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The Role of IoT in Enhancing Supply Chain Visibility and Risk Management in Finnish Supply Chains: A Qualitative Study

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Abstract
This qualitative study investigates the potential of Internet of Things (IoT) technologies to enhance supply chain visibility and risk management in Finnish supply chains. Conducting semi structured interviews with eight supply chain professionals managing logistics, manufacturing, procurements and digital transformation topics, this research has addressed a framework of questions concerning the application of IoT which leads to monitoring information on line, building supply chains visibility along distant supply network and developing new capabilities for organisation to foresee and face-off supply chain events. This six-phased process adopted a thematic analysis. Seven common themes were observed, covering information in line monitoring, visibility gain, proactive risk management, implementation challenges, data based decision making, keys success factors and future challenges for adoption. Results from the survey shows that the application of IoT allows considerable scope for improving operational efficiency and supply chain resilience but implementation faces obstacle as the main hurdles in order to adopt: prohibitive initial investment; cybersecurity risks; and employees struggle to embrace novelties technologies. The research adds to the growing body of knowledge focusing on digital supply chain transformation in Nordic countries, and provides practical recommendations for organizations planning to implement the technologies in supply chain operations.
Keywords: *IoT, Supply Chain Visibility, Risk Management, Finland*

Introduction

Increasing complexity and volatility of global supply chains are prompting companies of all sectors to adopt digital technology to strengthen supply chain visibility and resilience (Zamani, Smyth, Gupta & Dennehy, 2023). Among the variety of technologies designed to promote the supply chain transformation process, the Internet of Things (IoT) is emerging as a key enabling technology in terms of transforming data from physical resources to digital information, by using sensors, radio frequency identification and various other smart devices to transmit continuous information from physical sources to information systems, thereby providing an unprecedented level of insight into the various organizations' supply chain processes (Dolgui & Ivanov, 2022). The use of IoT enables companies to continuously obtain information on shipment locations, automatic inventory updates, as well as directly collecting operational data from intelligent machines. In addition to simple visibility provided by the information

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collected, IoT also enable organizations to react and identify potential risks proactively by early spotting deviations and deviations to anticipated flows to trigger alerts before these "early deviations" can trigger and manifest as operational or financial problems (Zhao, Hong, & Lau, 2023).

The countries from Nordics, such as Finland are broadly considered a leader in digital adoption. These countries have strong infrastructure and highly digitized economy characterized by a widespread reliance on logistics, manufacturing, and international trade (Harju, Hallikas, Immonen, & Lintukangas, 2023). Finnish supply chain and procurement function are indeed increasing their level of digitalization as to have the capacity to deal with the complex supply chain disruptions (e.g. Pandemic shocks, geopolitical tensions, extreme weather etc.) that occur due to the instability of international trade flows (Glgeci & Kuivalainen, 2020).

Even though Finnish supply chain context and professionals, like other countries in Nordics regions are characterized by high readiness toward adoption of technology, only little research have explored qualitatively on the experiences of actually using IoT within supply chain operational practice in Finnish context. Most research on the topic tends to be quantitative and report data from general surveys or concept papers (Harju et al., 2023; Zamani et al., 2023). This study seeks to fill the gap in knowledge and explore first-hand experiences and perspectives of supply chain professionals in Finland regarding the use of IoT in enhancing supply chain visibility and risk management.

Problem Statement

Although a high level of IoT potential has been identified for strengthening supply chain visibility and risk management, the process of adopting it faces continuous problems like the high cost of infrastructure investment, risks of cyber security, integration with already existing systems and user resistance. (Rashid, Rasheed, Ngah, & Amirah, 2024). Most of the literature on this topic follows a quantitative or concept-oriented approach, whereas qualitative studies examining direct experiences by practitioners using IoT in supply chain operations are lacking.

From a practitioners' perspective there is a need to identify which critical success factors support IoT adoption and implementation and what the main challenges organizations could face. By qualitatively exploring these aspects, this study seeks to address the research gap.

Significance of the Study

The purpose of this study is to contribute to the growing literature on the digital transformation of the supply chain in the Nordic region by build upon Harju et al. (2023) and adding qualitative support to the quantitative evidence that already exists. It attempts to add practical and applicable findings, for practitioners and managers that plan to invest in IoT, by describing main enabling factors and possible pitfalls through its implementation phase. Additionally, the paper makes a theoretical contribution by linking practitioner voices to various concepts of information processing and digital supply chain resilience (Feng, Zheng, & Shen, 2024; Wamba, Dubey, Gunasekaran, &

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Akter, 2020) and it also adds value to policy makers, vendors, and educators willing to accelerate digital transformation in the supply chain and logistics sectors.

Research Questions

RQ1: How are the use of IoT devices enabling to provide more visibility along the supply chain within Finnish organisations?
RQ2: How does the use of IoT devices influence in risk management for Finnish supply chains?
RQ3: What are the impediments and critical success factors to the adoptability ofIoT devices for the Finnish supply chains?

Research Objectives

RO1: To examine how the use of IoT devices enable more visibility along the supply chain within Finnish organisations.
RO2: To explore the use of IoT devices influence in risk management for Finnish supply chains.
RO3: To investigate and identify the impediments and critical success factors to the adoptability of IoT devices for the Finnish supply chains.

Literature Review

Internet of Things (IoT) in Supply Chain Management

The IoT is considered as "a network of things in the real world that is augmented with sensors, software, and connectivity in order to capture and exchange data" (Dolgui & Ivanov, 2022). In SCM, IoT technologies refers to radio frequency identification tags, global positioning system trackers, smart sensors and connected machinery that constantly collect operational information and upload them into the central information system for analysis (Ivanov, 2021). Scholars claim that IoT as one of the driving forces behind Industry 4.0 and digital SC transformation along with Big Data Analytics, Cloud Computing, Artificial Intelligence and Blockchain (Zamani et al., 2023; Cui, Gaur, & Liu, 2023). The power of IoT is enabling organizations to make their SCM moving from reactive to proactive by having real-time product location, status, and condition knowledge across supply network (Quayson, Bai, Sun, and Sarkis, 2023).
It has been pointed out by Wamba et al. (2020) that "the combination of Big Data Analytics and digitally enabled SC ambidexterity enhanced firm performance when environmental dynamism was higher", in fact, it is a very common phenomenon in global and Finnish SC nowadays due to the recurring disruption of international trade patterns.

IoT and Supply Chain Visibility

Visibility can be defined as "the degree to which Supply chain partners are able to have information on their position, status and movement of goods throughout the Supply chain" (Razak, Hendry & Stevenson, 2023). With IoT it's possible to monitor items continuously through technologies like RFID, and GPS. They give live information on the physical locations of the products (Dolgui and Ivanov, 2022). Furthermore, IoT also help to develop inventory visibility, as sensors are able to automatically provide

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updated information on remaining inventory stock, reducing need for physical counting of goods and periodic stocktaking (Feng, Zheng, & Shen, 2024). The improvement of visibility can further enhance information sharing and trust among Supply chain partners as well as internal collaboration (Cui et al., 2023; Liu, Du, Kang, & Kang, 2024).

Razak et al. (2023) highlight traceability as a construct which is closely related to visibility and it leads to supply chain resilience by helping faster to locate affected products in the case of recall or disruption, so that they can be eliminated from farther part of supply network.

IoT for Supply Chain Risk Management

Supply chain risk management "refers to the process of planning, designing and implementing supply chain response strategies to minimize the potential negative impacts of supply chain disruptions" (Zhao, Hong, & Lau, 2023). In terms of risk management, IoT assists in early detecting of any deviations, such as equipment failure, temperature control problems or delivery delays, then the organizations would able to provide timely interventions before the problem develops into an irreversible crisis (Ivanov, 2021). The predictive functions powered by IoT in cooperation with data analytics enable companies to turn from reactive to pro-active risk management approaches (Rashid, Rasheed, Ngah, Pradeepa Jayaratne, Rahi, & Tunio, 2024). Through demonstrating its results, Choudhary, Ramkumar, Schoenherr & Rana (2021) suggest the importance of a network based approach in measuring resilience of a supply chain during critical disruption like pandemic, highlighting the contribution of real-time information in understanding the cascading effects of risk in a complex network structure.

The most substantial impact is from systematic review by Zamani et al. (2023) which confirms that combining IoT with artificial intelligence and big data analysis can remarkably enhance organizations' readiness and responsiveness to supply chain risks, although challenges involved with new technology implementation should not be overlooked.

Challenges and Success Factors of IoT Adoption

While there are undeniable benefits that IoT can brings to SCM, it is accompanied by a set of certain challenges. High capital investment of devices, connectivity infrastructure and integration to existing system is identified as a significant barrier to its adoption (Rashid, Rasheed, Ngah, & Amirah, 2024). Cybersecurity becomes a major concern for organizations by expanding more and more device connecting to the Internet, increasing the risks and vulnerability to malicious activities and data breaches (Dey, Chowdhury, Abadie, Vann Yaroson, & Sarkar, 2023). The difficulty of system interoperability between legacy systems and IoT devices is another prominent hurdle to be overcome (Centobelli, Cerchione, Maglietta, & Oropallo, 2023). Last but not least is the human element - the lack of experience employees in this new field requires investment on training, personnel development and overcoming resistance through

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management's encouragement and support, leading to successful organizational change (Kazancoglu, Ozbiltekin Pala, Mangla, Kazancoglu, & Jabeen, 2022).
In addition to the challenges, leadership commitment and gradual implementation starting with pilot projects along with tight integration with the existing Enterprise Resource Planning (ERP) systems are identified across the literatures as key success factors for achieving competitive business through the implementation of IoT technology (Rashid et al., 2024; Dey et al., 2023).

IoT Adoption in Finnish Supply Chains

Finland has long been renowned as a nation with cutting edge infrastructure for ICT technologies, thus creating a positive environment for applying these in various industries ranging from manufacturing, logistics, and procurement (Harju, Hallikas, Immonen, & Lintukangas, 2023). In the study of 147 Finnish companies, the procurement digitalization, covering data analytics and information sharing, can improve Supply Chain resilience and enable reduction of uncertainty (Harju et al., 2023). The Nordic organization are considering digitization as a strategic driver not only for enhancing operational efficiency, but also for building resilient supply chain in face of ever changing market disruptions, for example pandemic, Geopolitics impacting international trade routes (Glgeci & Kuivalainen, 2020). As the existing Finnish focused researches mainly depended on survey-based approach and quantitative method (Harju et al., 2023), and research on how Finnish SCM professionals use and experience IoT in their daily work still insufficient, this current study aims to bridge this gap.

Research Methodology

Research Design

This is an exploratory research designed in a qualitative manner, in order to better capture the complexities and depths of the participant's live experiences and opinions regarding the use of IoT technologies (Nowell, Norris, White, & Moules, 2017). This research design is suitable for an exploratory context as the research questions are open, and it aims to understand participants meaning, rather than measuring a certain variable and identifying correlations.

Research Approach

Interpretivism was chosen as the research paradigm, as it highlights the socially construction understanding of the IoT in business organizations and individual's perceptions. Inductive was the chosen analytical strategy as the analysis aimed to identify emergent findings from the data instead of testing hypothesis. Inductive strategy is widely recommended for Thematic Analysis research designs (Nowell et al., 2017).

Data Collection

The data were gathered through semi-structured interviews; which were chosen due to the need to obtain richer and deeper understanding of individuals, while allow

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flexibility for discussing the subject in relation to the participant's personal professional experience. Key interview themes corresponded to the relevant topics such as, present IoT use, improvement visibility, aid risk management, implementation challenges, the role of decision making influencers, critical factors for success, as well as recommendations for the future. A total of seven main topics covered corresponded to the seven research interview questions explained in section 4. The data were collected from August till September 2026 in Finland and recorded using consent of the interviewers for later transcription of the interview material.

Sampling Technique and Participants

Participants for the research were purposively recruited in the study according to their work experience; which were considered to include supply chain, logistics, manufacturing, procurement, and/or digital transformation professionals from organisations in Finland. In total eight interviewees with different managerial and technical experience in each sector were selected and have been labelled R1 until R8 in this research study, they included but were not limited to: a supply chain manager, a logistics manager, an operations manager, a procurement manager, a digital transformation specialist, a warehouse operations manager, a production manager, and a supply chain analytics manager, as specified in the table below (Table 4.1).

It is agreed among qualitative researchers that relevant themes can arise from relatively small and specifically selected samples, because of the expert and pertinent background of the participants on the subject they provide in depth views of that topic (Nowell et al., 2017).

Data Analysis (Thematic Analysis)

An inductive and six step process was carried out for the analysis of the collected interview data. Step 1 of the process included reading multiple times, and for several days, transcribing of all individual Interviews for sufficient familiarisation with the content. Following that, step 2 involved identification, annotation, and assignment of meaning to various text segments across all interviews (initial coding).

Once the initial coding had generated about five to ten codes (per interview), the, in step 3 of the process, they were grouped into candidate themes based on a similar pattern of meaning shared among some segments.

In step 4 of the thematic analysis process all candidate themes, codes and the data were revisited to refine and ensure accuracy with regard to representing the data collected and answer the original research questions for each main question separately. By this systemic method step 5 involved naming and giving an explicit definition to each identified main theme before finalizing step 6, presenting the final report with excerpts of participants accounts to illustrate each main finding presented in section 4.

Data Analysis

In this study, IoT adoption in Finnish supply chains was examined with reference to supply chain visibility and risk management. Data from eight semi-structured interviews with individuals working within the areas of supply chain management,

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logistics, manufacturing, procurement, and digital transformation in the Finnish operating environment was collected. Each interview focused on participants' perspectives on IoT adoption, benefits for visibility and risk management, challenges experienced with adoption, how IoT supports decision making, and recommendations for adoption in the future.

By applying a thematic analysis method of data collection and interpretation on the interview data, a broad range of findings regarding Finnish companies' utilization of IoT technologies for operational excellence and resilient supply chain building in accordance with digital transformation in other Nordic countries was captured (Harju et al., 2023).

Demographic Information of Respondents

The study respondents were representative of managerial and technical jobs among various manufacturing, logistics, and supply chain firms in Finland. All respondents had multiple, and a broad background related to supply chain work, which could inform their answers about IoT adoption in supply chains and its effect on supply chain resilience.

Table 4.1 Demographic Information of Respondents

Respondent	Background / Role
Respondent1	Supply Chain Manager
Respondent 2	Logistics Manager
Respondent 3	Operations Manager
Respondent 4	Procurement Manager
Respondent 5	Digital Transformation Specialist
Respondent 6	Warehouse Operations Manager
Respondent 7	Production Manager
Respondent 8	Supply Chain Analytics Manager

Stages of Thematic Analysis

The thematic analysis data was conducted by following the six step processes suggested by Nowell et al. (2017). They included familiarization with interview data, generation of initial codes, developing themes, refining and reviewing themes, defining themes and coding names, and composing a report. This was a systematic method to extract relevant patterns and ideas from the data concerning supply chain visibility and risk management.

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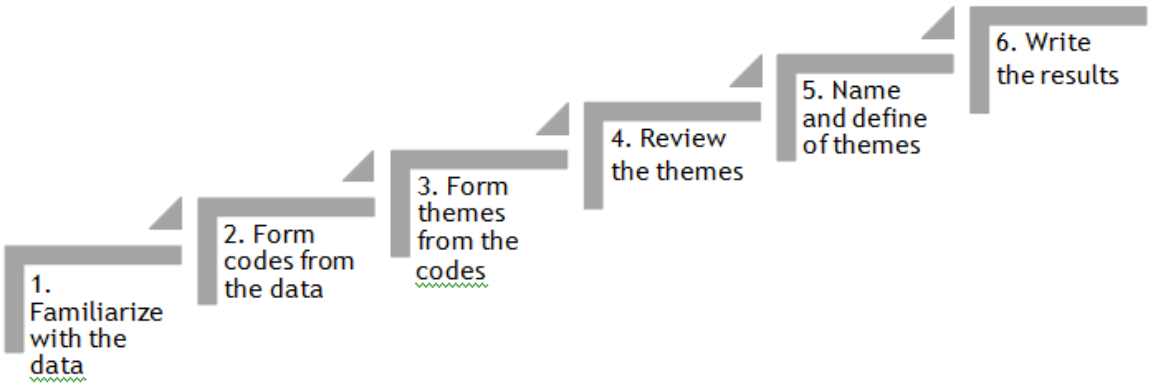

Figure 4.1: *Phases of Thematic Analysis (Nowell et al., 2017)*

Thematic Analysis

Question 1: Can you describe how your organization currently uses IoT technologies in supply chain operations?

Theme 1: IoT Adoption for Real Time Monitoring

Table 4.2

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R3, R8	Real time tracking	We use sensors and GPS to monitor shipments continuously.	Real time monitoring	IoT Adoption for Real Time Monitoring
R2, R5	Inventory monitoring	RFID tags help us monitor inventory automatically.	Smart inventory management	
R4, R6, R7	Connected devices	Machines automatically send operational data to our system.	Connected operations	

Results

Finnish companies have moved from discrete tracking tools toward full monitoring. Their sensor technology, as well as RFID tags and GPS devices, in contrast to traditional snapshot-taking, works constantly in background to monitor entire chains and thus providing the organizations information that reflects real-time operational situations instead of fixed ones. The research respondents' words suggest that, this fully connected ecosystem also influences how organizations observe issues within a supply chain. Rather than getting notice upon the appearance of events like a delay or malfunction, a concerned team immediately receive the information upon event emergence.

This means that the full integration is more about setting an environment for future and valuable actions rather than functionality in isolation.

Question 2: In what ways has IoT improved supply chain visibility?

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Theme 2: Improved Supply Chain Visibility

Table 4.3

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R2, R5	Better shipment tracking	We always know where products are during transportation.	End to end visibility	Improved Supply Chain Visibility
R3, R6	Inventory transparency	Inventory information is updated instantly.	Inventory visibility	
R4, R7, R8	Data sharing	Departments receive the same real time information.	Information transparency	

Results

This theme describes the process by which continuous data collection leads to a shared and truthful vision of the goods and inventory reality. Participants mentioned two closely associated advantages – first, simply having visibility into location, and second, maintaining an inventory count without relying on physical counting. Equally significant, this new information is no longer isolated within specific business units; by giving multiple teams access to real-time data simultaneously, organizations foster better alignment and reduce contradictory decision-making. This pattern demonstrates that visibility doesn't manifest as having increased data availability but through broad and common accessibility of the data, resulting in an organisation that feels well-informed as opposed to merely data-collecting.

Question 3: How has IoT helped your organization identify and manage supply chain risks?

Theme 3: Proactive Risk Management

Table 4.4

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R5, R8	Early detection	IoT alerts us before equipment failures occur.	Predictive monitoring	Proactive Risk Management
R2, R4	Delay management	We immediately detect transportation delays.	Risk identification	
R3, R6, R7	Faster response	Real time data allows quick corrective actions.	Rapid response	

Results

Responses under this theme suggest that IoT transforms organisation's relationship with disruption. The participants were willing to move away from simply recognizing problems when a customer complains, or when a project falls behind schedule; sensing technologies allow them to identify problems sooner, with evidence of an anomalous

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equipment state or late shipments. In this sense, it revolutionizes risk management from being a process that reacts to events to being a process that anticipates events. The frequent use of terms like time, early detection and fast response suggests that in this case the focus is perhaps less on eliminating any or all disruptions, and more on reducing the interval time between their occurrence and a proper response.

Question 4: What challenges has your organization faced when implementing IoT technologies?

Theme 4: Implementation Challenges

Table 4.5

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R4	High investment	Installing IoT infrastructure requires significant investment.	High implementation cost	Implementation Challenges
R2, R5, R8	Data security	Cybersecurity remains one of our biggest concerns.	Security concerns	
R3, R6, R7	Employee adaptation	Employees required extensive training.	Change management	

Results

This theme underscores the fact that advantages described previously do not come easily. Three types of drawbacks were evident, including financial, technical, and human factors. The cost aspect involves making a significant financial commitment when deploying new sensors and attendant infrastructure. Concerns surrounding security include the safety and integrity of a continually interconnected system as additional devices increase the attack surface. As to human obstacles, employees need training so they are prepared to operate new technology and do so successfully; a tool remains ineffective if staff refuses or is unable to utilize it. Notably, each of these are interconnected challenges organisations should consider holistically rather than hierarchically.

Question 5: How has IoT influenced decision making during unexpected disruptions?

Theme 5: Data Driven Decision Making

Table 4.6

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R3, R7	Faster decisions	Managers receive immediate information during disruptions.	Quick decision making	Data Driven Decision Making
R2, R4	Resource allocation	We adjust deliveries based on live data.	Operational flexibility	

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Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R5, R6, R8	Performance monitoring	Dashboards support informed operational decisions.	Analytical decision support	

Results

This theme highlights how the uninterrupted availability of real-time information influences an organisation's approach to action in crisis scenarios. In this theme, managers were able to modify project plans with real-time information on a number of fronts while a crisis unfolded, instead of only once a disruptive event had already transpired. In contrast with conventional reporting, where managers relied on an outdated report to guide actions and decision-making after the fact, there is now availability of useful information to inform daily operations. With increased ability and flexibility, such as dynamically re-routing inventory based on, for instance, the latest weather report, is possible because of this seamless communication flow that enables swift and nimble actions beyond what was previously practical.

Question 6: What factors have contributed to the successful adoption of IoT in your organization?

Theme 6: Critical Success Factors

Table 4.7

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R5	Management support	Leadership strongly supported digital transformation.	Leadership commitment	Critical Success Factors
R2, R6, R8	Employee skills	Training helped employees adopt the new technology.	Employee competence	
R3, R4, R7	System integration	Integration with existing ERP systems was essential.	Technology integration	

Results

This theme explains the various ingredients that have allowed successful adoption and integration of the IoT within organisational operations, whilst simultaneously providing a counterpoint to where implementation efforts often stumble. These key elements can be categorized as organisational, human, and technological. Organisational change necessitates sustained support from leadership; technical adoption hinges on systems integration so as to ensure newly implemented devices augment an organisation's existing capabilities. For new technology to be leveraged efficiently and effectively, well trained personnel are essential.

Any disruption across these core functional areas can impede success. It therefore stands to reason that in order to realize the full potential benefits of IoT adoption,

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organisations are best advised to address these different functional areas in concert rather than separately.

Question 7: What recommendations would you give to organizations planning to implement IoT in supply chain management?

Theme 7: Future Recommendations

Table 4.8

Respondents	Initial Code	Authentic Data Extract	Re coded As	Theme
R1, R4	Start gradually	Organizations should begin with pilot projects.	Pilot implementation	Future Recommendations
R2, R5, R8	Invest in cybersecurity	Protecting IoT data should be the first priority.	Strong cybersecurity	
R3, R6, R7	Continuous employee training	Regular training improves long term success.	Capacity building	

Results

The suggestions are practical recommendations based on lived experience rather than theoretically conceptualized advice. Initiating a project with small pilot projects rather than an organization-wide rollout allows issues to arise on a smaller level before an organization commits to large-scale adoption and investment. Building cybersecurity from the start as opposed to bolting it on later addresses something that participants obviously saw as non-negotiable. Continuing training and not stopping after an initial on-boarding period suggests that the ease of technology adoption must develop with comfort, over time, and not just on a single instance.

Overall, the recommendations point to a model where continued adoption relies on thoughtful, step-wise investment and roll-out as opposed to a one time, all encompassing, gain of the benefits of Io.

Conclusion

Summary of the Study

This study aimed to qualitatively investigate how Internet of Things technology would be relevant for the improvement of visibility and risk management in Finnish supply chains. Eight semi structured interviews with managers holding roles in supply chain management, logistics, manufacturing, purchasing, and digitalization have provided data which was analyzed using the six-step process suggested by Nowell et al. (2017). As a result of the analysis seven interconnected themes has been identified from participants' experiences; real time monitoring, better visibility, anticipatory risk management, implementation barriers, decision making on the basis of data, critical success factors and advice for future implementation. These seven themes provided a grounded description of how people perceive and value these technologies in Finnish supply chain.

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Findings

There is a strong consensus among participants that the utilization of IoT technology has a significant impact on the visibility within the supply chain due to real-time monitoring, information flow and shared data visibility (Feng et al., 2024; Cui et al., 2023). Risk management capabilities are improved through early identification of disruptions, resulting in a more anticipatory approach from organizations (Zhao et al., 2023; Ivanov, 2021). However, there are concerns about implementation issues, such as costs, security concerns and employees' willingness to adopt the new system which are also found in previous researches (Dey et al., 2023; Rashid et al., 2024). It seems that the success of IoT technology is dependent on strong leadership, relevant employee competencies, integration with enterprise systems and that for the most part, successful implementation is achieved via pilots, significant investments into cybersecurity and training for employees.

Practical Implications

Managers and decision makers in Finnish companies are recommended to invest into IoT solutions more strategically, starting from utilizing the new technologies through piloting to developing appropriate in-house capabilities before considering a wider scale of implementation (Dey et al., 2023). According to participants, adequate resources and training for employees to become able to adapt to new systems is essential; the change management aspect is as critical as the technology itself. It is recommended not to neglect the cybersecurity aspect of IoT technology, as the increase of connectivity would naturally mean a broader attack surface. The system needs to be able to integrate effectively with existing enterprise resource planning infrastructure to enable better visibility and risk management in operations.

Limitations of the Study

The present qualitative study as well as a relatively small sample size, the present study has several limitations regarding its generalizability. The seven participants come from different organizations and business sectors. Furthermore, based on the personal perceptions of the participants, there may be other contributing factors beyond the presented topics that would affect the adoption and implementation of IoT technology. As an addition, combining this research with a quantitative study about specific key performance indicators could strengthen the results found from the interviews.

Recommendations for Future Research

Future research could use a mixture of both quantitative and qualitative approaches to get a broader view of the impact of IoT. Studies within specific industries would be beneficial as every organization's context varies widely from one another. Follow-up studies through longitudinal perspective can help in understanding how organizations develop their in-house capabilities over time when adopting IoT technologies. Furthermore, research on integration of AI and IoT within Finnish supply chain would also be a useful study.

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