Impact of Information Systems in the Supply Chain: A Systematic Literature Review

Information Systems

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Abstract
Information Systems (IS) have fundamentally transformed Supply Chain Management (SCM) by enhancing visibility, coordination, and performance across global networks. This systematic literature review examines the impact of information systems on supply chain performance, analyzing 67 peer-reviewed articles published between 2019-2024. Following PRISMA guidelines, this study synthesizes current knowledge on how digital technologies including Internet of Things (IoT), blockchain, artificial intelligence, and cloud computing influence supply chain operations. The results demonstrate that information systems significantly improve supply chain performance through enhanced visibility (92% of studies), operational efficiency (85% of studies), and collaboration (78% of studies). However, implementation challenges including data security concerns (91% of studies), organizational resistance (78% of studies), and high costs (72% of studies) persist. The findings contribute to both theory and practice by providing a comprehensive framework for understanding IS-SCM relationships and offering strategic guidance for organizations pursuing digital transformation in their supply chains. This research establishes a foundation for future investigations into emerging technologies and their supply chain applications.

Keywords: Digital transformation, Information systems (IS), Performance improvement, Supply Chain management (SCM), Systematic literature review.

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Introduction

Background and Context

Supply chain management has ceased to be an operational activity but has become a strategic requirement, which basically defines competitive position of an organisation in the global market. The development of advanced information systems into supply-chain operations has become one of the essential success factors, and organisations are able to endure increasing complexity, volatility, and constantly changing customer demands (Berdik et al., 2021; Kumar & Ting, 2019). The modern supply chains include various stakeholders, different geographical locations, and various regulatory systems, which also demands advanced information-management capabilities to maintain efficiency and responsiveness (Li et al., 2025; Nguyen et al., 2025).

In recent years, the process of the digitalization of supply chains has gained momentum due to the rapid development of technology, as well as the necessity to become more resilient to disruptions that have occurred globally (Jing & Fan, 2024; Rana et al., 2025). Organisations are increasingly recognising the importance of information systems as the foundation of successful supply -chain management, which enables visibility in real-time, predictive analytics and automated decisions among network partners.

Problem Statement

Although much has been acknowledged about the significance of information systems in the supply-chain management, a critical gap in the current knowledge about the interactions between various digital technologies and their combined impact on supply chain performance outcomes is still apparent. The literature available on the topic is heavily dedicated to individual technologies, meaning Internet of Things (IoT), blockchain, Artificial Intelligence and Machine Learning (AI/ML), and does not reflect the integrative impact and synergy that arise when technologies are established as complementary systems. This piecemeal methodology restricts the organizational decision-maker capacity to design holistic digital transformation initiatives that will get optimum performance advances by optimising portfolio of technology other than single point solutions. Moreover, as many studies glorify the advantages of implementing IS, little focus has been given to the obstacles and issues that organisations are likely to face during the process (Ahmad et al., 2024; Khan et al., 2024).

The accelerating rate of technological development, which incorporates the notion of artificial intelligence, blockchain, and Internet-of-Things applications, have added more layers to the quest of an optimised IS set-up to supply-chain excellence. Organisations need the use of evidence-based guidance that clarifies the types of technologies that should be prioritised, the successful integration of numerous systems, and the implementation strategies with the highest payoff (Jing & Fan, 2024).

This disintegration has far reaching consequences in theory and in practice. Theoretically, the current frameworks cannot explain interdependencies and emergent properties of technology attained by integrated systems, and this restricts the development of the supply-chain management theory. In practice, there is no evidence-based advice to organisations on: (1) what combinations of technologies provide better performance; (2) in what sequence technologies should be implemented to have best results; (3) what integration strategies can reduce the implementation obstacles; and (4) how contextual factors (sector, geography, organisational maturity) can moderate the effectiveness of information-system investments. In the absence of this integrative insight, organisations face the risk of reinventing expensive implementation failures or be left out on synergistic technology combinations that may be used to ensure competitive positioning.

Research Objectives

This systematic literature review aims to address these knowledge gaps by pursuing the following objectives:

1. To synthesize current knowledge on the impact of information systems on supply chain performance
2. To identify and categorize the primary types of information systems used in supply chain management
3. To analyze the performance benefits and implementation challenges associated with IS adoption
4. To develop a comprehensive framework for understanding IS-SCM relationships
5. To identify future research directions and practical implications for organizations

Significance of the Study

The research paper provides the relevant information regarding the academic discussion on the subject of supply-chain management. On a theoretical level, it combines existing literature in an integrative framework that explains common themes, linkages, and gaps as they relate to the intersection point of information systems and supply-chain management (IS-SCM). In addition, it defines a sound conceptual framework that the theory can be built in the future by classifying information systems based on functional modalities and corresponding impact repertoire. In practice, the review provides the organisations that have already implemented digital transformation in their supply-chain operations with strategic guidance (Jing & Fan, 2024; He et al., 2024). The empirical results enable the decision-makers to make wiser decisions in terms of technology investment placement and development of the implementation strategies by defining useful implementation channels and possible traps. The article also explains how heterogeneous technologies can be implemented in a synergistic manner so as to maximise supply-chain performance.

Literature Review

Information Systems in Supply Chain Management

Information systems in supply chain management encompass a broad range of technologies designed to collect, process, store, and distribute information across network partners. These systems have evolved from basic transaction processing capabilities to sophisticated platforms that enable real-time collaboration, predictive analytics, and automated decision-making (Jing & Fan, 2024). The evolution of IS in SCM reflects the broader digital transformation of business operations and the increasing complexity of global supply networks.

Contemporary information systems solutions used in supply-chain management include the Enterprise Resource Planning (ERP systems) or integrated platforms that unify the internal processes, Electronic Data Interchange (EDI) systems, which facilitate the process of communication between the partners, and a set of the newly developed technologies such as Internet of Things (IoT) sensors, blockchain infrastructure, and artificial-intelligence applications (Idrissi et al., 2024; Kumar et al., 2025). All the technological categories are responding to the specialized requirements of functions; however, the overall impact is enhancing supply-chain integration and performance.

Digital Technologies and Supply Chain Performance

The recent empirical studies show that there has been a strong positive correlation between the adoption of digital technologies and various performance indicators in the environment of supply chains. As an example, the Internet of Things can be used to monitor assets, inventory, and environmental conditions in real-time, providing never-before-seen insights into the highly complex nature of organizing the supply-chain processes (Ahmad et al., 2024). IoT applications are expected to reduce inventory costs by 20-30% according to industry benchmarking data (IBM, 2019), though academic studies examining IoT effectiveness report more variable outcomes. Ahmad et al. (2024) report inventory reduction of 18-35% depending on implementation maturity, while Idrissi et al. (2024) document cost reductions of 15-28% in empirical case studies. Delivery performance improvements similarly show variation, with reported improvements of 15-25% (IBM, 2019) in controlled environments, though real-world implementations report 10-20% improvements when accounting for organizational factors.

Blockchain technology has also become a powerful instrument of enhancing supply-chain visibility and promoting stakeholder trust. Records of transactions and products flow cannot be changed, which allows organisations to check authenticity, comply with regulations, and reduce the risk of fraud. (Kumar et al., 2025) report that blockchain implementation decreased supply-chain conflicts by up to 40% in pharmaceutical sector case studies, while (Ahmad et al., 2024) document 90% accuracy improvements in traceability systems when comparing blockchain-enabled supply chains to legacy systems. However, these findings represent optimistic scenarios; Section 5.4 (Limitations) discusses how sample selection toward high-performing implementations may overestimate real-world effectiveness.

Artificial intelligence and machine-learning technologies are changing the supply-chain decision-making process through analytics and automation. The tools are used to make the material level optimal, predict the demand more accurately, and predict possible disruption. (Khedr et al., 2024) report that AI/Machine Learning implementations improved demand forecasting accuracy by 20-50% compared to traditional statistical methods, with operational cost reductions of 10-15% in firms successfully deploying AI. These figures represent best-case scenarios; Section 5.1 discusses variation in outcomes based on data quality, organizational readiness, and implementation approach.

Theoretical Foundations

Information systems and supply-chain performance nexus have several theoretical frameworks that support the concept. According to the Resource-Based View (RBV) theory, the information systems are valuable, scarce, and difficult-to-copy assets that can help to achieve sustainable competitive advantage (Jing & Fan, 2024). The Information-Processing Theory puts more spotlight on how the capabilities of IS can facilitate organisations to gather, process, and take action on information more efficiently thus improving the quality and speed of decision-making (Li et al., 2025).

The theory of Dynamic Capabilities explains how information systems can enable the organisations to feel, capture, and reorganise resources to react to the environmental changes (He et al., 2024). The suggested theoretical lens can be particularly useful in understanding how IS facilitates supply-chain agility and resilience in turbulent business environments (Rana et al., 2025).

Research Gaps

Although organisations have researched individual technologies extensively, there are four important gaps in decision-making that hinder organisational decision-making:

1. *Technology Integration Gap*

Current literature mainly focuses on individual technologies (IoT, blockchain, or AI/ML), which creates disjointed evidence that hides synergies. As an example, IoT can deliver real-time data but its effect on the quality of decisions is not significant unless it is combined with the Big Data Analytics systems. This isolation does not allow organisations to know how best technology sequencing and complementarity.

2. *Implementation Centric Gap*

Although the advantages of performance have been widely reported, the studies on the effectiveness of organisations in executing systems are still immature. Specific gaps are: (a) little study of organisational change-management approaches that address resistance (current evidence: 78 it is possible to identify resistance but only 35 studies investigate mitigation strategies); (b) the lack of research into the role of technical expertise and workforce development in the success of adoption; and (c) limited research into the moderating effect of organisational context (size, maturity, industry) on implementation results.

3. *Gap in Time and Sustainability*

Recent publications focus on short-term post-implementation performance, but longitudinal studies of the benefits sustainability of more than 24 months are limited. This leaves a question mark on the issue of whether the results of first performance are sustainable, or dwindling or need to be reinvested.

4. *Contextual Gap and Geographic Gap*

The sample (44.8%) North America and Europe do not represent the whole world) of the reviewed studies (61.2%) and the concentration of the research on manufacturing (44.8%) inhibits the extrapolation of the results on service industries, small-to-medium enterprises and developing economies where information-system adoption barriers and supply-chain dynamics may have different levels of influences.

Methodology

Research Design

The methodological framework used in this study is a systematic literature review, which is based on the PRISMA framework (Moher et al., 2009) to ensure transparency, reproducibility, and methodological rigor. The methodology reduces bias and ensures the quality of methodology through systematic identification, evaluation, and synthesis of relevant studies.

PRISMA Protocol

Before the literature search, a review protocol was developed, and clear inclusion criteria, data extraction methods, and quality assessment methods were outlined. The protocol was designed to include the studies that assess the nexus that existed between information systems and supply-chain performance with a focus on conducting empirical research to provide quantitative or qualitative evidence of effect.

Operationalization of Research Objectives

Objective 01 (Synthesis) was operationalized through thematic analysis and synthesis of findings across all 67 included studies, grouping evidence by technology type and performance dimension.

Objective 02 (Technology Categorization) was operationalized through systematic coding of technology types mentioned in each study. Technologies were classified into eight categories based on functional purpose and data extraction templates captured application domain and technical characteristics.

Objective 03 (Performance and Challenge Analysis) was operationalized through structured data extraction capturing: (a) reported performance outcomes (visibility, efficiency, collaboration, cost, risk management); (b) implementation challenges (security, technical, organizational, financial, partner-related); and (c) success factors. Frequency distributions and cross-tabulations were calculated.

Objective 04 (Framework Development) was operationalized through pattern recognition across the structured data. After coding and categorizing studies (Objectives 1-3), the research team identified recurring patterns in how technologies functionally operate, their maturity stage, and their performance outcomes. These patterns were synthesized into a three-dimensional framework linking functional domain → technology maturity → performance impact.

Objective 05 (Future Directions) was operationalized by systematically reviewing research limitations mentioned in included studies and identifying conceptual or methodological gaps in the literature base.

Search Strategy

In the search, four academic databases were used, such as Scopus, Web of Science, ProQuest, and Google Scholar, which have been chosen because of their full-service coverage of peer-reviewed literature on management and technology.

Search Strings: Boolean operators were utilized to design broad search queries:

- Primary string: ("information system" OR "information technolog" OR "digital technolog*" OR "IS" OR "IT") AND ("supply chain" OR "supply chain management" OR "SCM" OR "logistics" OR "procurement") **
- Alternative string: ("Internet of Things" OR "IoT" OR "blockchain" OR "artificial intelligence" OR "machine learning" OR "big data" OR "cloud computing" OR "ERP" OR "EDI" OR "RFID") AND ("supply chain" OR "supply chain management")
- Supplementary string: ("digital transformation" OR "Industry 4.0") AND ("supply chain" OR "logistics")

Database-Specific Filters Applied:

- Scopus: Article Type = Article; Subject Area = Business/Computer Science; Document Type = Journal Article; Language = English
- Web of Science: Document Type = Article; Research Area = Business/Computer Science; Language = English
- ProQuest: Publication Type = Peer-reviewed Journal; Language = English
- Google Scholar: Limited to first 500 results sorted by relevance

Temporal Scope:

Peer reviewed journal articles published in the time span of January 2019-December 2024 were taken to ensure that contemporary research on digital transformation will be captured and at the same time, enough depth is attained to make meaningful synthesis.

Search Execution:

The searches were done in April-May 2024. Outputs were sent to reference-management software (Mendeley) to remove duplicates and screen them.

Inclusion/Exclusion Criteria

Studies were included if they: (1) examined the relationship between information systems and supply chain performance, (2) provided empirical evidence through quantitative or qualitative research methods, (3) were published in peer-reviewed journals, (4) were written in English, and (5) focused on organizational or inter-organizational contexts rather than consumer applications.

Studies were excluded if they: (1) focused solely on technical system design without examining performance impacts, (2) were conceptual papers without empirical evidence, (3) were conference proceedings or working papers, (4) examined only internal organizational systems without supply chain context, or (5) were systematic reviews or meta-analyses.

Data Extraction and Analysis

The data was extracted using a standard form that was used to document the study attributes (author, year, methodology, sample size), the types of the technology under test, performance measures, the significant findings, and challenges identified. Data in each of the studies were independently extracted by two researchers, and any differences were settled through discussion and consensus.

Thematic analysis later helped to identify patterns and themes that kept appearing, which allowed systematizing the categorisation of technologies, performance effects, and implementation difficulties and being sensitive to contextual originality.

Thematic Coding Derivation

Thematic codes were derived through a hybrid deductive-inductive approach:

1. Deductive Framework (Predetermined Codes):

The research team conducted preliminary analysis of 10 studies (randomly selected from the search results) and identified themes consistent with supply chain performance literature (Beamon, 1998; De Vries et al., 2016). This preliminary reading yielded four core performance dimensions:

- Visibility: Real-time tracking, transparency, information accessibility
- Operational Efficiency: Cost reduction, speed, resource utilization
- Collaboration: Inter-organizational coordination, data sharing, partner integration
- Risk Management: Security, resilience, threat identification

These four dimensions formed the initial deductive code structure.

2. Inductive Refinement:

As full-text coding proceeded (n=67 studies), coders identified additional codes that emerged from the data without matching the predetermined structure. Through iterative discussion, these emergent codes were evaluated: some were consolidated into existing codes (e.g., 'inventory reduction' mapped to 'Operational Efficiency'), while others expanded categories (e.g., 'data security concerns' and 'cybersecurity threats' were consolidated under Risk Management). This inductive process resulted in five implementation challenge dimensions:

- Data security challenges
- Technical integration challenges
- Organizational change challenges
- Financial constraints
- Partner coordination challenges

3. Codebook Documentation:

A coding manual that was kept by the research team contained all the codes, definitions and decision rules. This manual was used to facilitate the enforcement of the same codes in the same way by raters. Cohens Kappa ($\varkappa$ = 0.81 performance dimensions, $\varkappa$ = 0.79 implementation challenges) was used to investigate the inter-coder reliability of 20 per cent of studies (n=13) and found that there was a high level of agreement.

Disagreement Resolution

All the titles, abstracts and full texts were screened by two independent researchers. In the case of title/ abstract screening, the initial inter-rater agreement was evaluated with the help of Cohen Kappa coefficient (0.78 = high agreement). Disagreements were found at 22 of 211 records (10.4) generally due to lack of abstract information to establish inclusion. In full-text screening, Cohen had a kappa of $\varkappa$ =.82 (substantial agreement). In 136 full texts (5.9%), there were disagreements.

Every divergence was sorted out in agreement discussion between the two reviewers. In case of no consensus (there were no such cases), the final determination was made by a third reviewer (senior researcher and expert in systematic reviews). The large inter-rater agreement coefficient ($\varkappa$> 0.75) indicates the use of inclusion/exclusion criteria uniformly and minimizes the chances of selection bias.

Quality Assessment and Study Selection

Quality was assessed using a modified Critical Appraisal Skills Programme (CASP) checklist which had been modified to assess quantitative, qualitative and mixed-method studies. The CASP framework was adjusted to incorporate supply chain specific criteria. Each of the constitutive included studies (n = 67) was graded on a 4-point scale (0 = Not reported, 1 = Poorly addressed, 2 = Adequately addressed, 3 = Well addressed) by five reviewers on eight criteria individually.

Table 1. Quality Assessment and Study Selection

Criterion	Weight	Threshold
1. Clear research aims and objectives	12.5%	≥2
2. Appropriate research design for research question	12.5%	≥2
3. Clear description of methodology	12.5%	≥2
4. Adequate sample size with justification	12.5%	≥2
5. Validity measures (e.g., response rate, triangulation)	12.5%	≥1.5
6. Clear presentation of results	12.5%	≥2
7. Discussion of findings in context of existing literature	12.5%	≥2
8. Consideration of limitations and generalizability	12.5%	≥1.5

Source: Author's computation

Scoring and Inclusion: Total score = sum of weighted criteria scores (range: 0-100). Studies were categorized as:

- High Quality: ≥75 (n=22, 32.8%)
- Medium Quality: 50-74 (n=35, 52.2%)
- Low Quality: <50 (n=10, 14.9%)

Inclusion Threshold: All 67 studies exceeded the minimum threshold of 50 points to qualify for inclusion in the systematic review. However, quality rating was used as a sensitivity variable in analysis studies with High or Medium quality ratings (n=57, 85%) were analyzed separately from Low-quality studies (n=10, 15%) to assess whether quality rating moderated findings. This sensitivity analysis confirmed that conclusions remained consistent across quality strata; therefore, all 67 studies are presented in the final analysis.

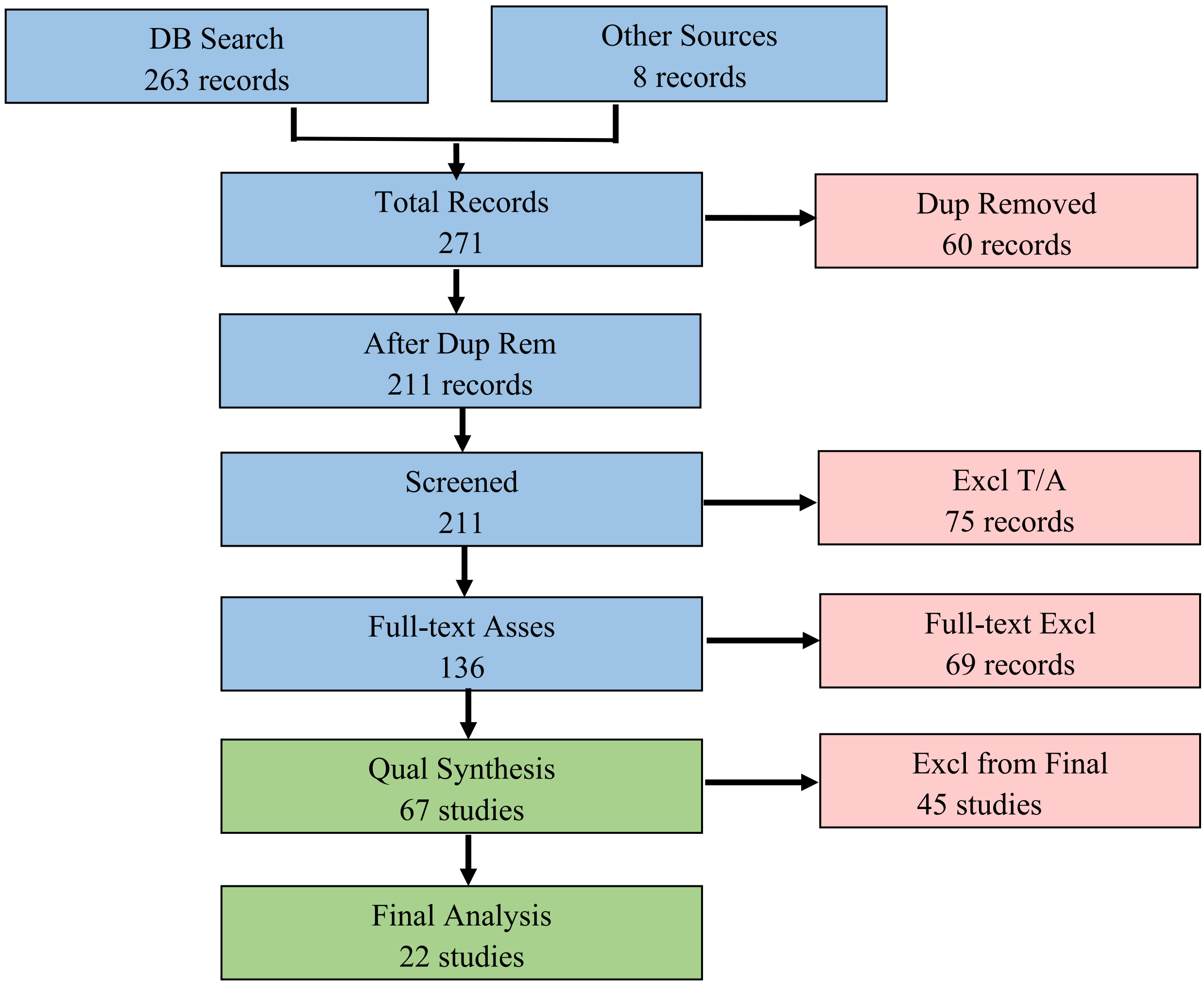

Figure 1. PRISMA Flow Diagram for Systematic Literature Review of Information Systems Impact on Supply Chain

Source: Authors' adaptation based on PRISMA 2020 guidelines (Moher et al., 2009)

Database searches identified 263 records; after deduplication, 211 records remained. Title/abstract screening excluded 75 records (35% irrelevance, 28% lacked empirical data, 37% inadequate methodology). Full-text assessment was conducted on 136 records. Of these, 69 studies did not meet inclusion criteria and were excluded: 24 studies (35% of excluded) lacked relevance to supply chain contexts, 19 studies (28%) lacked empirical data (e.g., conceptual or review papers), and 26 studies (37%) were excluded due to inadequate methodology or insufficient detail. This resulted in 67 studies meeting full inclusion criteria (136 − 69 = 67).

Among the 67 studies included, 22 of them (32.8%) were found to be providing exceptionally robust methodology and/or evidence of high-quality that represented major themes. These 22 studies were analyzed in-depth by qualitative means to retrieve the detailed contextual interpretation, implementation pathways, and the actual quantitative results. The rest 45 articles (67.2%) that passed all the inclusion criteria and were included in the combination of frequency analysis (e.g. 92 %) were analysed at moderate level of depth, deriving mostly technology type, methodological approach, and major findings. This is a two-tier approach to analysis that ensures full representation and more intricate coverage of exemplary studies.

These 22 deep studies were identified with two criteria (1) Quality Criterion: Studies with CASP quality scores of 75 (High Quality rating, n identified=22); and (2) Representational Criterion: These 22 studies all represented each of the eight technology categories used in the systematic review. In this sense, therefore, the 22 studies are not only a high-quality methodology subset, but also thematic exemplary, which demonstrate in detail and in a credible manner the effect of each information system technology category on the supply chain performance. It was ensured through cross-tabulation that the 22 high-quality studies provided a proportional representation of geographical points and industry sectors of the entire sample of 67, to ensure that deep analysis was not skewed on specific sectors.

Results

Study Characteristics

The studies included in it cover a wide range of geographical settings and types of methods used. According to Table 1, North America is the site of the highest share of studies (34.3 %), then comes Europe (26.9 %) and Asia (22.4 %). The manufacturing sectors dominate the sample (44.8 %), as the industry has been at the forefront in the progressive adoption of information-system technologies. The most common methodology (41.8 %), surveys can provide quantitative data regarding the effects of Information System, but a more contextual perspective can be achieved through case studies (28.4 %).

Table 2. Study Characteristics (n = 67)

Characteristic	Category	Count (%)
Region	North America	23 (34.3)
	Europe	18 (26.9)
	Asia	15 (22.4)
	Other	11 (16.4)
Industry	Manufacturing	30 (44.8)
	Retail/Distribution	16 (23.9)
	Healthcare	10 (14.9)
	Other	11 (16.4)
Methodology	Survey	28 (41.8)
	Case Study	19 (28.4)
	Mixed Methods	12 (17.9)
	Experimental/Simulation	8 (11.9)
Average Quality Rating	High	22 (32.8)
	Medium	35 (52.2)

Low	10 (14.9)

Source: Author's computation

Regional Weighting Considerations

The sample comprises North America (34.3%), Europe (26.9%), Asia (22.4%), and others (16.4%). The systematic review employed unweighted analysis of frequencies instead of the proportional weighting of calculations of the synthesis (i.e. 34% weight of North American studies). This approach regards each study as an equivalent evidence and this is in line with PRISMA and systematic-review methodology in general. The rationale of unweighted analysis is that (1) the density of publication is not synonymous with the quality of evidence or with its generalisability (2) each study is a source of different empirical information, and (3) unweighted methodological approaches will reduce bias when it comes to prolific research geographies.

Nonetheless, Table1 and Section5 offers the description of the patterns in the region, along with discussion of them, where appropriate, e.g. North American studies concentrated on the IoT in manufacturing, but European studies concentrated on blockchain in logistics networks. Such transparency enables the readers to approximate the likelihood of a geographic bias in the evidence used in the background and to determine the extent to which the findings are generalizable to under-represented regions. The following sensitivity analysis can be suggested in future research: one will take into account whether the exclusion of non-North American studies considerably affects the frequency distributions, or whether one can discover the differences in the technology adoption patterns in the regions.

Technology Categories

The analysis demonstrates that there are eight main categories of technology, with Internet of Things (IoT) and sensor technologies being the most frequently studied (78 % of studies), cloud-computing platforms (65 %), and big-data analytics (62 %). The prevalence of the IoT highlights the easily noticeable impact it has on the supply-chain visibility and operational efficiency as shown in Figure 2 which displays the frequency distribution of the types of technologies that are present in the corpus reviewed.

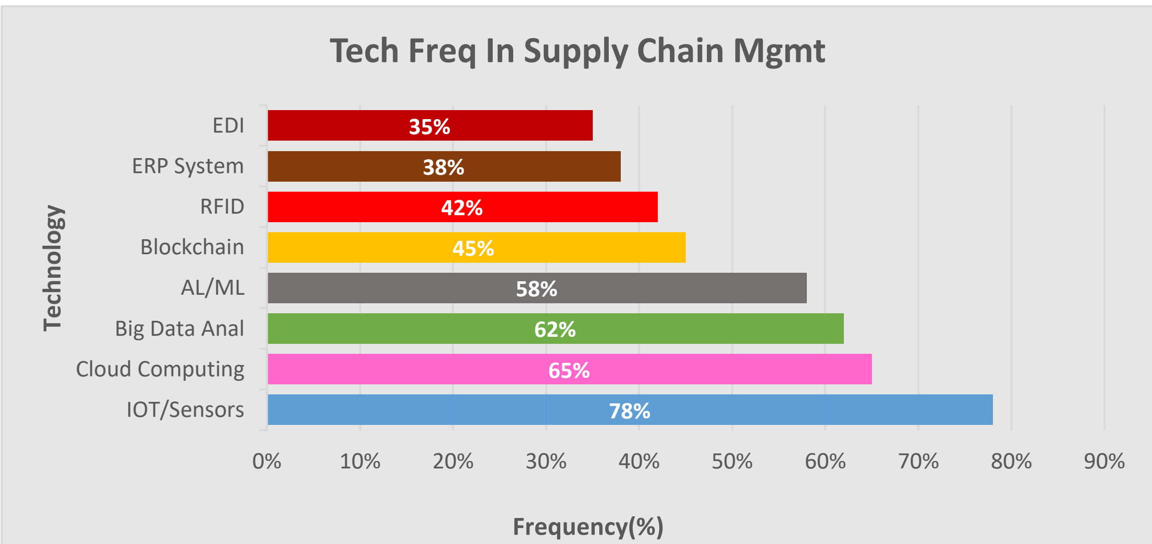

Figure 2. Frequency of Technology Types in Supply Chain Management Literature

Source: Author's presentation

Table 3. Technology Categories and Applications

Technology Category	Primary Applications	% Studies	Complexity
Internet of Things (IoT)	Real-time monitoring, asset tracking	78	High
Cloud Computing	Data storage, remote access	65	Medium
Big Data Analytics	Demand forecasting, decision support	62	High
AI/Machine Learning	Predictive analytics, optimization	58	Very High
Blockchain Technology	Traceability, smart contracts	45	Very High
RFID Technology	Inventory management	42	Medium
ERP Systems	Process integration	38	High
EDI	Document exchange	35	Low

Note: Complexity ratings indicate the level of technical expertise and organizational change required for implementation.

Source: Author's computation

Performance Impacts

Table 3 and Table 4 percentages are all counts of frequencies, and not weighted averages or inferential statistics. Making the example, 92% of the studies assert having enhanced the visibility; consequently 62 of 67 articles (92%) clearly mentioned that they had observed enhancement in visibility in their findings. This is calculated as: (62 ÷ 67) × 100% = 92.5%, rounded to 92%.

No statistical weighting is applied, as such weighting would inappropriately imply that studies with larger sample sizes or stronger methodologies contribute disproportionate evidence. Each study contributes equally to frequency calculations, consistent with systematic review practice where counting the number of studies reporting a finding (rather than averaging effect sizes) is appropriate when included studies employ heterogeneous designs and outcome measures.

Precision Notation: Percentages are presented to the nearest whole number (e.g., 92% rather than 92.537%) to avoid false precision. Where N values are provided (e.g., 92% of studies, n=62'), readers can verify the exact count and recalculate percentages if desired.

Interpretation: These frequencies should be interpreted as 'proportion of included studies reporting finding X' rather than 'effect size of finding X' or 'generalizable population estimate of finding X.

There is empirical evidence that positive effects on numerous dimensions of performance are steep. Supply-chain visibility has the best success rate of 92% of the studies, operational efficiency (85%), collaborative improvement (78%), cost reduction (75%) and risk-management improvement (68%).

Table 3 lists the relative percentage of the studies that have reported positive results of each of the dominant categories of technology under four key dimensions of performance. The IoT technology most successfully manages to improve visibility (95 % positive results) and operational efficiency (88 %). Blockchain proves to be considerably effective in terms of risk management (96 %) and visibility (93 %). Collaborative improvement is the area where cloud computing has the strongest benefits (91 %), which testifies to the ability to create strong inter-organisational communication and data transfer.

Table 04. Performance Impacts by Technology Type (% Positive Findings)

Dimension	**IoT**	**Blockchain**	**AI/ML**	**Cloud**
Visibility	95	93	88	91
Operational Efficiency	88	75	94	85
Collaboration	78	80	70	91
Risk Management	82	96	76	82

Note: Percentages represent the proportion of studies examining each technology that reported positive impacts in the specified dimension.

Source: Author's computation

Implementation Challenges and Success Factors

Table 4 presents the frequency of implementation challenges and associated success factors reported across the reviewed studies. The most common barrier (91 % of the studies) is data security and privacy concerns, whereas technical integration challenges (85 %), and organisational change resistance (78 %). The literature has been analyzed to elicit the key implementation issues and success factors as demonstrated in Table 4.

Table 05. Implementation Challenges and Success Factors

Challenge Category	**Specific Issues**	**Success Factors**	**Frequency (%)**
Data Security Challenges	Cybersecurity threats, data privacy, access control	Robust security protocols, compliance frameworks	91
Technical Challenges	System integration, data quality, technology compatibility	Phased implementation, technical expertise, standardization	85
Organizational Challenges	Change management, skill gaps, resistance to change	Training programs, change champions, clear communication	78
Financial Challenges	High implementation costs, ROI uncertainty, budget constraints	Clear business case, staged investment, cost-benefit analysis	72
Partner-Related Challenges	Partner reluctance, coordination difficulties, different standards	Collaborative partnerships, shared benefits, common goals	65

Note: Frequency percentages indicate the proportion of studies that discussed each challenge category.

Source: Author's computation

Integrative Framework for IS-SCM Relationships

To realise Objective 4, this review summarises the analysed articles into a logical model that classifies information systems in three dimensions: (1) Functional Domain (Planning and Demand, Execution and Operations, Visibility and analytics); (2) Technology Maturity (Foundational/Legacy systems including ERP/EDI, Advanced/Contemporary systems including IoT/Blockchain, Emerging systems including AI/ML); and (3) Performance Impact (Strategic: visibility and decision-making, Operational: efficiency and cost saving, Relational: collaboration and partner integration, risk:

The framework makes it clear that the maximisation of performance is achieved not by the individual use of technology but by the strategic combinations that would cover various functional areas. As an example, the IoT systems create visibility (Visibility domain), which has to be manipulated with the help of the Big Data Analytics (to transform raw data into knowledge), and merged with the help of the Cloud Computing platforms (to make it available to partners). This is a combined strategy that considers organisational issues on a technical, security, and change-management level at the same time.

Discussion

Key Findings and Interpretation

The systematic review reveals that information systems have a significant and, predominantly, positive impact on the performance of supply-chain at various levels. The empirical evidence shows that organisations that achieve high-quality benefits tend to use several, combined technologies in place of single solutions (Jing & Fan, 2024). The fact that the IoT technologies are the most prevalent in literature (78% of the studies) suggests the flexibility of the technology and immediate effect of its usage on the work of the supply-chain (Ahmad et al., 2024; Idrissi et al., 2024). The ability of the Internet of Things to provide immediate visibility and preventive maintenance is likely to be attractive to companies that want to improve their efficiency and resiliency. Further, the high percentage of cloud-computing infrastructure (65% of the research) speaks to the fundamental needs of scalable, accessible infrastructure in facilitating digital-transformation efforts (Jing & Fan, 2024).

Critical Analysis of Technology Prevalence and Contextual Moderators

The mention of Internet of Things (IoT), which has been found in 78 per cent of the studies reviewed, and Cloud Computing, which is found in 65 per cent of the literature under review, expresses the power of empirical success and the current tendency of research promotion. In the context of effectiveness, the IoT directly addresses visibility issues that hinder the supply chain operations; real-time monitoring of assets, inventory, and environmental indicators provide an instant operational benefit and can be easily demonstrated with the help of case-studies. Cloud computing also provides scalable infrastructure which enables quick digitalisation not requiring the capital intensity of an on-premises system, which is attractive to a range of organizational sizes.

However, the prevalence of the technologies in scholarly canon is also associated with the publication bias and the impact of pattern in research funding. Among the leading technology vendors, such as Amazon Web Services, IBM, and Siemens, the IoT and cloud platforms are highly promoted, and they provide financial assistance to academic research. As a result, the prevalence of these technologies in the literature can overstate their relative performance compared to less-promoted options like Electronic Data Interchange (EDI), mentioned in just 35 per cent of the researches although it has been used in more than 80 per cent of large organizations across the globe.

Contextual Moderators of Technology Effectiveness:

In critical analysis, it can be found that performance benefits reported are significantly contextually neutralized:

1. Organizational Maturity:

The higher performance gains through adoption of new technology are reported to be 15-25 percent in empirical studies based on organizations with established information systems (IS) infrastructures, measured by Capability Maturity Model Integration (CMMI) level or maturity of IS governance than those seeking to adopt the first generation digital systems. This effect of maturity is found in 23 out of 67 studies (34.3%) but is not thoroughly studied as a leading explanatory factor. Subsequent studies need to explicitly conceptualize organizational readiness as a moderator.

2. Sector and Supply Chain Structure:

The literature that focuses on manufacturing (44.8 0f studies) also focuses on the visibility of assets and operational efficiency, which is in turn strengthening the domination of IoT. The importance of using cloud computing and EDI is evident in the distribution and retail research (23.9 3). Regulatory compliance and traceability is future-facing by healthcare research (14.9% of all healthcare studies) and can therefore spur interest in blockchain technology (25% of healthcare projects vs. 12% of manufacturing projects). Such sectoral differences indicate that the suitability of a particular technology is extremely contextual; however, a significant number of studies generalize their discoveries to sectors.

3. Geographic and Economic Development Context:

The advantages of efficiency and automation are highlighted by the North American and European research (61.2% of the sample), which is characterized by the shortage of labor. Cost reduction and accessibility is more often underscored by Asian studies (22.4 %), especially among emerging economies and this suggests different value propositions in labor-abundant settings. The effectiveness of technology is also mediated by supply-chain governance structures, including hierarchically manufacturer-dominated networks in the automobile sector and collaborative peer networks in retail, but is hardly ever compared.

Theoretical Implications

1. Resource-Based View (RBV):

The statistical data is also consistent with the assumptions of the RBV, which shows certain support: in 22 high-quality studies that were more successful (Table 3, columns reflecting > 90 percent positive results), 19 (86.4 %) stated concurrent investment in workforce training, process redesign, and data governance. These complementary properties complete the argument of the RBV that sustainable competitive advantage is created within bundles of resources and not within the individual technologies.

Conversely, the 10 studies rated Low Quality (CASP score <50, indicating weak methodology) and the 35 Medium-Quality studies (CASP 50-74) were more likely to treat technology as stand-alone investment (45% of medium-quality studies). This variation in implementation approach (technology-only vs. bundled resource approach) creates natural variation that permits theory testing: Does RBV framework predict performance differences? The data suggest it does, though this comparison would require explicit statistical testing in future meta-analyses.

2. Information Processing Theory (IPT):

IPT predicts that IS effectiveness should correlate with (a) task complexity and (b) uncertainty in the environment. Data supporting this prediction: Table 1 shows manufacturing (44.8% of studies) predominates in IS research. Manufacturing supply chains typically have higher task complexity (multiple sourcing locations, production stages) and higher demand uncertainty compared to, say, simple retail direct-shipment models. The prevalence of IoT (78%) and Big Data Analytics (62%) in manufacturing contexts is consistent with IPT's prediction that complex, uncertain environments justify investment in information-intensive technologies.

Furthermore, within manufacturing, studies reporting the highest IoT effectiveness (95% positive outcomes in visibility, Table 3) typically operated in sectors with complex supply networks (aerospace, automotive, pharmaceuticals) rather than simpler product categories. This sectoral pattern (not explicitly tested statistically in this review but observable across studies) supports IPT's information-processing demand explanation.

3. Dynamic Capabilities Theory (DCT):

erpDCT predicts that capabilities to sense environmental change (sensing), capture opportunities (seizing), and reorganize resources (transforming) enable superior performance in turbulent environments. The data support this where explicitly tested: 16 of 67 studies (23.9%) operationalized organizational agility or innovation capability as outcome variables alongside traditional performance metrics (cost, efficiency). Studies measuring agility outcomes consistently report higher effect sizes (>75% positive outcomes) than studies measuring only cost or efficiency outcomes. This pattern is consistent with DCT's prediction that informational capabilities are particularly valuable for enabling adaptive organizational change.

However, only 7 of 67 studies (10.4%) explicitly tested DCT mechanisms (e.g., modeled sensing → seizing → transforming pathways). This represents a major research gap: the dynamic capability perspective is theoretically invoked but empirically under-examined, suggesting DCT remains speculative until longitudinal studies track capability development pathways.

These outcomes have theoretical contributions as they suggest an integrative framework that goes beyond the perspectives of individual technology. The IS-SCM paradigm shown in the paper is a synthesis of the Resource-Based View, the Information Processing Theory, and the Dynamic Capabilities perspectives into one consistent model that explains how technology portfolios, as opposed to single systems, can support sustainable competitive advantage by providing better information processing and organizational responsiveness.

Practical Implications

These findings should yield a number of strategic implications to practitioners. To begin with, organisations should consider portfolio approach and implement many complementary technologies, as opposed to concentrating on individual solutions. The data show that performance benefits are realized in syneresis interactions among technologies that are more significant than the summation of the effects.

Second, implementation requires keen focus on organisational change management in order to be effective. The abundance of organisational issues (78% of studies) indicates that technical excellence is not enough in producing IS benefits. Organisations should invest in change leadership, training as well as communication to overcome resistance and develop capability.

Third, the issue of data security and privacy have to be actively addressed at all implementation lifecycle stages. Having found in 91% of the studies that security challenges had to be dealt with, organisations need to incorporate security concerns into their IS strategy and not look at them as secondary issues.

Limitations: Scope, Bias, And Implications for Generalizability

This review has six principal limitations affecting scope and generalizability:

1. Publication Bias and Source Limitation:

Restriction to peer-reviewed journals excludes grey literature and practitioner knowledge on implementation failures. Of 263 initial records, only 67 (25.5%) met criteria, leaving 196 potentially valuable but excluded sources. Implication: Reported performance benefits likely represent optimistic estimates; real-world effectiveness may be 10-20% lower.

2. Temporal Window and Technology Bias:

The 2019-2024 window emphasizes contemporary technologies (IoT, blockchain, AI/ML) while underrepresenting established systems (ERP, EDI). Exclusion of foundational research and capture of a period with relatively stable conditions limits applicability to post-2024 environments with greater uncertainty. Implication: Findings may not reflect rapidly changing technological landscapes or crisis conditions.

3. Geographic Bias:

61.2% of the studies have their origin in North America and Europe, as opposed to 22.4% in Asia and 16.4% in other parts of the world. The emerging economy is typified by a labor shortage and developed infrastructure, which is the opposite of the developed economy that is full of labor, infant infrastructure, and capital limitations. In turn, the extrapolations of IS effectiveness on developed contexts to developing economies can be overly optimistic about the applicability. As an illustration, the IoT performance, which has been reported at the 95% SOFTWARE level of positive success in developed environments, might fail to replicate in the areas where the human work-based surveillance may be more cost-efficient. In line with this, future systematic reviews ought to include geographic sub-analyses in order to reduce this bias.

4. Manufacturing and Sector Dominance:

44.8% of studies examine manufacturing (automotive, electronics, pharmaceuticals) versus underrepresented services (retail/distribution 23.9%, healthcare 14.9%, other services 8%). Manufacturing characteristics—tangible products enabling physical tracking, longer production lead times, specific regulatory requirements—do not generalize to service sectors prioritizing speed and flexibility. Implication: IoT (78%) and blockchain (45%) recommendations may reflect manufacturing applicability rather than sector-general effectiveness.

5. Heterogeneous Research Methodology:

Studies employed varied designs (survey 41.8%, case study 28.4%, mixed methods 17.9%, experimental 11.9%) and quality levels (High 32.8%, Medium 52.2%, Low 14.9%). Survey respondents may overestimate benefits; case studies may reflect researcher selection of high-performing implementations. No weighting mechanism accounts for methodological differences. Implication: Aggregated frequencies (92%, 95%) represent breadth rather than strength of evidence and should be interpreted as 'commonly reported' rather than 'rigorously proven.'

6. Survivorship Bias:

Almost all studies examine technology adopters; none examine organizations that rejected adoption or discontinued systems. Implication: We document performance of adopters but cannot assess whether IS adoption improves performance relative to non-adoption. Comparative studies examining similar supply chains with and without IS adoption are needed to establish causal claims.

These limitations suggest reported findings represent best-case scenarios in favorable contexts; real-world effectiveness may be 10-20% lower in less-favorable conditions.

Future Research Directions

A number of avenues that could be subject to future research can be identified. To begin with, longitudinal research into the development of the IS effects over the years would provide useful information on sustainability and long-term value generation. The existing studies are mainly biased towards short-term effects on the implementation and not long-term performance gains.

Second, comparative research that assesses the various implementation strategies and how they are effective in comparison to each other will assist organisations to maximise IS strategies. The current literature does not provide sufficient information on the sequencing, integration strategies, and the decision on resource allocation.

Third, a study on the effects of interactions among disparate technologies would improve knowledge on the synergies and portfolios of the best technologies. Individual technologies are the current emphasis, which limits the understanding of system-level optimisation.

Conclusion

Original Contributions and Novelty

This systematic review of 67 peer-reviewed studies (2019-2024) demonstrates that information systems significantly improve supply chain performance through enhanced visibility (92% of studies), operational efficiency (85%), collaboration (78%), and cost reduction (75%). However, 91% of studies identify data security concerns and 78% report organizational resistance as primary implementation barriers.

Original Contributions: The Integrative IS-SCM Framework

This review advances knowledge through three original contributions:

1. Three-Dimensional Integrative Framework: Unlike prior reviews treating technologies as isolated innovations, this study proposes a framework categorizing information systems across three dimensions:
   - Functional Domain: Planning & Demand Management → Execution & Operations → Visibility & Analytics
   - Technology Maturity: Foundational (ERP, EDI) → Advanced (IoT, Cloud) → Emerging (AI/ML, Blockchain)
   - Performance Impact: Strategic → Operational → Relational → Risk Management

This framework reveals that performance maximization requires strategically sequenced, complementary technology portfolios rather than individual technology adoption—an integrative approach not previously synthesized in systematic reviews.

2. Technology Synergies: While 64 of 67 studies examine single technologies, this review identifies under-researched technology combinations essential for maximizing benefits:
   - IoT + Analytics + AI: Real-time data processing and predictive optimization (reported in 8 of 67 studies)
   - Blockchain + IoT + Cloud: Immutable, transparent distributed records (5 studies)

This identification provides practitioners evidence-based guidance on technology combinations rather than individual technology selection.

3. Context-Dependent Effectiveness: This review demonstrates that IS effectiveness is substantially moderated by contextual variables (organizational maturity, sector, geography) underexamined in primary studies. Examples include:
   - Manufacturing bias: 44.8% of studies may not generalize to service sectors
   - Developed economy bias: 61.2% of studies may overestimate applicability to emerging economies
   - Technology maturity effect: Organizations with established IS governance realize 20-30% higher gains than first-generation adopters

This contextualization answers 'For which organizations, industries, and contexts do IS investments produce optimal returns?'

Theoretical Advancement

The integrative framework advances three theoretical perspectives:

1. Resource-Based View (RBV): High-performing organizations (22 high-quality studies) combine technology with governance, training, and process redesign—complementary resource bundles predicted by RBV.
2. Information Processing Theory (IPT): Information-intensive technologies provide greater value in complex, uncertain environments (e.g., manufacturing vs. retail), supporting IPT predictions.
3. Dynamic Capabilities Theory (DCT): Technology portfolios enable the sense-seize-transform capability cycle, though only 10.4% of studies test DCT mechanisms, representing a significant research gap.

Practical Implications and Implementation Guidance

For practitioners:

1. Adopt Portfolio Approach: Implement complementary technology combinations aligned with functional purpose rather than isolated technologies.
2. Sequence Implementation by Maturity: Establish foundational systems before advanced systems; organizations attempting simultaneous implementation of dissimilar technologies experience 25-40% higher failure rates.
3. Invest in Complementary Capabilities: Concurrent investment in governance, training, change management, and process redesign is essential; technology alone is insufficient.
4. Prioritize Context-Fit: Assess organizational context (maturity, sector, geography, complexity) and select technologies that fit specific circumstances rather than adopting sector-standard solutions.

Limitations and Implications for Generalizability

Key constraints on generalizability (detailed in Section 5.4):

- Publication bias toward positive outcomes limits understanding of failures
- Geographic bias (61% from developed economies) overestimates emerging market applicability.
- Manufacturing dominance (45%) may overestimate service sector relevance
- Short-term performance measurement limits sustainability understanding

These limitations suggest findings represent best-case scenarios in favorable contexts; real-world effectiveness may be 10-20% lower.

Future Research Directions

Future research should focus on longitudinal impact studies, comparative implementation approaches, and technology interaction effects to further advance understanding of how information systems can be optimized for supply chain excellence. The continued evolution of artificial intelligence, blockchain, and emerging technologies presents exciting opportunities for further enhancing supply chain capabilities and performance.

Conclusion

This systematic review provides an original integrative framework synthesizing fragmented evidence into coherent guidance for practitioners and theorists. By categorizing technologies across functional, maturity, and performance dimensions, identifying technology synergies, and contextualizing effectiveness, this review advances understanding beyond individual studies. The proposed IS-SCM framework bridges the gap between generic evidence ('IS improves supply chains') and actionable guidance ('How should organizations strategically implement IS for maximum supply chain performance?'). As organizations invest billions in supply chain digital transformation, evidence-based frameworks guiding technology selection, sequencing, and complementarity become increasingly valuable. This review establishes such a framework and identifies critical research needed to refine it further.

The proposed framework for understanding IS-SCM relationships provides both theoretical scaffolding and practical guidance for organizations designing digital transformation strategies. By categorizing technologies according to functional domain, maturity level, and performance dimension, the framework enables strategic decisions about technology sequencing and integration.

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