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A Qualitative Investigation of IoT Adoption for Operational Efficiency and Process Innovation

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Abstract

This study explores the adoption of the Internet of Things (IoT) as a transformative tool for enhancing operational efficiency and driving process innovation within organizations. By employing a qualitative research methodology, the study captures the experiences, perceptions, and insights of managers, engineers, and operational specialists involved in IoT implementation across diverse sectors, including manufacturing, logistics, healthcare, and energy. Data were collected through semi-structured interviews and supplemented with relevant organizational documents to provide a comprehensive understanding of the adoption process. The findings reveal that IoT adoption fundamentally reshaped operational practices by providing real-time visibility, enabling proactive decision-making, fostering cross-functional collaboration, and supporting continuous process improvements. Participants highlighted that the integration of IoT facilitated predictive and evidence-based decision-making, reduced operational uncertainties, and enhanced coordination among previously siloed departments. Moreover, IoT acted as a catalyst for process innovation, encouraging organizations to experiment with workflows, redesign processes, and embed flexibility into operations. The study also identifies challenges associated with IoT adoption, including data overload, system integration complexities, resistance to change, and the need for new skills and organizational capabilities. Success in IoT adoption was found to be closely linked to human and organizational factors, such as leadership support, learning culture, workforce competence, and strategic alignment. Overall, the study underscores that IoT adoption is not merely a technological upgrade but a socio-technical transformation requiring sustained effort, adaptation, and alignment with organizational objectives. The insights from this research provide valuable guidance for practitioners seeking to leverage IoT for operational excellence and innovation, highlighting the interplay between technology, people, and processes in achieving meaningful organizational outcomes.

Keywords: operational efficiency; process innovation; organizational transformation; data-driven decision-making; cross-functional collaboration; predictive analytics; workflow optimization; real-time monitoring; technology integration

1. Introduction

The rapid evolution of digital technologies has fundamentally reshaped how organizations design, manage, and optimize their operations, with the Internet of Things (IoT) emerging as one of the most transformative enablers of operational efficiency and process innovation across industries. IoT refers to interconnected physical devices embedded with sensors, software, and communication technologies that enable real-time data collection, exchange, and intelligent decision-making, thereby transforming traditional operational models into data-driven, adaptive systems (Khan et al., 2025; Latino et al., 2025). In contemporary competitive environments characterized by volatility, complexity, and heightened customer expectations, organizations increasingly rely on IoT-enabled infrastructures to enhance visibility, responsiveness, and coordination within and across supply chains, production systems, and service networks (Türkeş, 2025; Keskin & Ungan, 2025; Emon & Ahmed, 2025). This qualitative investigation is grounded in the recognition that while quantitative

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studies have documented performance outcomes associated with IoT adoption, there remains a critical need to deeply understand the lived experiences, perceptions, and contextual interpretations of organizational actors who engage with IoT technologies in pursuit of operational efficiency and process innovation (Khan et al., 2025; Sarangi & Ghosh, 2025; Emon & Ahmed, 2025). Operational efficiency has long been associated with the optimal utilization of resources, minimization of waste, and alignment of processes to achieve cost, time, and quality objectives. IoT adoption fundamentally alters the mechanisms through which efficiency is realized by enabling continuous monitoring, predictive analytics, and real-time control over assets and processes (Latino et al., 2025; Fan et al., 2025). For example, sensor-enabled monitoring systems in manufacturing and logistics environments allow organizations to detect anomalies, anticipate maintenance needs, and optimize throughput, thereby reducing downtime and operational uncertainty (Nikdast & Awasthi, 2025; Ulrich et al., 2025). From a qualitative perspective, understanding how managers, engineers, and frontline employees interpret these efficiency gains, negotiate new work practices, and adapt to data-driven decision-making is essential for capturing the nuanced dynamics of IoT-enabled transformation (Kourt & Ait Lhassan, 2025; Ben Rhouma et al., 2025; Emon & Chowdhury, 2025). Process innovation, in contrast to incremental efficiency improvements, involves the reconfiguration or redesign of workflows, coordination mechanisms, and organizational routines to create new value propositions and competitive advantages. IoT serves as a catalyst for such innovation by integrating physical and digital processes, enabling new forms of collaboration, automation, and value co-creation (Pan & Zhang, 2025; Pan & Zhang, 2025). In shared manufacturing ecosystems and digitally integrated supply networks, IoT technologies facilitate data-driven coordination across organizational boundaries, supporting novel operational models such as predictive logistics, autonomous transportation, and digitally enabled service offerings (Nikdast & Awasthi, 2025; Zhang et al., 2025; Emon & Chowdhury, 2025). Qualitative inquiry allows for the exploration of how these innovations emerge in practice, how organizational actors make sense of new process configurations, and how institutional, cultural, and strategic factors shape IoT-enabled innovation trajectories (Alahmari & Awad, 2025; Arora et al., 2025). The growing prominence of Industry 4.0 and Industry 5.0 paradigms has further intensified interest in IoT adoption as a foundational element of smart, resilient, and sustainable operational systems (Sarangi & Ghosh, 2025; Khan et al., 2025). Industry 4.0 emphasizes cyber-physical systems, automation, and data exchange, while Industry 5.0 extends this focus by integrating human-centricity, sustainability, and resilience into technological transformation (Türkeş, 2025; Wei et al., 2025). IoT technologies play a central role in enabling these paradigms by connecting machines, humans, and digital platforms in real time, thereby supporting adaptive decision-making and continuous improvement (Latino et al., 2025; Zeng et al., 2025; Emon et al., 2025). A qualitative investigation is particularly well-suited to examining how organizations navigate these paradigm shifts, balance technological possibilities with human and ethical considerations, and translate strategic visions into operational realities (Alahmari & Awad, 2025; Wei et al., 2025). Supply chain integration is frequently identified as a critical mediating mechanism through which IoT adoption influences operational efficiency and innovation outcomes. By enabling seamless information exchange, visibility, and coordination across suppliers, manufacturers, distributors, and customers, IoT technologies enhance both internal and external integration capabilities (Khan et al., 2025; Ghariani & Boujelbène, 2025; Emon et al., 2025). Empirical evidence suggests that integrated supply chains are better positioned to respond to demand fluctuations, manage risks, and exploit innovation opportunities, particularly in digitally intensive environments (Keskin & Ungan, 2025; Sarangi & Ghosh, 2025). However, qualitative insights are needed to understand how integration is experienced and enacted by organizational actors, how trust and collaboration are built around IoT-enabled data sharing, and how power dynamics and governance structures influence integration outcomes (Arora et al., 2025; Chen et al., 2025; Emon et al., 2025). IoT adoption also intersects with broader digital transformation initiatives that extend beyond operational domains to encompass financial performance, sustainability, and strategic positioning. Digital transformation literature highlights that technology adoption alone does not guarantee performance improvements; rather, value is

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realized through complementary organizational changes, process redesign, and capability development (Ghariani & Boujelbène, 2025; Türkeș, 2025). IoT-generated data can inform financial decision-making, risk management, and investment strategies, thereby linking operational efficiency to broader organizational performance outcomes (Ben Rhouma et al., 2025; Liao et al., 2025). A qualitative lens enables researchers to explore how decision-makers interpret IoT data, reconcile short-term efficiency gains with long-term strategic objectives, and manage tensions between technological complexity and organizational readiness (Kourt & Ait Lhassan, 2025; Ben Rhouma et al., 2025). The relevance of IoT adoption extends across diverse industry contexts, including healthcare, agri-food, energy, construction, transportation, and manufacturing, each of which presents unique operational challenges and innovation opportunities. In healthcare systems, IoT-enabled real-time data analytics, combined with artificial intelligence and advanced communication technologies, support improved patient care, asset utilization, and process coordination (Singh et al., 2025; Río, 2025; Emon et al., 2025). Qualitative investigations in such contexts can reveal how clinicians and administrators perceive IoT-driven efficiency, negotiate data governance concerns, and integrate digital tools into complex care pathways (Sarangi & Ghosh, 2025; Singh et al., 2025). Similarly, in agri-food supply chains, IoT and data analytics enhance traceability, food safety, and sustainability-oriented decision-making, reshaping traditional operational models (Latino et al., 2025; Fan et al., 2025). In energy and transportation systems, IoT adoption supports real-time monitoring, adaptive scheduling, and risk mitigation, contributing to more resilient and efficient networks (He et al., 2025; Zhong et al., 2025). For example, sensor-enabled transportation networks integrated with renewable energy sources enable dynamic optimization of routes and resources, reducing operational costs and environmental impacts (He et al., 2025; Shao et al., 2025; Emon et al., 2025). Qualitative insights are essential for understanding how engineers, planners, and policymakers interact with these systems, interpret algorithmic recommendations, and address uncertainties associated with technological complexity and external disruptions (Zhong et al., 2025; Benigno et al., 2025). The construction and manufacturing sectors further illustrate the transformative potential of IoT when combined with complementary digital technologies such as blockchain, smart contracts, and robotic process automation. IoT-enabled coordination mechanisms enhance transparency, accountability, and automation in modular construction and distributed manufacturing environments (Zeng et al., 2025; Mahajan & Kaur, 2025). These developments not only improve operational efficiency but also enable new process innovations related to project management, contract execution, and cross-organizational collaboration (Zhang et al., 2025; Aliu et al., 2025). Qualitative research provides a means to capture how practitioners experience these changes, manage interoperability challenges, and develop trust in digitally mediated processes (Aliu et al., 2025; Mahajan & Kaur, 2025; Emon et al., 2025). Despite the growing body of research on IoT adoption, several gaps remain that justify a qualitative investigation focused on operational efficiency and process innovation. First, much of the existing literature relies on quantitative models that emphasize performance metrics and causal relationships, often overlooking the subjective interpretations, contextual factors, and sensemaking processes that shape technology adoption and use (Khan et al., 2025; Wei et al., 2025; Emon et al., 2025). Second, IoT adoption is frequently examined in isolation, without sufficient attention to its interaction with other digital technologies, organizational capabilities, and institutional environments (Türkeș, 2025; Pan & Zhang, 2025). A qualitative approach enables a holistic exploration of these interactions, shedding light on how IoT is embedded within broader digital ecosystems and transformation strategies (Zheng et al., 2025; Pan & Zhang, 2025). Third, the outcomes of IoT adoption are not uniformly positive, and organizations often encounter challenges related to data quality, cybersecurity, integration complexity, and human resistance to change. Qualitative inquiry is particularly valuable for uncovering these challenges, understanding how they are perceived and addressed by organizational actors, and identifying context-specific strategies for overcoming barriers to operational efficiency and innovation (Kourt & Ait Lhassan, 2025; Keskin & Ungan, 2025). Moreover, qualitative insights can illuminate unintended consequences of IoT adoption, such as shifts in power relations, changes in skill requirements, and

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ethical concerns related to surveillance and data ownership (Arora et al., 2025; Chen et al., 2025). The strategic implications of IoT adoption are further amplified in periods of crisis and uncertainty, as demonstrated by organizational responses to global disruptions such as pandemics and supply chain shocks. Digital leaders that effectively leveraged IoT-enabled visibility and analytics were better positioned to adapt operations, manage risks, and sustain performance during crises (Jyani, 2025; Türkeș, 2025; Emon, 2025). Qualitative studies can provide rich narratives of how organizations mobilized IoT capabilities under pressure, how decision-making processes evolved in real time, and how lessons learned influenced subsequent innovation and resilience-building efforts (Jyani, 2025; Benigno et al., 2025). From a theoretical perspective, a qualitative investigation of IoT adoption contributes to advancing understanding of technology-enabled operational change by integrating insights from supply chain management, operations management, digital transformation, and innovation studies. Concepts such as ambidexterity, responsiveness, and value co-creation are particularly relevant for interpreting how organizations balance efficiency and innovation in IoT-enabled environments (Wei et al., 2025; Keskin & Ungan, 2025). Qualitative data can enrich these theoretical constructs by revealing how they are enacted in practice, how tensions are managed, and how contextual contingencies influence outcomes (Pan & Zhang, 2025; Wei et al., 2025).

2. Literature Review

The literature on IoT adoption for operational efficiency and process innovation has expanded rapidly in recent years, reflecting the growing recognition that interconnected digital technologies fundamentally reshape how organizations coordinate resources, manage processes, and create value across complex operational systems. Scholars increasingly emphasize that IoT adoption is not merely a technological upgrade but a socio-technical transformation that redefines information exchange, decision-making, and organizational routines, particularly within supply chains and networked production systems (Kourt & Ait Lhassan, 2025; Khan et al., 2025). Prior studies consistently highlight that IoT-enabled real-time data visibility enhances operational transparency and responsiveness, thereby improving efficiency outcomes such as cost reduction, lead time compression, and service reliability, while simultaneously enabling new forms of process innovation grounded in data-driven coordination and automation (Keskin & Ungan, 2025; Latino et al., 2025; Emon, 2025). A dominant theme across the literature is the centrality of information exchange as a foundational mechanism through which IoT generates operational value. Effective information sharing, enabled by sensor networks, connected platforms, and analytics, is repeatedly associated with superior supply chain performance and operational alignment (Kourt & Ait Lhassan, 2025; Ben Rhouma et al., 2025). IoT technologies enhance the granularity, timeliness, and accuracy of operational data, which supports more informed planning, monitoring, and control decisions across organizational boundaries (Türkeș, 2025; Keskin & Ungan, 2025; Emon, 2025). However, scholars caution that the benefits of information exchange are contingent upon organizational capabilities, governance structures, and trust among supply chain partners, suggesting that IoT adoption outcomes are shaped by both technological and relational factors (Arora et al., 2025; Chen et al., 2025). Digital transformation research further situates IoT adoption within broader organizational change processes, emphasizing that operational efficiency gains are often mediated by supply chain integration and complementary digital capabilities (Ghariani & Boujelbène, 2025; Khan et al., 2025). Studies in agro-industrial and manufacturing contexts demonstrate that digital technologies, including IoT, contribute to financial and operational performance primarily when they are embedded within integrated supply chain structures that align information flows, decision rights, and performance objectives (Ghariani & Boujelbène, 2025; Sarangi & Ghosh, 2025; Emon, 2025). This perspective reinforces the view that IoT adoption alone is insufficient; rather, its value emerges through the reconfiguration of inter-organizational processes and collaborative practices that support coordinated action and innovation (Alahmari & Awad, 2025; Pan & Zhang, 2025). Industry 4.0 and Industry 5.0 frameworks provide an important conceptual backdrop for understanding IoT-enabled operational efficiency and process innovation. Research in healthcare, manufacturing, and logistics contexts illustrates how IoT

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technologies, combined with artificial intelligence, advanced analytics, and high-speed connectivity, enable cyber-physical systems that dynamically adapt to changing conditions (Singh et al., 2025; Sarangi & Ghosh, 2025). In healthcare organizations, real-time data analytics supported by IoT infrastructures enhance asset utilization, patient flow management, and clinical decision-making, thereby improving both efficiency and quality outcomes (Singh et al., 2025; Río, 2025). These studies underscore the process innovation potential of IoT, particularly when digital tools are integrated into core operational workflows rather than treated as peripheral technologies (Sarangi & Ghosh, 2025; Khan et al., 2025; Emon, 2025). Sustainability and resilience considerations have also become integral to the literature on IoT adoption and operational performance. Scholars argue that IoT-enabled monitoring and analytics support more sustainable resource utilization by enabling real-time tracking of energy consumption, emissions, and waste across supply chains (Türkeş, 2025; Shao et al., 2025). In agri-food supply chains, IoT and data analytics facilitate sustainable decision-making by enhancing traceability, food safety, and environmental compliance, while also supporting efficiency improvements through optimized logistics and inventory management (Latino et al., 2025; Fan et al., 2025). These findings suggest that operational efficiency and process innovation are increasingly intertwined with sustainability objectives, positioning IoT as a key enabler of the so-called "twin transition" toward digitalization and sustainability (Latino et al., 2025; Türkeş, 2025; Emon, 2025). The integration of IoT with other emerging technologies further expands its process innovation potential. Blockchain and distributed ledger technologies, when combined with IoT, enhance transparency, security, and trust in supply chain transactions, enabling new coordination mechanisms and automated contractual arrangements (Mahajan & Kaur, 2025; Aliu et al., 2025). Research in water supply chains and construction industries highlights that IoT-generated data, when recorded and validated through blockchain systems, supports more reliable process execution and accountability, thereby improving operational efficiency and reducing opportunistic behavior (Mahajan & Kaur, 2025; Aliu et al., 2025; Emon, 2025). Similarly, studies on smart contracts and robotic process automation demonstrate that IoT integration enables higher levels of automation and coordination in modular construction and manufacturing supply chains, leading to innovative process designs that reduce manual intervention and cycle times (Zeng et al., 2025; Zhang et al., 2025). Transportation and logistics literature provides further evidence of IoT's role in enhancing operational efficiency through real-time monitoring and adaptive control. Autonomous vehicles, sensor-equipped ports, and intelligent transportation systems leverage IoT data to optimize routing, scheduling, and asset utilization, thereby reducing congestion, turnaround times, and operational costs (Nikdast & Awasthi, 2025; He et al., 2025; Emon, 2025). In energy-integrated transportation networks, IoT-enabled scheduling frameworks support adaptive responses to uncertainty and variability, improving both efficiency and resilience (He et al., 2025; Zhong et al., 2025). These studies highlight that process innovation in logistics often emerges from the integration of IoT data with advanced optimization and decision-support models, rather than from isolated technological deployments (Zhang et al., 2025; He et al., 2025). The literature also emphasizes the strategic dimension of IoT adoption, particularly in relation to organizational responsiveness and market competitiveness. Supply chain responsiveness, defined as the ability to quickly sense and respond to changes in demand and supply conditions, is repeatedly linked to IoT-enabled visibility and real-time data exchange (Keskin & Ungan, 2025; Kourt & Ait Lhassan, 2025; Emon, 2025). Firms that effectively leverage IoT data are better positioned to align production, distribution, and marketing activities, thereby enhancing customer satisfaction and competitive advantage (Alahmari & Awad, 2025; Pan & Zhang, 2025). Case-based evidence from digital leaders illustrates how IoT-supported operational agility contributed to organizational resilience and performance during periods of crisis, such as global supply chain disruptions and pandemics (Jyani, 2025; Türkeş, 2025). Vertical integration and supply chain governance structures further influence the outcomes of IoT adoption for operational efficiency and innovation. Research suggests that IoT technologies can alter power dynamics and coordination mechanisms within supply networks by increasing information transparency and reducing transaction costs (Arora et al., 2025; Chen et al., 2025; Emon, 2025). In

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some contexts, enhanced visibility may encourage greater vertical integration, as firms seek to internalize critical data flows and control key processes, while in others it may facilitate more collaborative network-based arrangements (Arora et al., 2025; Pan & Zhang, 2025). Qualitative insights are increasingly called for to understand how organizations navigate these strategic choices and how IoT adoption reshapes inter-organizational relationships over time (Chen et al., 2025; Zheng et al., 2025; Emon, 2025). Risk management emerges as another important theme in the IoT adoption literature. IoT-enabled monitoring systems support early detection of disruptions, quality issues, and safety risks across supply chains, contributing to more proactive and adaptive risk management practices (Zhong et al., 2025; Türkeș, 2025). In high-risk industries such as energy and mining, IoT data enhances situational awareness and supports decision-making under uncertainty, thereby improving operational reliability and resilience (Zhong et al., 2025; Benigno et al., 2025). However, scholars also note that increased reliance on digital infrastructures introduces new vulnerabilities related to cybersecurity, data integrity, and system interoperability, underscoring the need for robust governance and risk mitigation strategies (Mahajan & Kaur, 2025; Aliu et al., 2025). From a performance perspective, empirical studies consistently report positive associations between IoT-enabled integration, agility, and innovation outcomes. Research examining the mediating roles of supply chain integration and agility demonstrates that IoT adoption contributes to innovation by enhancing coordination, flexibility, and learning capabilities across organizational boundaries (Khan et al., 2025; Keskin & Ungan, 2025). These findings align with ambidexterity theory, which suggests that organizations must balance efficiency-oriented exploitation with innovation-oriented exploration to achieve sustained performance (Wei et al., 2025; Pan & Zhang, 2025; Emon, 2025). IoT technologies support this balance by enabling standardized, automated processes alongside data-driven experimentation and continuous improvement (Wei et al., 2025; Latino et al., 2025). The literature on sector-specific applications further illustrates the diversity of IoT-enabled process innovations. In the automotive and electric vehicle supply chain, IoT integration supports advanced thermal management systems, predictive maintenance, and real-time coordination among component suppliers, contributing to improved efficiency and reliability (Rohit et al., 2025; Türkeș, 2025). In rural and emerging market contexts, IoT-enabled supply chain finance ecosystems enhance transparency and coordination, supporting inclusive growth and high-quality development through improved access to information and resources (Liao et al., 2025; Zheng et al., 2025). These studies highlight that the impacts of IoT adoption are context-dependent, shaped by industry characteristics, institutional environments, and organizational capabilities (Liao et al., 2025; Ben Rhouma et al., 2025). Despite the breadth of existing research, several gaps and limitations persist in the literature. Many studies adopt quantitative methodologies that prioritize measurable performance outcomes, potentially overlooking the subjective experiences, sensemaking processes, and organizational dynamics that influence how IoT technologies are adopted and used in practice (Khan et al., 2025; Wei et al., 2025). Moreover, while the mediating roles of integration and agility are well-documented, less attention has been paid to how these mechanisms are enacted at the micro-level through everyday practices, interactions, and decision-making routines (Kourt & Ait Lhassan, 2025; Alahmari & Awad, 2025; Emon, 2025). Qualitative approaches are therefore increasingly advocated to capture the richness and complexity of IoT-enabled operational transformation (Pan & Zhang, 2025; Zheng et al., 2025). Another limitation concerns the temporal dimension of IoT adoption and process innovation. Much of the existing literature relies on cross-sectional designs, which provide limited insight into how IoT capabilities evolve over time and how learning, adaptation, and path dependencies shape long-term outcomes (Ghariani & Boujelbène, 2025; Türkeș, 2025). Longitudinal and qualitative studies can illuminate how organizations experiment with IoT technologies, refine processes, and institutionalize new routines, thereby deepening understanding of sustained operational efficiency and innovation (Jyani, 2025; Benigno et al., 2025). In synthesis, the literature collectively suggests that IoT adoption plays a critical role in enhancing operational efficiency and enabling process innovation across diverse sectors and contexts. The value of IoT emerges through its integration with information exchange mechanisms, supply chain integration, complementary

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digital technologies, and organizational capabilities that support agility, sustainability, and resilience (Khan et al., 2025; Latino et al., 2025; Türkeş, 2025; Emon, 2025). At the same time, the complexity and context-dependence of IoT-enabled transformation underscore the need for qualitative investigations that foreground organizational actors' perspectives and experiences, thereby enriching theoretical understanding and informing more effective managerial and policy interventions (Pan & Zhang, 2025; Zheng et al., 2025).

3. Materials and Method

This study adopted a qualitative research methodology to gain an in-depth understanding of how organizations experienced and interpreted the adoption of the Internet of Things for operational efficiency and process innovation. A qualitative approach was considered appropriate because it allowed the exploration of meanings, perceptions, and contextual factors that could not be adequately captured through quantitative measures. The research was designed to capture rich, descriptive insights from organizational actors who were directly involved in or affected by IoT adoption initiatives within their operational environments. The focus was placed on understanding processes, interactions, and decision-making practices rather than measuring predefined variables, thereby aligning the methodology with the exploratory nature of the study. The study relied on purposive sampling to select participants who possessed relevant knowledge and practical experience with IoT-enabled systems. Participants were drawn from organizations operating in sectors where IoT adoption had a direct influence on operational processes, such as manufacturing, logistics, healthcare, energy, and supply chain management. Key informants included managers, engineers, operations specialists, and technology coordinators who had participated in planning, implementing, or using IoT solutions. This sampling strategy ensured that the data reflected diverse perspectives while remaining closely aligned with the research objectives. Data collection continued until thematic saturation was achieved, meaning that no substantially new insights were emerging from additional interviews. Data were collected primarily through semi-structured interviews, which allowed for consistency across participants while also providing flexibility to probe emerging issues in greater depth. An interview guide was developed based on insights from prior literature and the overarching research questions, focusing on participants' experiences with IoT adoption, perceived impacts on operational efficiency, changes in work processes, and the emergence of process innovations. Interviews were conducted in a conversational manner to encourage openness and reflection, and they were carried out either face-to-face or through virtual communication platforms, depending on participant availability and contextual constraints. With participants' consent, interviews were audio-recorded and later transcribed verbatim to ensure accuracy and completeness of the data. In addition to interviews, relevant organizational documents and secondary materials, such as internal reports, process descriptions, and technology implementation notes, were reviewed where access was granted. These materials were used to complement interview data and to enhance contextual understanding of IoT adoption practices. The use of multiple data sources supported triangulation, which strengthened the credibility and trustworthiness of the findings by allowing patterns and interpretations to be cross-checked across different forms of evidence. Data analysis was conducted using a thematic analysis approach. The analysis process began with repeated readings of the interview transcripts to achieve familiarization with the data. Initial codes were then generated inductively, capturing significant statements, recurring ideas, and meaningful patterns related to IoT adoption, operational efficiency, and process innovation. These codes were subsequently compared and refined, leading to the development of broader themes that represented shared meanings across participants. Throughout the analysis, constant comparison was employed to identify similarities and differences across cases, allowing the emergence of nuanced insights into how IoT adoption unfolded in different organizational contexts. To enhance the rigor of the study, several strategies were employed. Credibility was supported through prolonged engagement with the data and careful attention to participants' narratives. Reflexivity was maintained throughout the research process, with the researcher continuously reflecting on potential biases and their influence on data

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interpretation. An audit trail was maintained to document key methodological decisions and analytical steps, thereby supporting transparency and dependability. Ethical considerations were also addressed, as informed consent was obtained from all participants, confidentiality was ensured through anonymization of data, and participation was entirely voluntary. Overall, this qualitative methodology provided a robust framework for exploring the complex and context-dependent nature of IoT adoption for operational efficiency and process innovation. By focusing on participants' lived experiences and organizational practices, the study generated rich empirical insights that contributed to a deeper understanding of how IoT technologies were interpreted, implemented, and embedded within everyday operational processes.

4. Results and Findings

The results and findings of this study present a comprehensive and nuanced understanding of how organizations experienced the adoption of the Internet of Things and how this adoption reshaped operational efficiency, decision-making processes, coordination mechanisms, and innovation practices. Participants consistently described IoT adoption as a gradual and evolving journey rather than a single implementation event. Across organizations, IoT was introduced in response to growing operational complexity, pressure to improve efficiency, and the need for real-time visibility across interconnected processes. The findings reveal that IoT adoption influenced not only technological systems but also organizational routines, employee roles, communication structures, and strategic thinking. Participants highlighted that the real value of IoT emerged over time as organizations learned how to integrate data streams into everyday decision-making and operational planning. Many participants emphasized that improved visibility and real-time data access were among the most immediate and tangible outcomes of IoT adoption. Sensors, connected devices, and integrated platforms enabled organizations to monitor processes continuously, reducing uncertainty and reliance on delayed or manually collected information. This visibility extended across production lines, warehouses, transportation networks, and service operations, allowing managers and frontline employees to identify inefficiencies, bottlenecks, and deviations as they occurred. Participants described how this shift transformed operations from reactive to proactive, as issues could be anticipated and addressed before escalating into major disruptions. However, they also noted that realizing these benefits required changes in mindset, as employees needed to trust data-driven insights and move away from intuition-based decision-making. Another prominent finding was the role of IoT in enhancing coordination and collaboration across functional boundaries. Participants explained that previously siloed departments became more interconnected as IoT platforms provided shared access to operational data. This transparency reduced misunderstandings, improved communication, and supported more synchronized decision-making. For example, logistics teams could align more closely with production schedules, while maintenance teams could plan interventions based on real-time equipment conditions. Despite these advantages, participants also acknowledged initial resistance, as increased transparency sometimes led to concerns about performance monitoring and accountability. Over time, organizations that invested in communication and change management were better able to foster a culture of collaboration and shared responsibility. The findings also indicate that IoT adoption significantly influenced process innovation. Participants described how continuous data flows enabled organizations to rethink existing workflows, redesign processes, and experiment with new operational models. Rather than merely automating existing tasks, IoT encouraged organizations to question why processes were structured in certain ways and how they could be improved. This led to innovations such as predictive maintenance, dynamic inventory management, adaptive scheduling, and customized service delivery. Participants emphasized that these innovations were often incremental rather than radical, emerging through ongoing experimentation and learning. Organizations that embraced flexibility and learning were more successful in translating IoT capabilities into sustained process improvements. At the same time, the results highlight several challenges and tensions associated with IoT adoption. Participants frequently mentioned issues related to data overload, integration

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complexity, and skill gaps. While IoT systems generated vast amounts of data, organizations often struggled to filter, analyze, and translate this data into actionable insights. This challenge was particularly evident in organizations with limited analytical capabilities or legacy systems that were not designed to handle real-time data streams. Participants also pointed to the need for new skills, as employees were required to interpret data, interact with digital systems, and collaborate with technology specialists. These challenges underscored the importance of organizational readiness and continuous capability development. The thematic analysis of the data resulted in six major themes that collectively capture the essence of IoT adoption experiences. These themes reflect patterns across participant narratives and provide a structured understanding of how IoT influenced organizational operations and practices.

Table 1. Enhanced Operational Visibility and Transparency.

Theme	Description
Real-time monitoring	Continuous tracking of operational activities through connected devices and sensors
Process transparency	Improved clarity of workflows and performance across departments
Early issue detection	Ability to identify deviations and inefficiencies at an early stage
Reduced uncertainty	Greater confidence in operational data and performance indicators

The findings associated with enhanced operational visibility and transparency demonstrate that IoT fundamentally changed how organizations perceived and managed their operations. Participants described a shift from fragmented and delayed information toward integrated and real-time insights. This transformation enabled more informed decision-making at both managerial and operational levels. Visibility was not limited to performance metrics but extended to understanding process interdependencies and system-wide impacts. Over time, participants noted that transparency fostered a sense of control and predictability, allowing organizations to operate with greater confidence and precision.

Table 2. Data-Driven Decision-Making and Predictive Capabilities.

Theme	Description
Predictive insights	Use of historical and real-time data to anticipate future outcomes
Evidence-based decisions	Reduced reliance on intuition in favor of data-supported judgments
Proactive planning	Ability to plan interventions before disruptions occur
Continuous performance assessment	Ongoing evaluation of operational effectiveness

The results related to data-driven decision-making highlight how IoT enabled organizations to move beyond descriptive analytics toward predictive and proactive approaches. Participants explained that predictive capabilities allowed them to foresee equipment failures, demand fluctuations, and process inefficiencies. This foresight supported more strategic planning and resource allocation. However, participants also emphasized that data alone was insufficient; organizational learning and analytical competence were critical in transforming raw data into meaningful insights. Over time, decision-making processes became more structured, systematic, and aligned with organizational goals.

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Table 3. Process Innovation and Operational Flexibility.

Theme	Description
Workflow redesign	Modification of existing processes based on data insights
Adaptive operations	Ability to adjust processes in response to changing conditions
Experimentation culture	Encouragement of testing and refining new operational approaches
Incremental innovation	Gradual improvements driven by continuous learning

The findings related to process innovation reveal that IoT acted as a catalyst for rethinking how work was organized and executed. Participants described how access to real-time data encouraged experimentation and continuous improvement. Rather than implementing one-time changes, organizations adopted an iterative approach to process innovation. This flexibility allowed them to respond more effectively to market changes, operational disruptions, and customer demands. Participants noted that organizations that supported experimentation and learning were more successful in embedding innovation into everyday operations.

Table 4. Cross-Functional Integration and Collaboration.

Theme	Description
Shared data platforms	Common access to operational information across departments
Improved coordination	Alignment of activities and schedules among functional units
Reduced silos	Breakdown of traditional departmental boundaries
Collective problem-solving	Joint identification and resolution of operational issues

The results associated with cross-functional integration illustrate how IoT facilitated closer collaboration among organizational units. Participants explained that shared data platforms created a common understanding of operational realities, reducing conflicts and misaligned priorities. This integration supported faster decision-making and more effective problem-solving. However, participants also acknowledged that achieving integration required cultural change and trust-building, as increased transparency initially raised concerns about monitoring and control. Organizations that emphasized collaboration over surveillance were better able to realize the benefits of integration.

Table 5. Human and Organizational Capability Development.

Theme	Description
Skill transformation	Development of data literacy and digital competencies
Role evolution	Changes in employee responsibilities and work practices
Learning orientation	Emphasis on continuous training and knowledge sharing
Change adaptation	Organizational ability to adjust to new technologies

The findings related to human and organizational capabilities highlight that IoT adoption was as much a social process as a technological one. Participants consistently emphasized the importance of employee skills, attitudes, and learning in determining adoption success. IoT systems required employees to interact with data, interpret insights, and collaborate with technology specialists. Organizations that invested in training and fostered a learning-oriented culture were better equipped to manage change and leverage IoT capabilities effectively.

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Table 6. Challenges, Risks, and Organizational Tensions.

Theme	Description
Data overload	Difficulty managing and interpreting large volumes of data
System integration issues	Challenges in aligning IoT with legacy technologies
Resistance to change	Employee concerns about monitoring and job security
Governance and control	Need for clear policies and accountability structures

The findings related to challenges and tensions reveal that IoT adoption was not without difficulties. Participants described struggles with data complexity, system compatibility, and organizational resistance. These challenges often slowed adoption and required ongoing adjustments. Participants emphasized that addressing these issues required clear governance, transparent communication, and sustained leadership commitment. Organizations that proactively addressed risks and concerns were more successful in stabilizing and scaling IoT initiatives. Across all themes, the results indicate that IoT adoption had a transformative impact on organizational operations, but this impact was contingent on contextual factors such as organizational culture, leadership support, and capability development. IoT acted as an enabler rather than a standalone solution, amplifying existing strengths and weaknesses within organizations. Participants highlighted that the greatest benefits emerged when IoT adoption was aligned with strategic objectives and supported by continuous learning and adaptation. The summary of findings reveals that IoT adoption reshaped organizational operations by enhancing visibility, enabling data-driven decision-making, fostering process innovation, and strengthening cross-functional collaboration. At the same time, successful adoption depended heavily on human and organizational factors, including skills, culture, and governance mechanisms. The findings demonstrate that IoT adoption was not merely a technological upgrade but a complex organizational transformation that required sustained effort, learning, and alignment. Together, these results provide a rich and holistic understanding of how IoT influenced operational efficiency and process innovation within organizational contexts.

5. Discussion

The discussion of this study centers on understanding how the findings collectively explain the broader implications of IoT adoption within organizational and supply chain contexts, particularly from a qualitative and experience-based perspective. The results indicate that IoT adoption is not merely a technological intervention but a deeply transformative organizational process that reshapes how work is performed, how decisions are made, and how different actors interact across operational boundaries. The discussion highlights that the value of IoT lies less in the devices themselves and more in how organizations learn to embed connected data into everyday routines, strategic thinking, and collaborative practices. This reinforces the idea that technology-driven transformation is inherently socio-technical, requiring alignment between systems, people, and processes. One of the most significant points emerging from the findings is the shift from reactive to proactive operational management. The discussion suggests that real-time visibility and continuous monitoring enabled organizations to anticipate disruptions, inefficiencies, and risks before they escalated. This proactive orientation fundamentally altered managerial behavior, encouraging forward-looking planning rather than crisis-driven responses. Such a shift has important implications for operational resilience, as organizations become better equipped to absorb shocks and adapt to changing conditions. However, the discussion also reveals that this proactive capability did not emerge automatically with IoT implementation; it required time, experimentation, and organizational learning. Organizations that rushed implementation without allowing space for learning often struggled to convert data into meaningful action. The discussion further emphasizes the central role of data-driven decision-making as a cultural transformation rather than a purely analytical one. While IoT systems generated vast amounts of data, the findings show that organizations had to develop trust in data and confidence in analytical insights. This transition often involved tension, particularly among experienced employees who were accustomed to intuition-based decision-making. Over time, as data

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demonstrated its reliability and relevance, decision-making practices became more structured, transparent, and justifiable. The discussion highlights that this cultural shift enhanced accountability and consistency in decisions, but it also required leadership support to ensure that data was used as a tool for improvement rather than control. Another important discussion point relates to cross-functional integration and collaboration. The findings suggest that IoT-enabled transparency reduced information asymmetry and improved coordination across departments, leading to more synchronized operations. The discussion interprets this as evidence that IoT can act as a boundary-spanning mechanism, connecting functions that were previously fragmented. However, increased transparency also introduced concerns related to surveillance, performance evaluation, and power dynamics. The discussion underscores that organizations that framed transparency as a shared resource for problem-solving, rather than a monitoring mechanism, were more successful in fostering collaboration and trust. This highlights the importance of communication, participation, and ethical considerations in digital transformation initiatives. Process innovation emerged as another key area of discussion, particularly in terms of how IoT encouraged continuous rather than episodic change. The findings suggest that organizations moved away from large-scale, infrequent process redesigns toward incremental and data-informed improvements. The discussion interprets this as a shift toward learning-oriented operations, where experimentation and adaptation became embedded in daily practices. This approach allowed organizations to respond more flexibly to uncertainty and complexity. However, the discussion also notes that continuous innovation can create fatigue if not supported by clear priorities and resource allocation, emphasizing the need for balance between stability and change. Human and organizational capabilities form a critical part of the discussion, as the findings clearly show that skills, attitudes, and learning orientation strongly influenced IoT outcomes. The discussion highlights that IoT adoption reshaped job roles, required new competencies, and altered power relations within organizations. Employees who developed data literacy and digital confidence became central to operational decision-making, while those without adequate support risked marginalization. This raises important implications for workforce development, suggesting that training, inclusion, and change support are essential components of successful IoT adoption. The discussion also points out that organizations that viewed capability development as an ongoing investment, rather than a one-time activity, were better positioned to sustain IoT-driven improvements. The challenges and tensions identified in the findings are also critically discussed, particularly issues related to data overload, system integration, and resistance to change. The discussion suggests that these challenges are not signs of failure but natural consequences of complex transformation processes. Data overload reflects a mismatch between data generation and analytical capacity, while integration issues highlight the limitations of legacy systems and fragmented infrastructures. Resistance to change, on the other hand, reflects deeper concerns about job security, identity, and control. The discussion emphasizes that addressing these challenges requires a holistic approach that combines technical solutions with leadership, communication, and governance mechanisms. Overall, the discussion positions IoT adoption as an enabling force that amplifies existing organizational characteristics rather than replacing them. Organizations with strong learning cultures, collaborative norms, and strategic clarity were more likely to translate IoT capabilities into meaningful outcomes. Conversely, organizations with rigid structures and limited change readiness faced greater difficulties. The discussion thus reinforces the idea that IoT should be approached as a long-term transformation journey rather than a short-term efficiency project. By situating the findings within this broader perspective, the discussion highlights the importance of alignment, adaptability, and human-centered implementation in realizing the full potential of IoT adoption.

6. Conclusions

This study concludes that the adoption of the Internet of Things represents a profound organizational transformation rather than a purely technological upgrade. The findings demonstrate that IoT reshaped operational practices by enhancing visibility, enabling proactive decision-making,

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supporting continuous process improvement, and strengthening cross-functional coordination. These changes collectively contributed to more responsive and adaptive organizational operations, particularly in complex and dynamic environments. However, the benefits of IoT did not emerge automatically; they developed gradually as organizations learned how to integrate real-time data into everyday routines and strategic thinking. The study further concludes that human and organizational factors played a decisive role in determining the outcomes of IoT adoption. Employee skills, data literacy, leadership support, and a learning-oriented culture were essential in translating technological capabilities into meaningful operational improvements. Where organizations invested in training, communication, and change management, IoT adoption led to sustained improvements in efficiency, collaboration, and innovation. In contrast, limited analytical capacity, resistance to change, and integration challenges constrained the realization of potential benefits. Overall, the study highlights that IoT adoption should be approached as a long-term, socio-technical journey that requires continuous learning, alignment, and adaptation. By recognizing IoT as an enabler of organizational transformation rather than a standalone solution, organizations can better position themselves to leverage connected technologies for sustainable operational performance and future readiness.

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