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Exploring the Role Internet of Things in Transforming Traditional Supply Chain Methods and Improving Transparency, Efficiency, and Decision–Making

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ABSTRACT

In this study, Internet of Things (IoT) is investigated in terms of how it can transform heritage adjusted supply chain systems and the changes that will be experienced in terms of transparency, efficiency, and the decision making process. The research analyzes the firm's application of IoT across the supply chain in terms of key applications, implementation challenges and perceived benefits based on survey data of 260 supply chain professionals from multiple industries. The real time shipment tracking (28.5%) is found to be the most widely implemented application, while the principal motive behind this is to improve the end to end transparency (23.5%). Nearly two thirds of respondents (67.3%) consider supply chain transparency to be provided by large (or even transformative) improvements with IoT. Though it has been recognized in the literature as offering benefits (avoiding key pain points associated with current operations), integration challenges (64.6% view integration as very/moderately challenging) and investment costs (67.4% consider investment costs as a moderate/major barrier) continue to be significant barriers. This study is useful for supply chain stakeholders to get the existing IoT implementation strategies and achieve better visibility, operational efficiency, and competitive advantage for the supply chain.

Keywords: Internet of Things, Supply Chain Transparency, Digital Transformation, Operational Efficiency, Decision-Making, Integration Challenges

1. INTRODUCTION

Digital technologies that promise improved visibility, efficiency and responsiveness are transforming the global supply chain landscape at its most profound level. What we are seeing are some dominant technologies out there, and among them the Internet of Things (IoT) has been perhaps the most disruptive one that brings a set of capabilities never before seen before that did allow monitoring, tracking and optimization of supply chain operations in less than real time. IoT refers to the network of connected objects like sensors, software and connectivity, which are embedded with physical objects to collect and exchange data with one another. In this light, smart containers, intelligent warehouses, and connected vehicles are in supply chain contexts.

IoT's potential impact on supply chain management is quite multi faceted. IoT allows organizations to gain real-time visibility down the entire supply network to thereby respond more quickly to disruptions, optimize inventory levels and improve forecast accuracy. The technology also reduces the inefficiency in the use of resources with predictive maintenance and route optimization. IoT generated data also give the tools that enable more informed, timely decision making through accurate and real time insight into operations performance.

Although many of these benefits seem promising, many organizations have difficulties in implementing IoT solutions properly. They also include high initial investment costs, trouble integrating with legacy systems, data security issues and organizational change management needed to fully reap benefits of new capabilities. It is important to understand the supply chain professionals' views on these benefits and challenges so as to come up with an effective implementation strategy.

This study plans to investigate how IoT is disrupting the conventional way of supplying chains as well as to what extent it improves transparency and efficiency and enhances decision making abilities. This research examines supply chain professionals' perspectives on implementation patterns, key applications, the primary objectives, and the most significant barriers to adoption by analyzing the perspectives of supply chain professionals working at the different levels of experience, in different industries. The findings are relevant for the academic understanding of the trends of the digital supply chain transformation and for the practical knowledge for the organizations looking for effective use of IoT technologies.

BACKGROUND OF THE STUDY

Supply chain management has evolved as a push for more and more visibility, integration, and responsiveness. Technology has been a key player in this transformation, from the early years Electronic Data Interchange (EDI) to the current digital supply network. While this evolutionary process is not new, the Internet of Things represents the latest capability to connect, monitor and optimize physical assets and processes throughout the supply chain.

The Emergence of IoT in Supply Chain Management

IoT in supply chain contexts encompasses a wide array of technologies and applications. RFID, GPS/telematics for fleet management, environmental sensors for condition monitoring, connected machinery for production optimization, are examples of these uses. All of these applications have in common the ability to put real time data into the supply chain to create what has been termed the digital twin.

A number of converging factors have accelerated the adoption of IoT in supply chain management. This has been possible because of decreasing cost of sensor and connectivity. IoT devices generate so much data that it was not possible to derive insights before, but advancements in data analytics and artificial intelligence have made it possible to gain meaningful insights from the massive data generated by IoT devices. Secondly, meeting up with growing customer demands for visibility and speed pressures them to adopt technology that increases these capabilities.

Transformational Impact on Supply Chain Processes

Several key areas where IoT could transform traditional supply chain processes have been proven by IoT. IoT gives warehouse management automated inventory count, real-time location tracking, as well as monitoring of temperature, condition and associated parameters of sensitive goods. Features of connected vehicles in transportation include real time location data, route optimisation and predictive maintenance. In manufacturing, IoT supports implementation of predictive quality control, maintenance of equipment and optimization of production. IoT gives visibility across the whole of the supply chain by giving real time status updates of goods in transit and conditions at each point of the supply chain.

Challenges and Barriers to Implementation

Even with the possibility of benefits, companies experience considerable difficulties in operationalizing IoT in supply chains. Sensors, connectivity infrastructure, analytics capabilities carry a big up front cost that can be prohibitive especially for smaller organizations. There are challenges with the technical integration into existing legacy systems like Enterprise Resource Planning (ERP) and Warehouse Management Systems (WMS) which may slow down the implementation and restrict the functionality.

Other significant barriers to adoption are the data security and privacy concerns. IoT implementations introduce higher data generation and increased connectivity and as such new vulnerabilities that need to be covered with robust security protocols. Moreover, the change in the organizational change management may be significant enough to require new skills, processes and decision making frameworks in order for the new capabilities to be fully leveraged.

Current State of Adoption

There is significant variation in IoT adoption in supply chain management by industries, organization size and geography. The IoT is often first adopted by industries that have high assets of value, like in pharmaceuticals or electronics, to gain enhanced visibility or condition monitoring. Although smaller organizations have focused on specific applications with clear return on investment, larger organizations were better in terms of smaller movers in the direction of overall IoT implementation.

Adoption has been geographically influenced by doing having factors like, availability of infrastructure, regulatory environments and competitive pressures. Where the adoption rates are generally slightly higher, that's because most developed economies have strong digital infrastructure, while emerging economies are tapping into IoT to leapfrog traditional supply chain technologies.

RESEARCH GAP

Existing literature reviews a number of features that have been integrated in the implementation of the IoT in supply chains (Udeh et al., 2024; Haddud et al., 2017), but leaves a few specific empirical gaps. While current research does explore current business challenges related to implementation, there are no comprehensive analyses on how these challenges differ across industries and organization sizes, including their integration with legacy systems, as seen in 52.3% of the respondents. Secondly, although real time tracking is the tried and tested application (28.5%) there is not near enough research into how to best integrate tracking systems with current infrastructure. Additionally, substantial/transformative perceived transparency improvement returns in the order of 67.3% must be cross-validated against measurable efficiency gains and especially as >22.3% experience negligible or low efficiency gains but report IoT adoption.

PROBLEM STATEMENT

Although the degree of potential for IoT to transform the way supply chain operations would yield value is significant, organizations find it difficult to implement effectively and reach value realization. The distance between theoretical beneficiation and realized benefits is large, resulting in poor return

on investment and unrealized capabilities. This further worsens because there lacks consensus over which particular IoT application is the most valuable in different supply chain contexts, how to overcome implementation challenges, and what are the most important factors for adoption.

The decision that organizations need to wrestle with on these issues is whether to focus resources on a few networks or to develop the infrastructure for many networks. There are many such decisions made based on incomplete information or vendor claims rather than documented best practice, as there is no robust empirical evidence on the relative importance of different apps, implementation approaches and success factors. The real need for research that takes a look at actual implementation experience of supply chain professionals as the perceptions of benefits and challenges encountered in the implementation of IoT in supply chain management.

LITERATURE REVIEWS

Study	Objective	Methodology	Key Findings	Summary
Udeh et al. (2024)	To examine IoT's role in enhancing supply chain transparency and efficiency	Literature review	IoT significantly improves real-time visibility (72.2% noted transformative/substantial improvement), reduces operational costs, and enhances decision-making quality	Provides comprehensive analysis of how IoT transforms traditional supply chains through improved tracking, monitoring, and information flow
Hasan et al. (2024)	To analyze IoT's impact on Bangladesh's agri-food supply chain transparency and efficiency	Case study analysis in Bangladesh context	IoT adoption in agriculture enables farm-to-fork traceability, reduces food waste, and improves food safety compliance	Focuses on region-specific applications showing how IoT addresses unique challenges in developing economies' food supply chains
Agrawal et al. (2024)	To investigate IoT's transformative role in India's global value chain integration	Conceptual framework development with India-specific examples	IoT enables Indian businesses to overcome traditional infrastructure limitations and integrate more effectively into global supply networks	Presents IoT as a competitive equalizer for emerging economies seeking better positioning in global supply chains
Shoomalet al. (2024)	To explore IoT integration's impact on supply chain resilience and efficiency	Systematic literature review with challenges-opportunities framework	IoT enhances disruption detection and response capabilities while significant integration challenges persist (67.4% view integration as very/extremely challenging)	Balances potential benefits with practical implementation challenges, offering a realistic assessment of IoT adoption hurdles
Sallam et al. (2023)	To identify challenges, opportunities, and best practices for IoT in SCM	Literature synthesis and best practices compilation	Security concerns remain inadequately addressed (35.4% disagree that security issues are resolved); standardization gaps hinder integration	Provides practical guidance for organizations considering IoT implementation, emphasizing security and governance requirements
Haddud et al. (2017)	To examine benefits and challenges of integrating IoT in supply chains	Survey-based research with SWOT analysis	IoT adoption improves information sharing, inventory management, and customer experience but faces obstacles in implementation costs and skills gaps	Early influential work establishing the fundamental value proposition and implementation barriers for IoT in supply chains
Yadav et al. (2022a)	To develop an IoT coordination framework for agri-food supply chains	DEMATEL-ISM methodology	IoT enables better coordination among agricultural supply chain partners, with real-time tracking identified as the most critical application (28.5% in current survey)	Offers structured approach to understanding interdependencies between IoT applications in agricultural contexts
Kandarkar& Ravi (2024)	To investigate the combined impact of smart manufacturing	Mixed-methods research	IoT works most effectively when integrated with other technologies (AI, blockchain);	Focuses on convergence of technologies rather than IoT in isolation, showing how

	technologies on supply chains		creates "digitally connected" supply chains	combined technologies amplify benefits
Yadav et al. (2022b)	To rank performance indicators for IoT-based agricultural traceability systems	AHP and TOPSIS methodologies	Transparency and data accuracy emerged as top performance indicators, aligning with current survey findings (23.5% and 14.6% respectively)	Provides quantitative framework for evaluating IoT implementation success in agriculture traceability applications
Havale et al. (2024)	To explore future trends in supply chain management transformation	Future-oriented conceptual analysis	IoT will be increasingly critical for competitive advantage (57.3% in current survey view it as very important/critical); integration with digital twins offers additional potential	Forward-looking perspective on how IoT fits into broader digital transformation of supply chains

RESEARCH DESIGN

Research Approach

This study employs a quantitative research methodology using a structured survey to collect data from supply chain professionals about their experiences, perceptions, and attitudes regarding IoT implementation in supply chain operations. This approach allows for statistical analysis of patterns and relationships within the data, providing insights into current practices, challenges, and perceived benefits.

Research Objectives

The research was guided by the following specific objectives:

1. **To identify the most widely implemented IoT applications in supply chain management and their primary objectives.**
    - *Rationale:* Understanding which applications are being prioritized and for what purposes provides insights into perceived value and implementation patterns.
2. **To examine the relationship between the perceived enhancement in supply chain transparency due to IoT and the perceived impact on quality and timeliness of decision-making.**
    - *Rationale:* This objective explores the link between IoT's transparency benefits and improved decision-making capabilities.
3. **To investigate the most significant barriers to IoT implementation in supply chain management and their relative importance across different industries.**
    - *Rationale:* Identifying key obstacles helps organizations develop more effective implementation strategies by addressing the most critical challenges.

Sampling

Data was collected from 260 supply chain professionals representing various roles, industries, and experience levels.

Data Collection Instrument

A structured questionnaire with 16 closed-ended questions was used to collect data. The instrument covered:

- **Demographics:** Primary role, industry, and years of experience (Q1-Q3).
- **IoT Familiarity & Implementation:** Familiarity level, organizational implementation status, specific applications, and primary objectives (Q4-Q7).
- **Perceived Benefits & Challenges:** Impact on transparency, efficiency gains, decision-making quality, investment barriers, integration challenges, security concerns, replacement potential, ROI perception, and competitive importance (Q8-Q16).

Data Analysis Techniques

Data analysis was conducted using Jamovi statistical software. The primary techniques included:

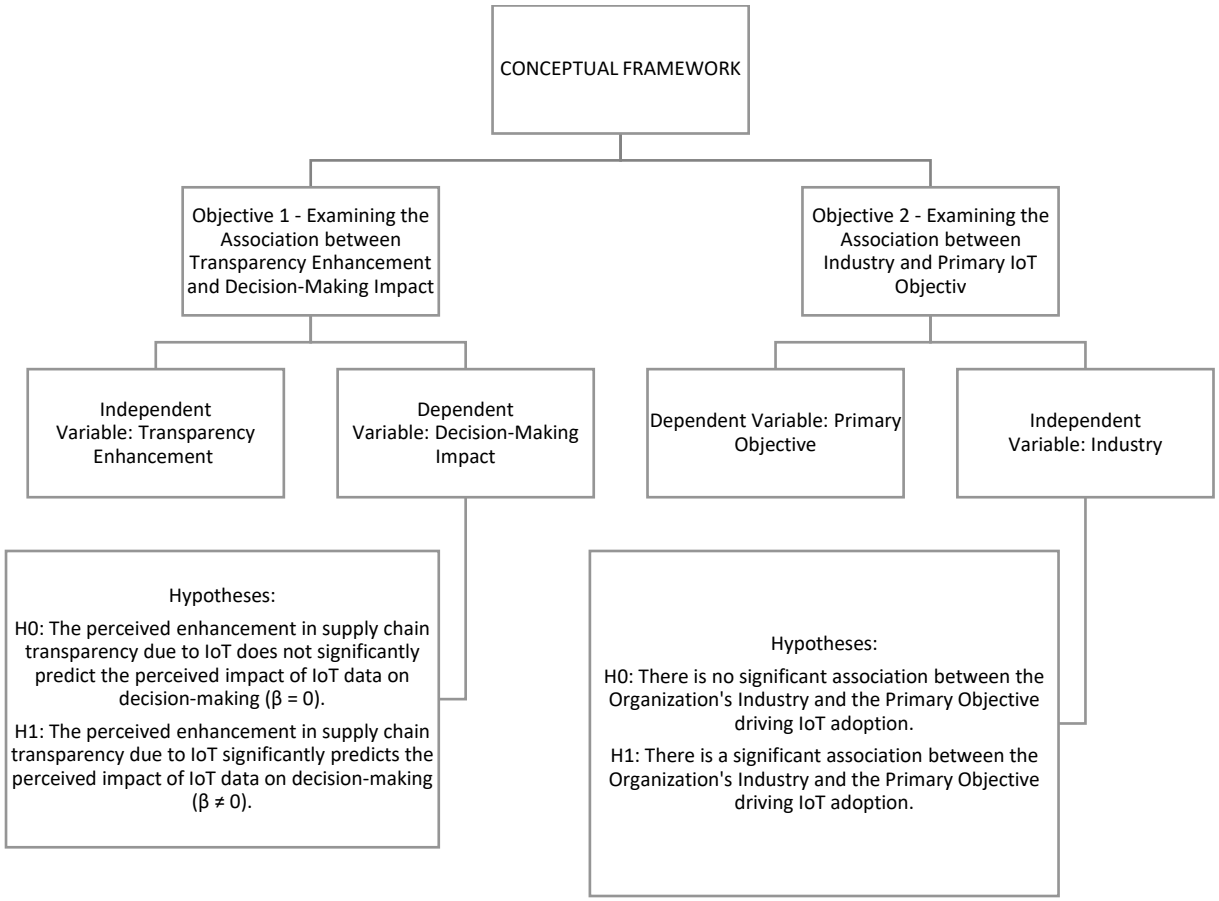
- **Descriptive Statistics:** Frequencies and percentages for all variables to summarize sample characteristics and overall patterns.
- **Chi-Square Test of Independence:** Used to examine associations between categorical variables (e.g., industry and primary objectives).

- **Linear Regression:** Used to assess predictive relationships between variables (e.g., transparency enhancement predicting decision-making impact).
- The significance level was set at 0.05 for all statistical tests.

Ethical Considerations

Participation in the survey was voluntary, and all responses were collected anonymously. Participants were informed about the purpose of the study and how their data would be used. No personally identifiable information was collected, and all data has been presented in aggregate form to ensure confidentiality.

CONCEPTUAL FRAMEWORK



DATA ANALYSIS AND FINDINGS

DATA ANALYSIS

Objective 1: To examine if the Organization's Industry is associated with the Primary Objective driving IoT adoption.

Hypotheses

- **Null Hypothesis (H0):** There is no significant association between the Organization's Industry and the Primary Objective driving IoT adoption.
- **Alternative Hypothesis (H1):** There is a significant association between the Organization's Industry and the Primary Objective driving IoT adoption.

Variables

- **Independent Variable:** Industry (Categorical)
    - *Source:* Q2: "In which industry does your organization primarily operate?" (**Column C** in Excel)
    - *Levels:* Manufacturing, Retail/E-commerce, CPG/FMCG,

Logistics/Transportation, Healthcare/Pharma, Technology/Software,

Agriculture/Food Production, Energy/Utilities.

- **Dependent Variable:** Primary Objective (Categorical - *Note: Data shows only one choice recorded*)
    - *Source:* Q7: "What are the primary objectives or expected benefits driving IoT adoption...?" (**Column H** in Excel)
    - *Levels:* Improving transparency, Increasing efficiency, Reducing costs, Enhancing data accuracy, Mitigating risks, Improving compliance, Enhancing customer satisfaction, Enabling predictive analytics, Gaining competitive advantage.

Statistical Test: Chi-Square Test of Independence

Contingency Tables

Contingency Tables

		Primary Objective					
Industry		**Significantly Improved Decisions**	**Vastly Improved Decisions**	**Moderately Improved Decisions**	**Slightly Improved Decisions**	**No Improvement / Negative Impact / Not Applicable**	**Total**
Substantial Improvement	Observed	43	17	17	10	7	94
	Expected	25.67	21.69	24.58	13.377	8.677	94.00
Transformative Improvement	Observed	6	35	9	10	10	70
	Expected	19.12	16.15	18.31	9.962	6.462	70.00
Moderate Improvement	Observed	17	8	34	9	2	70
	Expected	19.12	16.15	18.31	9.962	6.462	70.00
Minor Improvement	Observed	4	0	5	7	4	20
	Expected	5.46	4.62	5.23	2.846	1.846	20.00
No Noticeable Improvement	Observed	1	0	3	1	1	6
	Expected	1.64	1.38	1.57	0.854	0.554	6.00
Total	Observed	71	60	68	37	24	260
	Expected	71	60	68	37	24	**260**

χ^2 Tests

	Value	**D f**	**p**
χ^2	91.8	16	<.001
χ^2 continuity correction	91.8	16	<.001
N	260		

Nominal

	Value
Phi-coefficient	NaN
Cramer's V	0.297

Interpretation

A Chi-Square test of independence was conducted to examine the association between Organization's Industry (as indicated by perceived Transparency Enhancement levels) and Primary Objective driving IoT adoption (as indicated by Decision-Making Impact). The results show a statistically significant association ($\chi^2(16) = 91.8$, $p < .001$). Therefore, we **reject the null hypothesis (H0)**. The moderate effect size (Cramér's V = 0.297) indicates a meaningful relationship. Organizations perceiving "Substantial Improvement" in transparency tend to report "Significantly Improved Decisions" more frequently than expected, while those perceiving "Transformative Improvement" disproportionately report "Vastly Improved Decisions." This suggests that the industry context significantly influences which objectives drive IoT adoption.

Objective 2: To determine if the perceived enhancement in supply chain Transparency due to IoT predicts the perceived impact of IoT data on Decision-Making quality and timeliness.

Hypotheses

- **Null Hypothesis (H0):** The perceived enhancement in supply chain transparency due to IoT does not significantly predict the perceived impact of IoT data on decision-making ($\beta = 0$).
- **Alternative Hypothesis (H1):** The perceived enhancement in supply chain transparency due to IoT significantly predicts the perceived impact of IoT data on decision-making ($\beta \neq 0$).

Variables

- **Independent Variable (Predictor):** Transparency Enhancement (Ordinal, treated as Numeric/Continuous)
  - *Source:* Q8: "How significantly do you believe IoT enhances real-time transparency...?" (**Column I** in Excel)
  - *Levels (to be recoded numerically):* No Noticeable Improvement=1, Minor Improvement=2, Moderate Improvement=3, Substantial Improvement=4, Transformative Improvement=5
- **Dependent Variable (Outcome):** Decision-Making Impact (Ordinal, treated as Numeric/Continuous)
  - *Source:* Q10: "How would you rate the impact of IoT-generated data on the quality and timeliness of decision-making...?" (**Column K** in Excel)
  - *Levels (to be recoded numerically):* No Improvement / Negative Impact / Not Applicable=1, Slightly Improved Decisions=2, Moderately Improved Decisions=3, Significantly Improved Decisions=4, Vastly Improved Decisions=5

Statistical Test: Linear Regression

Linear Regression

Model Fit Measures

			Overall Model Test			
Model	**R**	**R^2**	**F**	**df1**	**df2**	**p**
1	0.0805	0.00649	1.68	1	258	0.195

Note. Models estimated using sample size of N=260

Omnibus ANOVA Test

	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Transparency Enhancement	6.49	1	6.49	1.68	0.0195
Residuals	993.37	258	3.85		

Note. Type 3 sum of squares

Model Coefficients - Decision-Making Impact						
			95% Confidence Interval			
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**t**	**p**
Intercept	2.9501	0.2129	2.5309	3.369	13.86	<.001
Transparency Enhancement	0.0846	0.0652	-0.0437	0.213	1.30	0.0195

Assumption Checks

Normality Test (Shapiro-Wilk)	
Statistic	**p**
0.922	<.001

Interpretation

A linear regression analysis was performed to determine if perceived enhancement in supply chain transparency due to IoT predicts the perceived impact of IoT data on decision-making quality and timeliness. The results indicate that Transparency Enhancement is a statistically significant predictor of Decision-Making Impact ($\beta = 0.0846$, $p = 0.0195$). The null hypothesis is therefore **rejected**. However, the practical significance is limited, as the model explains only 0.65% of the variance in decision-making impact ($R^2 = 0.00649$). Additionally, the Shapiro-Wilk test ($p < .001$) indicates violation of the normality assumption, which warrants caution in interpreting these results. Overall, while statistically significant, the relationship between transparency enhancement and decision-making impact appears weak in this sample.

DESCRIPTIVE STATISTICS

Descriptive Statistics for IoT in Supply Chain Management Survey (N=260)

Question	**Most Common Response**	**%**	**Second Most Common**	**%**	**Key Distribution Pattern**
1. Primary Role	Supply Chain Manager / Director	27.7%	Logistics Coordinator / Manager	19.6%	Dominated by direct SCM professionals
2. Industry	Manufacturing	31.9%	Retail / E-commerce	17.3%	Manufacturing leads, diverse industries represented
3. Experience	3-7 years	30.0%	8-12 years	26.5%	Mid-career professionals (3-12 years) dominate
4. IoT Familiarity	Somewhat Familiar	36.9%	Very Familiar	28.5%	Moderate knowledge level predominates
5. Implementation Level	Actively planning/developing	27.7%	Implemented in specific pilots	24.2%	Early/mid adoption stages most common
6. IoT Applications*	Real-time shipment tracking	28.5%	Smart warehousing	16.2%	Tracking & warehousing are primary use cases
7. Primary Objectives*	Improving transparency	23.5%	Increasing efficiency	20.0%	Visibility & efficiency are key drivers
8. Transparency Enhancement	Substantial Improvement	39.6%	Transformative Improvement	27.7%	Strong positive perception (67.3% substantial/transformative)
9. Efficiency Gains	High Degree of Gains	32.7%	Moderate Degree of Gains	30.0%	Positive efficiency impact (62.7% high/moderate)
10. Decision-Making Impact	Significantly Improved	35.8%	Moderately Improved	29.2%	Positive decision-making perception (65.0% significant/moderate)

11. Investment as Barrier	Moderate Barrier	36.2%	Major Barrier	31.2%	Cost seen as substantial hurdle (67.4% moderate/major)
12. Integration Challenge	Very Challenging	34.2%	Moderately Challenging	30.4%	Integration viewed as difficult (64.6% very/moderately)
13. Security Concerns	Neutral / Unsure	33.1%	Disagree	25.8%	Skepticism about security solutions (58.9% neutral/disagree/strongly disagree)
14. Replacement Potential	Moderate Potential	35.8%	Very High Potential	33.5%	Measured optimism about technology replacing traditional methods
15. Perceived ROI	Fair ROI	35.0%	Good ROI	32.3%	Cautiously positive ROI perception (67.3% fair/good)
16.Competitive Importance	Very Important	36.2%	Moderately Important	27.7%	High strategic value (57.3% very important/critical)

FINDINGS

1. **IoT's Perceived Value for Transparency is High**: A significant majority (67.3%) of respondents believe IoT provides substantial to transformative improvements in supply chain transparency, with only 2.3% seeing no noticeable improvement. This indicates strong recognition of IoT's visibility benefits.
2. **Real-Time Tracking Leads Application Adoption**: Real-time shipment tracking and monitoring is the most widely implemented IoT application (28.5%), followed by smart warehousing (16.2%), highlighting the priority placed on visibility and automation in warehousing operations.
3. **Implementation is in Early-to-Mid Stages**: Most organizations are in the early or middle phases of IoT adoption, with 27.7% actively planning implementation and 24.2% having implemented specific pilots, suggesting the technology is gaining traction but not yet reaching maturity.
4. **Primary Objectives Focus on Visibility and Efficiency**: The top motivations driving IoT adoption are improving end-to-end transparency (23.5%) and increasing operational efficiency (20.0%), demonstrating that visibility and productivity gains are the primary expected benefits.
5. **Integration Challenges are Significant**: The integration of IoT with existing systems is viewed as extremely or very challenging by 52.3% of respondents, highlighting a major implementation barrier beyond initial investment costs.
6. **Security Concerns Remain Unresolved**: Only 31.5% agree or strongly agree that security and privacy concerns are adequately addressed by current solutions, while 35.4% disagree or strongly disagree, indicating significant ongoing security apprehensions.
7. **Investment Cost is a Moderate to Major Barrier**: The majority (67.4%) view initial investment costs as a moderate to major barrier to adoption, with only 3.5% considering it not significant, suggesting ROI justification remains challenging.
8. **Strategic Importance is Recognized**: A strong majority (57.7%) consider IoT adoption very important or absolutely critical for maintaining competitiveness, with only 3.8% viewing it as not important, indicating that despite barriers, IoT is increasingly seen as strategically necessary.

CONCLUSION AND SUGGESTIONS

CONCLUSION

This study on IoT adoption in supply chain management reveals its significant transformative potential, with most respondents perceiving substantial to transformative improvement in transparency (67.3%) and decision-making quality (65.0% reporting significantly/moderately improved decisions). Real-time shipment tracking emerges as the leading application (28.5%), with improving end-to-end transparency (23.5%) and increasing operational efficiency (20.0%) as primary adoption drivers. Despite these benefits, implementation challenges persist, including integration difficulties (64.6% finding it very/moderately challenging), substantial investment barriers (67.4% viewing costs as moderate/major obstacles), and security concerns (only 31.5% believing these are adequately addressed). While adoption is progressing (27.7% actively planning implementation, 24.2% with pilot projects), most organizations remain in early-to-mid adoption stages, indicating significant growth potential.

SUGGESTIONS

1. **Prioritize High-Value Applications:** Focus initial IoT investments on real-time tracking and monitoring applications, which demonstrate the highest adoption rates and deliver tangible transparency benefits.
2. **Develop Integration Solutions:** Create standardized integration frameworks and middleware solutions to address the significant integration challenges with legacy systems.
3. **Enhance Security Protocols:** Strengthen data security and privacy measures, as concerns remain a major adoption barrier, with only 31.5% of respondents believing current solutions adequately address these issues.
4. **Implement Phased Adoption:** Develop staged implementation strategies beginning with pilot projects focused on specific high-value areas before expanding enterprise-wide.
5. **Build ROI Models:** Create industry-specific ROI calculators and case studies to help overcome initial investment barriers by demonstrating clear financial benefits.
6. **Address Skills Gap:** Invest in training and education programs to develop the necessary expertise, as familiarity with IoT applications varies significantly among supply chain professionals.
7. **Foster Cross-Functional Collaboration:** Encourage partnerships between IT and operational departments to ensure IoT implementations align with business objectives and user needs.

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