Unit of Analysis

Participants were sampled using purposive sampling methodology whereby the researcher selects a sample to fit a specific research design or purpose. The reason for using purposive sampling was that an interpretivist philosophy is one concerned with understanding the world as experienced by a few carefully selected individuals capable of providing in-depth understanding. Eligibility for participation in this research required participants to be able to demonstrate practical experience of using or supervising data analytics practices within a supply chain context and to hold a managerial or analytical role in a Finnish SME within the supply chain, logistics or manufacturing related sector. The unit of analysis in this study is individual professionals working in Finnish SMEs. The sample size for this exploratory qualitative study was perceived to be adequate based on the notion that a small, highly experienced sample can be used to capture a phenomenon (Nowell et al., 2017).

Data Analysis

This study explores data analytics capability and its effects on the resilience of supply chains in the Finnish SMEs. A total of six semi-structured interviews were conducted with individuals working in the areas of supply chain analytics, business intelligence, logistics, procurement, operations management, and data analytics within Finnish SMEs. The interview explored about their experiences related to the role of data analytics in supply chain operations, impact on enhancing supply chain resilience, importance in supporting data-driven decision making, use in managing supply chain disruptions, challenges in adopting these capabilities, and the prerequisite organizational capabilities needed in adopting data analytics capabilities.

Data from the interviews were analyzed using thematic analysis. The results of the interviews provide significant insights in to the way Finnish SMEs adopt data analytics capability for improving operational performance, enhancing supply chain resilience and strengthening the capabilities of anticipating, responding to and recovering from supply chain disruptions in an increasingly volatile business environment.

Demographic Information of Respondents

The respondents were taken from various managerial and operational functions in Finnish manufacturing, logistics and supply chain businesses. Their work experiences provided a diverse array of viewpoints concerning the application and adoption of data analytics capabilities to supply chain management. Competence in business intelligence, logistics planning, procurement, operational management and analytical decision-making enabled the researcher to obtain comprehensive understanding on how data analytics impacts the resilience of an organization. The diversity also added credibility

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to the outcomes as individuals in different hierarchical levels both operating and supporting the supply chain functions were engaged.

Table 4.1 Demographic Information of Respondents

Respondent	Background / Role
R1	Supply Chain Analytics Manager
R2	Data Analytics Specialist
R3	Business Intelligence Analyst
R4	Logistics Manager
R5	Procurement Manager
R6	Operations Manager

Stages of Thematic Analysis

This study uses a 6-step approach to thematic analysis based on the approach suggested by Nowell et al. (2017). These include familiarity with transcripts, generating initial codes, finding themes, reviewing themes, defining themes and reporting results.

Through the usage of this systematic process, meaningful trends relating to data analytics capabilities, supply chain resilience, organizational decision-making, challenges of adoption of data analytics capabilities, and enabling factors impacting the successful implementation of data analytics capabilities in Finnish SMEs were discovered and identified.

Coding involved reviewing each interview and identifying relevant statements from it, grouping together related findings into categories and defining these broader themes as "themes".

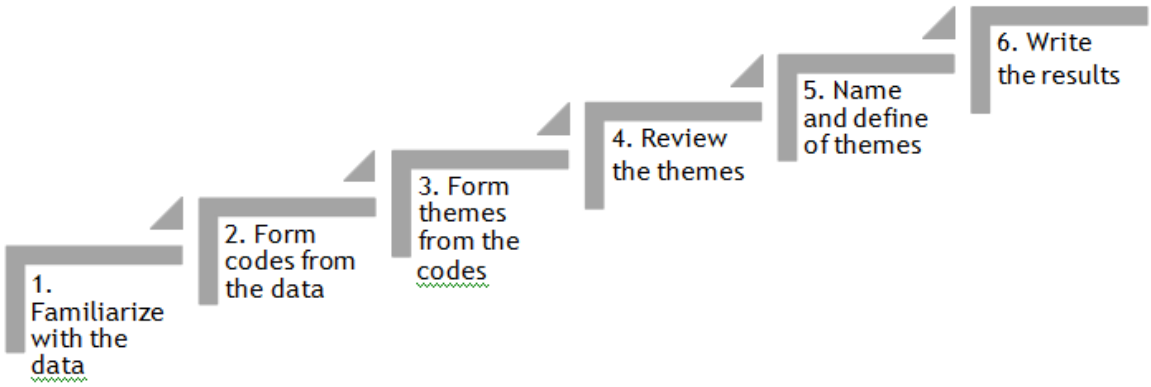


Figure 4.1: Phases of thematic analysis (Nowell et al. 2017)

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Thematic Analysis

Question 1

Can you describe how your organization currently uses data analytics in supply chain management?

Theme 1: Data Analytics Adoption in Supply Chain Operations

Table 4.2

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R6	Demand forecasting	"We use predictive analytics to forecast customer demand, which helps us adjust production schedules and inventory levels before market demand changes."	Predictive demand planning	Data Analytics Adoption in Supply Chain Operations
R2, R3	Business intelligence dashboards	"Interactive dashboards provide real time information about inventory, transportation, and supplier performance, enabling quicker operational decisions."	Real time analytical monitoring	
R4, R5	Supplier and logistics analytics	"We analyse supplier delivery performance and transportation data to identify bottlenecks and improve procurement efficiency."	Performance driven supply chain management	

Results

Data analytics plays an increasingly important role in the supply chains of Finnish SMEs. Organizations in Finnish SMEs use data analytics to predict demand, manage inventory, assess suppliers and monitor logistics activities on a day-to-day basis. Data analytics is beneficial in enabling forecasting of demand for the organization and thus manage the resource planning in anticipating the potential disruptions in the economy and at the customer's end. Business intelligence also play an important role providing the relevant and timely operational information required by the management for various functions of the supply chain network.

In addition, data analytics provides an appropriate system for analyzing suppliers and transportation services in order to achieve efficient procurements and operations. From the results, data analytics is viewed by Finnish SMEs as a capability that ensures a stable and efficient management of the supply chain.

Question 2

How has data analytics improved visibility across your supply chain?

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Theme 2: Enhanced Supply Chain Visibility

Table 4.3

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R4	Real time operational information	"We can monitor inventory, shipments, and warehouse activities in real time, which improves coordination across the supply chain."	End to end operational visibility	Enhanced Supply Chain Visibility
R2, R3	Centralized reporting	"Managers from different departments access the same dashboard, so everyone works with consistent and updated information."	Cross functional information sharing	
R5, R6	Supplier performance monitoring	"Supplier performance indicators allow us to identify delays and quality issues before they affect production."	Supplier visibility and monitoring	

Results

The findings emphasize on the importance of data analytics for supply chain visibility. Using real-time data, organizations are able to effectively monitor logistics operation, warehouse operations, transport operation, supplier management etc. Many respondents also identified the improvement in collaboration resulting from the use of unified data systems by different departments.

Effective use of business intelligence and data analytics enable early detection and prevention of various problems that lead to disruptions such as, supply shortage, inventory problems and supplier related issues. Data analytics also positively affect the coordinated functioning of various parts of the supply chain leading to efficient and resilient performance of the entire network.

Question 3

In what ways has data analytics helped your organization respond to supply chain disruptions or unexpected events?

Theme 3: Strengthening Supply Chain Resilience through Data Analytics

Table 4.4

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R5	Early risk identification	"Analytics provides early warning signals for inventory shortages and supplier delays, allowing preventive action before operations are affected."	Predictive risk management	Strengthening Supply Chain Resilience through Data Analytics

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Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R2, R6	Rapid operational response	"Real time data enables us to react quickly by adjusting production schedules and delivery plans when disruptions occur."	Responsive decision making	
R3, R4	Alternative sourcing decisions	"Historical and real time data help us evaluate alternative suppliers and select the most reliable option during disruptions."	Adaptive supply chain planning	

Results

Participants generally agree that data analytics significantly enhances supply chain resilience. Businesses are able to better respond, cope with and recover from disruptions by using this capability. Analytical tools allow prediction of problems such as supplier delays, stock shortages and fluctuations in demand, enabling managers to take pre-emptive steps for their solutions. Real-time operational information provided by data analytics enables swift responses and re-planning of various operations, such as production, transportation and logistics for adjusting to unexpected disruptions in the supply chain.

Procurement departments are better able to make accurate choices concerning alternative suppliers during supply chain disruptions. Overall, data analytics offers Finnish SMEs more agility and a quicker responsiveness, resulting in more resilience.

Question 4

How does data analytics support decision making related to procurement, inventory, or logistics?

Theme 4: Data Driven Decision Making

Table 4.5

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R3	Procurement planning	"Purchasing decisions are supported by demand forecasts and supplier performance reports rather than assumptions."	Evidence based procurement	Data Driven Decision Making
R2, R5	Logistics optimization	"Analytics identifies inefficient transport routes and helps us reduce delivery times and logistics costs."	Logistics optimization	
R4, R6	Inventory performance evaluation	"Inventory dashboards allow us to monitor stock movements	Inventory optimization	

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Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
		and prevent excess inventory or stock outs."		

Results

Participants indicate that data analytics can be viewed as an important contributor towards effective managerial decision-making in the areas of procurement, logistics and inventory management. Procurement managers gain benefit of an objective assessment of performance metrics of various suppliers and are better able to identify and selecting suitable supply sources based on evidence. Logistics is made more efficient, by analyzing relevant data to minimize transportation time and costs, with data analytics improving the overall transit of goods, thus reducing operational expenses. Inventory management benefits from having accurate real-time information about the stock, which enables them to optimize the use of funds and inventory levels.

Question 5

Can you share an example where data analytics helped improve your supply chain resilience?

Theme 5: Business Continuity through Data Analytics

Table 4.6

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R2	Inventory recovery	"Demand forecasting helped us redistribute inventory between warehouses, preventing stock shortages during supplier disruptions."	Inventory resilience	Business Continuity through Data Analytics
R3, R5	Supplier performance evaluation	"Supplier analytics enabled us to identify unreliable vendors and switch to alternative suppliers before production was interrupted."	Supplier resilience	
R4, R6	Operational flexibility	"Real time analytics allowed us to revise production schedules immediately when transportation delays occurred."	Operational adaptability	

Results

There were number of examples that respondents cited on the usefulness of data analytics for supply chain continuity during the time of disturbances. Data analytics and inventory forecasting help in the optimal use of inventories, distributed across several supply chain nodes, thereby minimizing the impact of supplier disruptions or sudden

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shifts in demand. Supplier analyses allowed effective selection of appropriate suppliers and their replacement. By collecting real-time information on supply chains operations logistics also helps production and logistics managers in making suitable adjustments for responding quickly to different disturbances in supply chain. This makes the organization more resilient to the vagaries of supply chain.

Question 6

What challenges has your organization experienced when implementing data analytics in supply chain management?

Theme 6: Challenges in Implementing Data Analytics

Table 4.7

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R5	High implementation cost	"Investing in analytical software, cloud platforms, and supporting infrastructure requires significant financial resources, which can be challenging for SMEs."	Financial investment barriers	Challenges in Implementing Data Analytics
R2, R6	Lack of analytical expertise	"One of the biggest challenges is finding employees who have both analytical knowledge and an understanding of supply chain processes."	Skills and competency gap	
R3, R4	Data quality and system integration	"Incomplete data and poor integration between existing systems reduce the reliability of analytical results and delay decision making."	Data management challenges	

Results

Respondents highlighted key challenges impacting the successful implementation of data analytics capabilities within Finnish SMEs. Among the key challenges identified include: high financial costs incurred in purchasing the necessary software and hardware for advanced analytics solutions and maintaining these systems; the scarcity of competent and well-trained employees with expertise in supply chain and analytics; the poor quality of raw data and low integration of existing systems, leading to increased doubts regarding the reliability of analytical results.

Question 7

What organizational resources or capabilities have supported the successful use of data analytics?

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Theme 7: Organizational Capabilities Supporting Data Analytics Adoption

Table 4.8

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R4	Leadership commitment	"Senior management consistently encourages data driven decision making and allocates resources for analytical initiatives."	Management support	Organizational Capabilities Supporting Data Analytics Adoption
R2, R3	Employee development	"Continuous training helps employees understand analytical tools and improves their confidence in using data for operational decisions."	Workforce capability development	
R5, R6	Digital infrastructure	"Cloud based ERP systems and integrated databases make analytical processes faster, more accurate, and easier to manage."	Technology infrastructure	

Results

Participants concluded that capabilities of an organisation form basis for successful uptake of data analytics. Strong management leadership supports employees in adopting analytical ways of thinking and it also provides funding needed to obtain technology. Further the respondents highlighted ongoing training for employees leads to higher skills and confidence in interpreting data in the context of operational decision making. Moreover, participants were able to conclude that new digital technology, such as integrated ERP and cloud systems allow a good access to an organisation's data at all times. These factors together bring conditions under which the organisations of Finnish SMEs benefit fully from data analytics capabilities.

Question 8

How important are employee skills and management support in effectively using data analytics?

Theme 8: Human Capital and Leadership Support

Table 4.9

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R6	Leadership involvement	"Managers actively encourage employees to use analytical evidence when making operational and strategic decisions."	Leadership engagement	Human Capital and Leadership Support

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Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R2, R5	Analytical competencies	"Employees need continuous learning because analytical technologies and reporting tools continue to evolve."	Employee analytical capability	
R3, R4	Organizational culture	"A culture that values data and continuous improvement increases employees' willingness to adopt analytical systems."	Data driven organizational culture	

Results

Study conclusions have drawn into that both employees' competencies and leadership support are essential to successful utilization of data analytics. Through the interviews it has become clear that if leadership, as a team is committed on utilization of analytical data as evidence in decisions or on moving the organization toward in digital era, it inspires its personnel into using analytical ways of thinking and in becoming more supportive to utilizing any changes resulting from the utilization of the technologies. The respondents have also stressed continuous training, because software applications and their technologies evolve in a rapid rate and business needs continue changing, which requires updating the staff's skills continually. Additionally, in organisations having strong data culture employees are engaged more enthusiastically and are more tolerant towards the integration of analytical technologies to organization's business. Thus, the findings suggest that the building of employees' competencies, development of appropriate leadership and supportive data-centered organizational culture play together a great role to make analytical ability strengthening the long term resilience of the supply chain.

Question 9

What technologies or systems have been most valuable for improving supply chain resilience through data analytics?

Theme 9: Digital Technologies Enabling Supply Chain Resilience

Table 4.10

Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
R1, R5	Enterprise resource planning	"ERP systems integrate purchasing, inventory, production, and logistics information into a single platform for analysis."	Enterprise data integration	Digital Technologies Enabling Supply Chain Resilience
R2, R3	Business intelligence platforms	"Business intelligence dashboards provide managers with real time performance	Business intelligence capabilities	

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Respondents	Initial Code	Authentic Data Extract	Re Coded As	Theme
		indicators and visual reports for faster decision making."		
R4, R6	Cloud based analytical systems	"Cloud platforms improve collaboration by allowing employees to access real time supply chain information regardless of their location."	Cloud enabled analytics	

Results

In this part the various factors of modern digital technologies that are enhancing the supply chain resilience by making the operational functionality using data analytic better are provided. Data analytics is highly dependent on modern digitally enabled technology where key elements of technological infrastructure enable this better. ERP (Enterprise Resource Planning) system helps in providing comprehensive analysis and better cross functional coordinations through its integration capability making information available for analysis.

Business Intelligence platforms are the most preferred because with dashboard functionalities they help in improving decision making for effective managerial functions and operational improvements by real time insights.

Moreover, the cloud based analytical technologies enable organisations to be collaborative while provide smooth access to the organisational data even by remote access by making an organisation's infrastructure more efficient.

Question 10

Based on your experience, what recommendations would you give to other Finnish SMEs seeking to strengthen supply chain resilience through data analytics?

Theme 10: Recommendations for Strengthening Data Analytics Capabilities

Table 4.11

Respondents	Initial Code		Authentic Data Extract	Re Coded As	Theme
R1, R4	Gradual implementation		"Organizations should begin with small analytical projects before expanding data analytics across the entire supply chain."	Phased analytics implementation	Recommendations for Strengthening Data Analytics Capabilities

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Respondents	Initial Code		Authentic Data Extract	Re Coded As	Theme
R2, R5	Continuous employee training		"Investing in employee skills is just as important as investing in analytical technologies."	Continuous capability development	
R3, R6	Data quality improvement		"Reliable, accurate, and well managed data should be treated as a strategic organizational asset."	Data governance and quality	

Results

The implementation strategies suggested by Finnish companies included moving gradually toward developing data analytics capabilities. Initially, it might be recommended to carry out limited, less risky analytical projects to build organisational experience in data analytics usage and to generate demonstrative results. These will help generate confidence about further investment into analytical applications and tools. Employee training was another essential success factor mentioned in the interviews; it could also help close any skills gap that exists within some organisations regarding data utilization or analytics understanding for operational decision-making. Building on high quality and governed data was another success factor for making effective use of data analytics, the analytical insights can't become reliable if based on incomplete or inaccurate data.

Conclusion

Introduction

This paper aims to provide answers and conclusions from the case study, with overall focus being in strengthening the operational supply chain resilience of Finnish Small and Medium sized Enterprises (SMEs) with the means of data analytics. In this final part, after the analysis part in section 4, the findings of the study are summarized, and it highlights key findings of the study as they respond to the initial research questions, reflects their implication for business practice and policy, points out the limitations of the current study, and gives recommendations for future research based upon the discussed insights.

Key Findings

Data analytics has in fact emerged as integral in many, but not all, Finnish SME supply chain operations, impacting operational planning (demand forecasting and inventory

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optimisation), procurement (supplier evaluations), and supply chain monitoring (logistics). Key, organisation-level drivers influencing their adoption are organisational capabilities – particularly leadership support, employee competence, and enabling digital infrastructure; these, coupled with a data-driven organisational culture, collectively form the strongest precursors for successful adoption. Several digital technologies were specifically highlighted as enhancing supply chain resilience through improving analytical capability, principally enterprise resource planning (ERP) systems, business intelligence (BI) platforms, and cloud-based analytical tools; their role in integration and data accessibility are key.

Supply chain resilience benefits are in the form of early warning (faster detection of disruptions), enhanced ability to adapt operationally and strategically (early intervention/response, effective sourcing, and flexible production schedules), improved overall supply chain visibility and efficiency, and more data-driven decision-making (as opposed to intuition-based judgments).

Challenges observed revolve around implementation costs, a scarcity of individuals possessing both analytics and supply chain competencies, and significant issues with data quality and integration. Generally, recommendations centered on gradual/phased implementation strategies (starting small, demonstrating value), combined with extensive employee training and robust data quality governance measures.

Practical Implications

Several practical implications arise from this research that could help Finnish SMEs improve their supply chain resilience through the use of data analytics. Firms may wish to use a phased approach to implementation of analytical systems, with low-risk projects offering quicker potential value, reducing the perceived burden of investment for smaller organisations. The clear lack of employees with integrated supply chain and analytics competency indicates a need for significant investment in training programmes to build internal capability and, conversely, may necessitate exploration of external expertise or partnerships (industry associations or innovation hubs, as examples) for those firms unable to develop such resources internally; leadership's commitment can be a key factor to spur such initiatives.

The importance of digital infrastructure suggests that organisations need not only possess appropriate technology (e.g., ERP, cloud capabilities) but that the data should be sufficiently structured and integrated for analytics, which may involve increased efforts toward data governance.

Policy bodies or intermediary organisations such as ELY centers and TEK may wish to consider these findings when devising support strategies to help Finnish SMEs adopt and better utilize data analytics to build more resilient supply chains.

Limitations of the Study

It is important to note certain limitations of the research when interpreting the results. As an explorative qualitative study, its small sample size (n=6), though suitable for capturing depth of insight, does not allow for the generalisation of the findings to the wider population of Finnish SMEs. This research did not capture opinions from SMEs

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in non-manufacturing industries. Moreover, all data was derived from self-reporting by study participants, raising the possibility of recall biases and 'soft washing' (a tendency to represent organisational practice in a positive light), and only one perspective from each participating organisation was available.

In addition, this research adopts a cross-sectional approach; due to the nature of interviews, only perceptions at a single point in time could be captured, precluding analysis of the dynamic interplay between the uptake of analytics capability and resilience over time. Due to purposive sampling procedures it is also likely that the respondents generally were interested in utilising analytics, and so the results may not accurately represent firms that have no interest in this type of operations.

Recommendations for Future Research

As a conclusion from this study, and acknowledging its limitations, the following are suggested as directions for future research. A longitudinal design would allow insights into whether (and how) analytics capabilities and supply chain resilience practices of Finnish SMEs would evolve across multiple disruption events. A comparative study where Finnish SMEs could be contrasted with SMEs from other Nordic countries or wider Europe could illuminate which findings are contextual to the Finnish institutional and economic context or reflect patterns common across resource-constrained organizations.

Future quantitative research with bigger sample could help confirm statistical relation between certain analytical practices and quantitative outcomes regarding organizational resilience in the whole Finnish SME population.

Further research could analyze further in more depth role played by external parties (such as innovation intermediaries, digital policy and programmess from state, business associations etc) in facilitating adoption of business analytics in the SMEs, expanding the identified topics about external network in this paper.

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