Measuring the value of blockchain adoption in supply chain management: an empirical analysis of key success dimensions

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Abstract

Purpose – Blockchain technology is widely discussed as an enabler of transparency, efficiency and trust in supply chain management (SCM). However, empirical evidence on which blockchain-related success dimensions translate into value perceptions remains limited. This study aims to examine how the perceived relevance of blockchain success dimensions relates to realized benefits and whether these benefits contribute to overall perceived blockchain value.

Design/methodology/approach – A quantitative survey of 41 companies with blockchain experience in SCM is conducted. Success dimensions are prioritized using best–worst scaling (MaxDiff). Relationships between perceived relevance, dimension-specific benefits and overall perceived value are analyzed using partial least squares structural equation modeling (PLS-SEM). Exploratory analyses assess company characteristics.

Findings – Contrary to dominant expectations in academic and practitioner narratives, even highly prioritized blockchain success dimensions fail to translate into measurable firm-level value perceptions. While transparency and traceability are associated with significant dimension-specific benefits, these improvements do not produce statistically significant direct or indirect effects on overall perceived blockchain value. This suggests that localized operational gains alone may be insufficient to generate overall perceived value and indicates that blockchain benefits may depend on broader organizational and technological complements.

Originality/value – The study moves beyond identifying potential blockchain benefits by empirically differentiating which success dimensions matter and which do not. By combining MaxDiff with PLS-SEM, it offers a structured, mechanism-oriented framework for evaluating blockchain success and highlights boundary conditions for value realization in SCM.

Keywords Blockchain, Supply chain management, Success measurement, Perceived value, PLS-SEM

Paper type Research paper

1. Introduction

Blockchain technology has been widely discussed as a promising enabler of transparency, efficiency and trust in supply chain management (SCM). Its decentralized data structures, immutability and shared information infrastructure have stimulated numerous pilot projects and conceptual discussions across application areas such as product tracking,

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provenance verification, compliance monitoring and automated contracting across supply chains (Huang *et al.*, 2023; Oriekhoe *et al.*, 2024). Despite this growing interest, managers still face substantial uncertainty regarding whether blockchain adoption generates tangible business value for companies.

Existing research has increasingly begun to examine the organizational and performance implications of blockchain adoption in supply chains. Several empirical studies link blockchain implementation to firm performance outcomes such as operational efficiency, supply chain resilience or process improvements (e.g. Li *et al.*, 2022; Aslam *et al.*, 2023; Wamba *et al.*, 2020). While these studies provide important insights into the potential outcomes of blockchain adoption, they primarily focus on observable performance effects. However, in emerging technology contexts such as blockchain-based supply chain applications, performance impacts are often difficult to isolate and may only materialize after longer implementation periods. As a result, companies frequently evaluate blockchain initiatives based on managerial value perceptions rather than immediately observable performance indicators.

Against this background, empirical evidence on how specific blockchain success dimensions contribute to such overall value perceptions remains limited. While prior studies discuss various blockchain-related benefits conceptually or within individual use cases, systematic empirical evaluations of which success dimensions are most relevant for companies and how they translate into overall value remain scarce (Hübschke *et al.*, 2025; Abdelkafi *et al.*, 2023). In particular, prior work rarely distinguishes between the perceived strategic relevance of blockchain success dimensions, the actual benefit improvements experienced by companies and their contribution to an overall evaluation of the technology (Queiroz *et al.*, 2020). Consequently, it remains unclear which dimensions are most strongly associated with overall perceived value and how operational blockchain benefits translate into overall perceived value from a business perspective. To address this gap, this study empirically investigates blockchain success from a business perspective. Because companies first assess the relevance of potential benefits before experiencing concrete improvements, perceived benefit changes are expected to represent a central mechanism linking relevance perceptions and overall value. We therefore combine a best–worst scaling (MaxDiff) approach to prioritize success dimensions with partial least squares structural equation modeling (PLS-SEM) to examine the relationships between perceived relevance, perceived benefits and overall perceived value.

Based on this approach, the study addresses the following research questions:

RQ1. Which blockchain success dimensions in supply chain management are perceived as particularly relevant by adopting companies?

RQ2. To what extent do perceived benefit improvements contribute to the overall perceived value of blockchain adoption in supply chain management?

RQ3. Do perceived benefit improvements mediate the relationship between perceived relevance and overall perceived value of blockchain in supply chain management?

This study contributes to the SCM literature in three ways. First, it challenges the widespread assumption that operational blockchain improvements automatically translate into overall business value. By empirically demonstrating that even highly prioritized and realized benefits do not necessarily aggregate into overall value perceptions, the study identifies important boundary conditions of blockchain-related value creation. Second, it provides one of the first quantitative prioritizations of blockchain success dimensions using best–worst scaling. Third, it develops and tests a theoretically grounded model that disentangles perceived relevance, realized benefits and overall value, thereby offering a more mechanism-based understanding of how blockchain success materializes in practice.

The remainder of the paper is structured as follows. Section 2 reviews the literature and develops the hypotheses, Section 3 outlines the methodology, Section 4 presents the results and Section 5 discusses implications and limitations.

2. Theoretical background

2.1 Blockchain in supply chain management

Blockchain is widely described as a digital infrastructure that enables multiple independent organizations to document and share process and transaction information within a jointly accessible system (Singh *et al.*, 2024). By providing a shared and tamper-resistant database, blockchain supports a consistent and traceable representation of process events across business boundaries and is therefore frequently associated with increased transparency, improved traceability and higher reliability of interorganizational information (Uddin *et al.*, 2025).

These characteristics render blockchain particularly relevant for supply chains, which are inherently characterized by interorganizational coordination, fragmented process structures, heterogeneous information technology (IT) systems and persistent information asymmetries between partners (Andrew, 2024). In such environments, limited visibility and information discontinuities frequently impede coordination, control and decision-making across organizational boundaries (Bhati, 2025; Andrew, 2024). Blockchain is therefore commonly discussed as an infrastructural mechanism that may enhance information sharing and process transparency across supply chains.

From a theoretical perspective, the value of blockchain in supply chains has been discussed using different economic and organizational lenses, including transaction cost economics, principal-agent theory and network governance (Treiblmaier, 2018). These perspectives highlight that blockchain can influence supply chain performance by reducing coordination costs, improving information symmetry and strengthening trust between supply chain actors.

Empirical research has increasingly begun to examine the performance implications of blockchain adoption in supply chains. Several studies link blockchain implementation to operational efficiency, supply chain resilience, adaptability and overall firm performance (e.g. Sheel and Nath, 2019; Wamba *et al.*, 2020; Aslam *et al.*, 2023; Dong *et al.*, 2025).

However, empirical findings remain heterogeneous and appear to be highly context-dependent, as the value generated by blockchain adoption depends strongly on specific application contexts, organizational integration and interorganizational coordination structures.

Moreover, prior studies often treat blockchain benefits as a broad set of potential advantages without systematically differentiating between their relative relevance to companies or examining how specific benefit perceptions relate to overall evaluations of the technology.

The literature increasingly emphasizes that blockchain adoption should be understood not merely as a technical implementation but as an organizational and interorganizational phenomenon whose outcomes depend on how the technology is integrated into existing processes and coordination structures (Jum'a, 2023). Building on this perspective, this study conceptualizes blockchain adoption as the integration of blockchain solutions into operational processes and interorganizational coordination practices and focuses on the perceived benefits that emerge from this integration. From a business perspective, this shift enables a systematic examination of which benefit dimensions are considered relevant by companies and how these perceived improvements are associated with their overall evaluation of blockchain adoption.

2.2 Success dimensions of blockchain in supply chain management

In information systems and management research, the success of digital technologies is commonly conceptualized as a multidimensional phenomenon rather than a single outcome variable (DeLone and McLean, 2003). Digital technologies typically generate effects across multiple layers, including information-related, process-related, interorganizational and economic outcomes (Schöggl *et al.*, 2024). This perspective is particularly relevant in supply chains, where technology-enabled improvements rarely occur in isolation but emerge through interdependent processes and coordination mechanisms across organizational boundaries.

Accordingly, prior research on enterprise systems, interorganizational information systems and Internet of Things (IoT) applications has introduced the concept of success dimensions to structure heterogeneous benefit effects, such as improvements in information quality, process transparency, efficiency, coordination or relational aspects including trust (DeLone and McLean, 2003; Zhu *et al.*, 2010; Vogelsang *et al.*, 2018). Building on this logic, blockchain-related success dimensions can be understood as a contextual refinement of these general digital technology mechanisms, reflecting blockchain's specific characteristics, including shared data governance, immutability and interorganizational accessibility (Javadi *et al.*, 2025).

A substantial body of blockchain research in SCM has consequently identified a wide range of potential success dimensions, including transparency, traceability, trust, efficiency, data quality, fraud prevention, sustainability proof and collaboration. These dimensions are frequently discussed as mechanisms through which blockchain adoption may improve supply chain processes and performance (e.g. Wamba *et al.*, 2020; Latan *et al.*, 2024). Drawing on a preceding systematic literature review of blockchain success measurement in supply chains, Table 1 summarizes the dimensions most frequently discussed in prior studies and provides a structured overview of the conceptual foundation of this research (Hübschke *et al.*, 2025).

Despite the broad discussion of blockchain-related success dimensions, prior research largely treats these dimensions in parallel and often emphasizes context-specific advantages without systematically assessing their relative importance or examining how individual benefit perceptions relate to an overall evaluation of blockchain adoption. From a business perspective, it therefore remains unclear which success dimensions are perceived as most relevant by companies and which are most strongly associated with overall perceived value.

Addressing this limitation, the present study moves beyond the mere identification of benefits by prioritizing success dimensions using a best–worst scaling approach and by empirically analyzing their relationships with overall perceived blockchain value in a structural model.

2.3 Success measurement of blockchain adoption in supply chain management

The identification of blockchain success dimensions provides a foundation for structuring blockchain adoption in supply chains. However, assessing adoption outcomes requires clarifying how these dimensions translate into value for companies. Rather than merely listing potential benefits, success measurement focuses on how operational improvements associated with blockchain applications are reflected in companies' evaluations of the technology.

Prior empirical research on blockchain adoption in supply chains has frequently examined its impact using firm performance indicators such as operational efficiency, supply chain resilience or financial performance (e.g. Sheel and Nath, 2019; Wamba *et al.*, 2020). These outcome-oriented measures provide valuable insights into the potential performance implications of blockchain adoption. However, in emerging technology contexts such as blockchain-based supply chain applications, performance effects are often difficult to isolate and may only materialize after longer implementation periods.

From a theoretical perspective, the value of blockchain in supply chains has therefore also been discussed beyond purely performance-based outcomes. For example, Treiblmaier (2018) conceptualizes blockchain value through mechanisms such as reduced transaction costs, improved coordination and enhanced trust between supply chain actors. These perspectives highlight that organizations may evaluate blockchain initiatives not only based on measurable performance outcomes but also based on broader managerial assessments of the technology's overall contribution to business activities.

Against this background, perceived value represents an important evaluative construct for assessing blockchain adoption. Perceived value captures how decision-makers integrate multiple operational improvements into an overall judgment of whether blockchain adoption creates value for the organization.

A central distinction in this context concerns perceived relevance and perceived benefit realization. Perceived relevance reflects the strategic importance that decision-makers attribute to a specific blockchain success dimension. In contrast, perceived benefit realization captures the extent to which

Table 1 Overview of blockchain success dimensions in supply chain management

Blockchain success dimension	Author
Trust between supply chain partners	Nandi *et al.* (2021), Treiblmaier (2018), Queiroz and Wamba (2019) and Rejeb *et al.* (2021)
Supply chain transparency	Nandi *et al.* (2021), Treiblmaier (2018), Queiroz and Wamba (2019), Rejeb *et al.* (2021) and Saberi *et al.* (2019)
Cost efficiency	Çodur and Erkayman (2025), Treiblmaier (2018), Queiroz and Wamba (2019), Rejeb *et al.* (2021) and Saberi *et al.* (2019)
Product traceability	Ghode *et al.* (2023), Wolf *et al.* (2024), Jung (2022), Yousefi and Tosarkani (2022), Nandi *et al.* (2020), Paul *et al.* (2021), Wamba *et al.* (2020), Kshetri (2018), Noor (2022) and Hong and Hales (2021)
Data quality and information availability	Baral *et al.* (2022), Jung (2022), Sheel and Nath (2019), Garg *et al.* (2021), Appiah Otoo and Singh (2020), Kurdi *et al.* (2022) and Potnis *et al.* (2023)
Fraud and counterfeiting prevention	Sharma *et al.* (2023), Akhavan and Philsoophian (2023), Hasan *et al.* (2020), Khan *et al.* (2021), Meidute-Kavaliauskiene *et al.* (2021), Paul *et al.* (2021), Treiblmaier (2018) and Garg *et al.* (2021)
Process efficiency and speed	Almasarweh *et al.* (2023), Purwaningsih *et al.* (2024) and Ali *et al.* (2023)
Proof of sustainability	Mohamed *et al.* (2023), Ezzi *et al.* (2023), Ronaghi and Mosakhani (2022), Yousefi and Tosarkani (2022) and Tawiah *et al.* (2022)
Collaboration and contract management	Rakshit *et al.* (2022), Dhaiouir (2021) and Kim and Shin (2019)

companies experience tangible improvements associated with that dimension. Importantly, highly relevant dimensions do not necessarily result in realized benefits, particularly during early stages of technology adoption.

Beyond dimension-specific assessments, adoption success is typically evaluated at an aggregated level. Overall perceived value represents a holistic managerial judgment of whether blockchain adoption generates value from a business perspective. This construct allows organizations to integrate multiple perceived improvements into a single overall evaluation of the technology.

Given the early maturity of many blockchain applications in supply chains and the lack of standardized performance indicators for evaluating blockchain outcomes, perception-based measures constitute an appropriate approach for capturing adoption success in practice. Accordingly, this study operationalizes blockchain success using three complementary components: perceived relevance of selected success dimensions, realized benefit improvements and overall perceived value. This structure enables both the prioritization of success dimensions and the examination of how realized benefits relate to overall value perceptions.

3. Research design and methodology

3.1 Research design

This study follows a quantitative, survey-based research design to empirically examine the relationships between the perceived relevance of blockchain success dimensions, realized benefit improvements and the overall perceived value of blockchain adoption in supply chains. A quantitative approach is appropriate because the study focuses on measuring latent perceptual constructs and analyzing their relationships across multiple dimensions from a business perspective.

Given that only a limited number of companies currently possess hands-on experience with blockchain applications in supply chain contexts, the target population is relatively small and specialized. A standardized online survey was therefore used to systematically collect comparable assessments across organizations and to enable the statistical analysis of cross-company patterns in perceived blockchain outcomes.

PLS-SEM was selected as the primary analytical approach instead of covariance-based SEM. This choice is justified by several considerations. First, the study relies on a relatively small and specialized sample of companies with hands-on blockchain experience, for which PLS-SEM provides greater robustness and statistical power. Second, the research has an exploratory and prediction-oriented character, aiming to identify key value drivers rather than to confirm a well-established covariance structure. Accordingly, the study should be understood as an exploratory analysis of relationships between blockchain success dimensions and perceived value rather than as a basis for strong explanatory or causal claims. Third, several measurement scales were specifically developed and adapted to the emerging blockchain context, making PLS-SEM particularly suitable for theory development and early-stage empirical testing. Together, these characteristics make PLS-SEM an appropriate and widely recommended method for the present study.

Details regarding the operationalization of constructs, measurement procedures and analytical techniques are described in the subsequent sections.

3.2 Research model and hypotheses

To examine how blockchain-related success perceptions translate into overall value assessments, this study develops the conceptual model depicted in Figure 1. The model links perceived relevance, realized benefit improvements and overall perceived blockchain value from a business perspective and provides the structural basis for the subsequent empirical analysis.

Prior research identifies a broad set of blockchain-related success dimensions in supply chains (see Section 2.2). However, including all identified dimensions simultaneously in a single structural equation model would substantially increase model complexity, inflate the number of parameters and reduce statistical power, particularly given the relatively small and specialized population of companies with hands-on blockchain experience. To ensure a parsimonious and empirically robust

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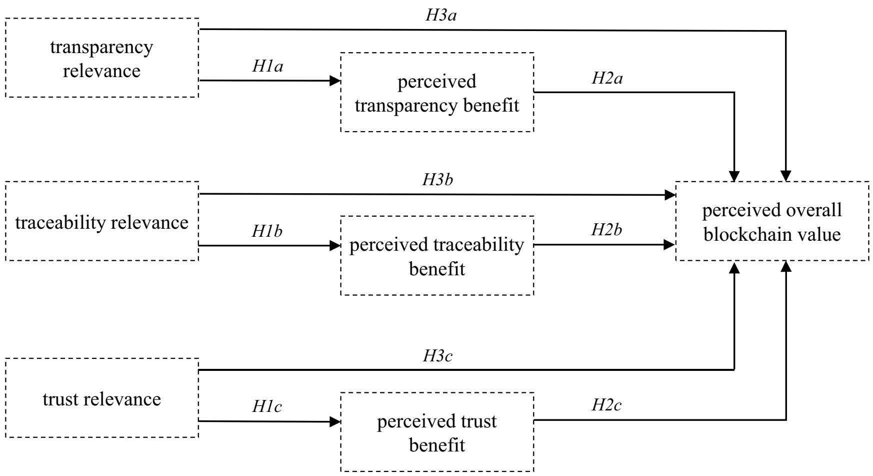
Figure 1 Conceptual research model with hypothesized direct and indirect relationships



model specification, a best–worst scaling (MaxDiff) procedure was therefore conducted prior to the structural analysis to prioritize the relative importance of the identified success dimensions.

MaxDiff requires respondents to repeatedly select the most and least important options within small subsets, enabling the estimation of relative importance scores across all dimensions. Importantly, these scores were used solely for prioritization and dimension selection. They were not used as measurement indicators in the structural equation model. All constructs included in the subsequent PLS-SEM analysis were operationalized using standard multi-item Likert scales. Thus, the structural model relies on reflective measurement rather than formative specifications.

Based on this prioritization step, the three dimensions most consistently perceived as relevant by companies – transparency, traceability and trust – form the basis for the following hypothesis development.

3.2.1 H1: Relevance → Benefit

From a managerial perspective, companies tend to allocate attention and resources to those aspects they consider strategically important. Success dimensions perceived as highly relevant are therefore more likely to be actively addressed during implementation and use, increasing the likelihood that corresponding improvements are realized and perceived. Accordingly, higher perceived relevance is expected to be associated with stronger perceived benefits within the same dimension:

H1a–H1c. The perceived relevance of each success dimension (transparency, traceability, trust) is positively associated with the perceived benefit realized within that same dimension.

3.2.2 H2: Benefit → Overall value

While dimension-specific improvements capture localized effects of blockchain adoption, managerial evaluations are typically formed at a more aggregated level. Overall perceived blockchain value reflects a holistic assessment of whether blockchain adoption is beneficial for the company as a whole. Consequently, stronger perceived improvements within individual dimensions should be reflected in higher overall value perceptions:

H2a–H2c. Perceived benefit improvements in each success dimension are positively associated with overall perceived blockchain value.

3.2.3 H3: Direct effects of relevance on overall value

Beyond indirect effects through realized benefits, relevance perceptions may also exert a direct influence on overall value assessments. Managers may value certain dimensions strategically even when realized improvements are not yet fully observable. To account for this possibility and to enable a test of partial mediation, direct paths from perceived relevance to overall perceived blockchain value are therefore included in the structural model:

H3a–H3c. The perceived relevance of each success dimension is directly associated with overall perceived blockchain value.

3.2.4 H4: Indirect (mediated) effects

Conceptually, the influence of relevance perceptions on overall value is expected to operate primarily through realized benefits. Perceived benefits thus represent the central mechanism through which relevance translates into value creation. Accordingly, the indirect effects of perceived relevance on overall value via dimension-specific perceived benefits are examined:

H4a–H4c. The perceived benefit in each dimension mediates the relationship between perceived relevance and overall perceived blockchain value.

The resulting framework enables the simultaneous examination of relevance perceptions, realized benefits and their direct as well as indirect contributions to overall perceived blockchain value and forms the basis for the subsequent empirical analysis.

3.3 Measurement instruments

The constructs were measured using a structured online questionnaire derived from the theoretical conceptualization developed in Sections 2 and 3. Prior to data collection, the instrument was pretested with academic experts and practitioners to assess clarity, content validity and contextual appropriateness. Based on this feedback, several wording adjustments were made to improve comprehensibility.

All latent constructs were operationalized as reflective measurement models, as the indicators were conceptualized as manifestations of the underlying constructs rather than as formative components.

For each of the blockchain success dimensions identified in the preceding literature review, three items were developed to capture perceived relevance and three corresponding items to capture perceived benefit realization. The items were theory-driven and adapted from prior conceptualizations of digital technology success and SCM performance effects, while being tailored to the specific context of blockchain adoption. Given the emerging nature of blockchain research and the absence of established validated scales for several constructs, the measurement approach should be considered exploratory. Accordingly, the results are intended to provide directional insights and may serve as a foundation for future scale refinement and validation.

Overall perceived blockchain value was measured using multiple reflective items capturing a holistic, company-level evaluation of the business benefits associated with blockchain adoption.

All constructs were measured using seven-point Likert scales ranging from "strongly disagree" to "strongly agree," as such scales provide an appropriate balance between measurement sensitivity and respondent cognitive effort and are widely used in quantitative management research (Hair *et al.*, 2021; Dawes, 2008).

In addition, a best–worst scaling (MaxDiff) instrument was integrated to capture the relative importance of the success dimensions. Respondents repeatedly selected the most and least important dimension within systematically constructed subsets. Importantly, the resulting MaxDiff scores were used exclusively for prioritization and dimension selection and were not incorporated as measurement indicators in the structural equation model.

Key structural characteristics of participating companies were also collected to describe the sample and enable contextual analyses. Due to space constraints, the complete questionnaire and all measurement items are not included in the manuscript but are available from the authors upon request.

3.4 Sample and data collection

Data collection followed a purposive sampling approach, as the number of companies with hands-on blockchain experience in supply chains remains limited and the underlying population is only partially identifiable. The target group comprised companies that had implemented blockchain solutions operationally or conducted pilot projects.

Based on a systematic identification of blockchain adopters from research collaborations, industry reports, professional publications and publicly available sources, a sampling frame of 132 companies was compiled. Relevant contact persons were identified within these organizations and approached individually via professional networking platforms and e-mail. To ensure informed responses, the survey targeted individuals who were directly involved in blockchain-related initiatives within their organizations. Invitations were therefore primarily addressed to professionals working in areas such as SCM, digital transformation, innovation management or IT functions responsible for blockchain implementation or digital supply chain projects. This purposive targeting ensured that respondents were familiar with their organization's blockchain activities and able to assess the perceived relevance and benefits of blockchain adoption.

In total, 448 individuals were contacted. After excluding 27 undeliverable e-mails, 421 invitations were successfully delivered. Of these, 94 respondents initiated the survey (22% response rate). Following data cleaning and the removal of incomplete questionnaires, 42 usable company-level responses remained. In cases where multiple respondents represented the same company, responses were aggregated to the company level to avoid duplication. The final sample thus consists of 41 distinct companies.

Data collection was conducted using a standardized online survey administered via the general data protection regulation (GDPR)-compliant platform SoSci Survey. Participation was voluntary and anonymous, and respondents provided informed consent prior to participation.

Although the final sample size is modest, it reflects the limited population of organizations with practical blockchain experience in supply chains. Such sample sizes are common in emerging-technology contexts where the population of adopting organizations remains limited. Nevertheless, the relatively small sample size requires a cautious interpretation of structural relationships, particularly with regard to nonsignificant effects and limits the statistical generalizability of the results.

3.5 Data preparation

Prior to analysis, the collected data were systematically screened for completeness and response quality. Of the 94 respondents who initiated the survey, 42 cases were excluded due to substantial missing information or largely incomplete questionnaires.

The remaining responses were further assessed for data quality. Ten additional cases were removed due to implausible or nonsubstantive response behavior, including uniform answering across Likert-scale items and disproportionately short completion times indicative of insufficient engagement.

This resulted in 42 valid responses. In one instance, two respondents represented the same company. To avoid double-counting, their responses were aggregated at the company level, yielding a final analytical sample of 41 distinct companies.

Missing values at the item level were rare and showed no systematic pattern. Remaining missing values were treated using mean replacement, applied only to otherwise complete and valid cases.

3.6 Data analysis procedure

Data analysis followed a two-stage procedure. In the first stage, the best–worst scaling (MaxDiff) data were analyzed to derive relative importance scores for the identified blockchain success dimensions. Respondents' best and worst selections were aggregated to calculate standardized importance weights and establish a ranking of dimensions. To determine which dimensions should be included in the structural equation model, the ranked scores were inspected using an elbow-type criterion to identify a natural cutoff between highly prioritized and secondary dimensions. Importantly, the MaxDiff scores were used exclusively for prioritization and dimension selection and were not incorporated as measurement indicators or variables in the subsequent structural equation model.

In the second stage, the relationships between the selected constructs were estimated using PLS-SEM.

To mitigate potential common method bias, several procedural remedies were implemented, including anonymous participation, voluntary responses and the separation of measurement blocks within the questionnaire. In addition, Harman's one-factor test was conducted as a diagnostic statistical check (Podsakoff *et al.*, 2003). Furthermore, full collinearity variance inflation factors (VIFs) were inspected and remained below recommended thresholds, indicating no substantial common method bias.

The measurement model was assessed following established criteria for reflective constructs, including indicator reliability, internal consistency reliability (Cronbach's alpha, rho_A and composite reliability), convergent validity (average variance extracted) and discriminant validity using the heterotrait–monotrait ratio (HTMT). Indicators with insufficient loadings were removed where appropriate, provided that their exclusion improved reliability and validity without altering the conceptual meaning of the constructs (Hair *et al.*, 2021).

Structural model estimation used a bootstrapping procedure with 5,000 resamples. Model evaluation was based on path coefficients and their significance, coefficients of determination (R^2), effect sizes (f^2) and predictive relevance (Q^2). Direct and indirect effects were examined to assess potential mediation relationships.

Additional subgroup analyses were conducted on an exploratory basis to examine potential differences across company characteristics such as industry, company size and the use of complementary technologies.

3.7 Software

The online survey was programmed and administered using the platform SoSci survey. The cleaned data sets were further processed in SPSS and R for descriptive preanalyses and the assessment of missing values. Estimation of the measurement and structural equation models was conducted using SmartPLS 4. Tables describing the sample characteristics as well as the graphical visualization of the MaxDiff results were created using Microsoft Excel.

4. Results

4.1 Sample characteristics

The empirical analysis is based on a final sample of 41 companies that currently use or have previously used blockchain technology in their supply chain processes. The sample is dominated by large organizations, with the majority representing corporations with substantial employee bases and revenues, indicating that blockchain adoption is primarily concentrated among resource-intensive companies.

Participating companies span a broad range of industries, particularly sectors characterized by high transparency, traceability and regulatory requirements, such as food and beverage, automotive and pharmaceutical supply chains. Geographically, the sample shows a strong European focus while still reflecting international participation across North America, Asia and South America.

Most companies operate as manufacturers or suppliers and report several years of blockchain implementation experience, suggesting a relatively mature user base. Blockchain is typically deployed in combination with complementary digital technologies, most notably ERP systems, cloud infrastructures, artificial intelligence (AI) and IoT-based tracking solutions, highlighting its role as an embedded rather than standalone technology.

A detailed overview of the sample composition is provided in Table 2.

4.2 Prioritization of blockchain success dimensions (MaxDiff results)

The MaxDiff analysis reveals a clear prioritization pattern among the considered blockchain success dimensions. Transparency receives the highest relative importance score, closely followed by traceability and trust. These three dimensions stand out distinctly from the remaining dimensions, indicating a strong concentration of perceived relevance among a limited set of core success factors.

A pronounced decline in importance occurs after the third-ranked dimension, whereas subsequent dimensions exhibit comparatively small differences, followed by a second drop among the lowest-ranked dimensions. This stepwise pattern suggests a natural separation between a small group of highly prioritized dimensions and a broader set of secondary and peripheral aspects.

Based on this empirical prioritization, the subsequent analyses focus on the three highest-ranked dimensions – transparency, traceability and trust – which form the basis for the measurement and structural model assessment. The observed elbow pattern serves as a heuristic to identify a natural break in importance scores and to reduce dimensionality. Given the relatively small and specialized sample ($n = 41$), this parsimonious specification was chosen to ensure statistical stability and model interpretability rather than to optimize results in a data-driven manner. Detailed results are reported in Table 3, while Figure 2 visualizes the elbow-type pattern of ranked importance scores.

4.3 Measurement model assessment

The reflective measurement model was evaluated following established PLS-SEM guidelines (Hair *et al.*, 2021). All indicators exhibit satisfactory outer loadings above 0.70, confirming indicator reliability. Internal consistency reliability is supported, as Cronbach's alpha and composite reliability values exceed the recommended threshold of 0.70 for all constructs. Convergent validity is established with AVE values above 0.50, and discriminant validity is confirmed as all HTMT values remain below 0.85 (Henseler *et al.*, 2015). Detailed results are reported in Tables 4 and 5.

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Table 2 Sample characteristics

Category	Item	Frequency	%
Company size	Small business (up to 49 employees)	6	15
	Medium-sized business (50–249 employees)	2	5
	Large business (250–999 employees)	2	5
	Corporation (≥1,000 employees)	31	76
Revenue	<$10M	5	12
	$10–50M	1	2
	$50–250M	2	5
	$250M–1bn	2	5
	>$1bn	29	71
Industry	Automotive industry	5	12
	Mining	2	5
	Chemical industry	1	2
	Retail	1	2
	Wholesale	2	5
	Wood and furniture industry	1	2
	Agriculture and forestry/agribusiness	2	5
	Food and beverage industry	11	27
	Logistics/freight forwarding/transportation	3	7
	Mechanical and plant engineering	3	7
	Metal processing/steel industry	1	2
	Pharmaceutical industry	4	10
	Textile and apparel industry	4	10
	Other	1	2
Country of headquarter	*Australia*	*1*	*2*
	Australia	1	2
	South America	*1*	*2*
	Brazil	1	2
	North America	*9*	*22*
	USA	8	20
	Canada	1	2
	Europe	*28*	*68*
	Belgium	1	2
	Germany	12	29
	England	2	5
	France	1	2
	Italy	2	5
	The Netherlands	1	2
	Austria	3	7
	Sweden	1	2
	Switzerland	4	10
	Spain	1	2
	Asia	*2*	*5*
	Singapore	1	2
	Thailand	1	2
Role in SCM	Distributor/trader	5	12
	Manufacturer	21	51
	Supplier	12	29
	Logistics service provider	3	7
BC deployment	Currently in use	24	59
	Used in the past	17	41
Year of BC implementation	2017	5	12
	2018	7	17
	2019	9	22
	2020	6	15
	2021	8	20
	2022	4	10

(*continued*)

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Table 2

Category	Item	Frequency	%
	2023	1	2
	2024	1	2
Use case	Product traceability and provenance verification	23	56
	Anti-counterfeiting/authenticity verification	9	22
	Sustainability verification	7	17
	Automated contract management (smart contracts)	13	32
	Compliance tracking/certificate management	8	20
	Product status monitoring/monitoring of sensitive goods	9	22
	Collaborative platforms and data spaces	8	20
	Tokenization of goods, components or CO_2 assets	5	12
Complementary technologies	Internet of things (IoT)	23	56
	Artificial intelligence (AI)	29	71
	ERP-systems	41	100
	Cloud technologies	31	76
	Big data and analytics	16	39
	Digital twins	10	24
	RFID/sensor-based tracking technologies	21	51
	other	3	7

Table 3 Prioritization of blockchain success dimensions (MaxDiff results)

Blockchain success dimension	Relative importance (0–100)	Rank	Δ to next
Transparency	100.0	1	−4.1
Traceability	95.9	2	−9.3
Trust	86.6	3	−13.4
Process efficiency	73.2	4	−1.0
Cost efficiency	72.2	5	−1.1
Fraud and counterfeiting prevention	71.1	6	−43.3
Data quality and information availability	27.8	7	−7.2
Sustainability proof	20.6	8	−20.6
Collaboration and contract management	0.0	9	–

Note(s): **Δ** indicates the difference in relative importance to the next lower-ranked success dimension

Figure 2 Elbow criterion based on ranked MaxDiff importance scores

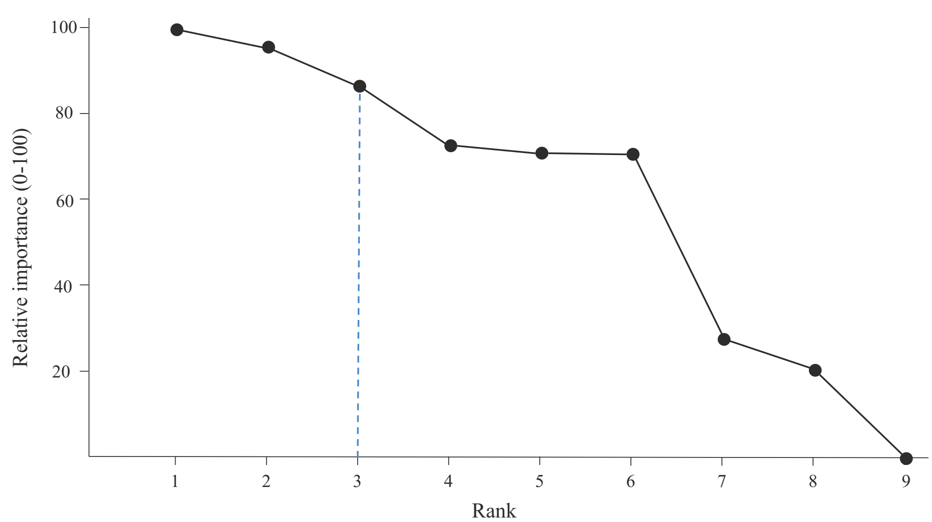

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Table 4 Measurement model assessment (thresholds: loadings ≥ 0.70; Cronbach's $\alpha \geq 0.70$; CR ≥ 0.70; AVE ≥ 0.50)

Construct	Item	Outer loading	Cronbach's α	Composite reliability (CR)	AVE
Transparency relevance	TP_R1	0.966	0.970	0.981	0.944
	TP_R2	0.967			
	TP_R3	0.982			
Perceived transparency benefit	TP_B1	0.913	0.967	0.978	0.938
	TP_B2	0.961			
	TP_B3	0.971			
Traceability relevance	PT_R1	0.985	0.983	0.989	0.968
	PT_R2	0.976			
	PT_R3	0.990			
Perceived traceability benefit	PT_B1	0.984	0.985	0.990	0.970
	PT_B2	0.991			
	PT_B3	0.981			
Trust relevance	TR_R1	0.890	0.865	0.910	0.772
	TR_R2	0.802			
	TR_R3	0.939			
Perceived trust benefit	TR_B1	0.970	0.976	0.984	0.954
	TR_B2	0.980			
	TR_B3	0.980			
Perceived overall blockchain value	OB_1	0.980	0.966	0.978	0.936
	OB_2	0.957			
	OB_3	0.966			

Table 5 Discriminant validity assessment (HTMT < 0.85)

Construct	Transparency relevance	Perceived transparency benefit	Traceability relevance	Perceived traceability benefit	Trust relevance	Perceived trust benefit	Perceived overall blockchain value
Transparency relevance	–						
Perceived transparency benefit	0.586	–					
Traceability relevance	0.625	0.556	–				
Perceived traceability benefit	0.628	0.646	0.775	–			
Trust relevance	0.325	0.233	0.370	0.102	–		
Perceived trust benefit	0.234	0.791	0.322	0.386	0.131	–	
Perceived overall blockchain value	0.497	0.790	0.372	0.549	0.096	0.692	–

4.4 Structural model results

After establishing satisfactory measurement properties, the structural model was estimated using PLS-SEM with bootstrapping (5,000 resamples). The analysis explores the hypothesized relationships between perceived relevance, dimension-specific perceived benefits and overall perceived blockchain value. Before evaluating the structural relationships, potential multicollinearity among predictor constructs was assessed using VIFs. All VIF values were below the recommended threshold of 5 (Hair *et al.*, 2021), with the highest observed value being 4.586, indicating that collinearity does not pose a critical issue in the model.

Figure 3 visualizes the structural relationships and reports the standardized path coefficients and coefficients of determination (R^2) of the endogenous constructs. Detailed numerical results are presented in the following subsections.

4.4.1 Path coefficients and hypotheses testing

Table 6 summarizes the estimated direct effects, including the relevance-benefit relationships (*H1*), the benefit-value relationships (*H2*) and the additionally specified direct relevance-value paths (*H3*).

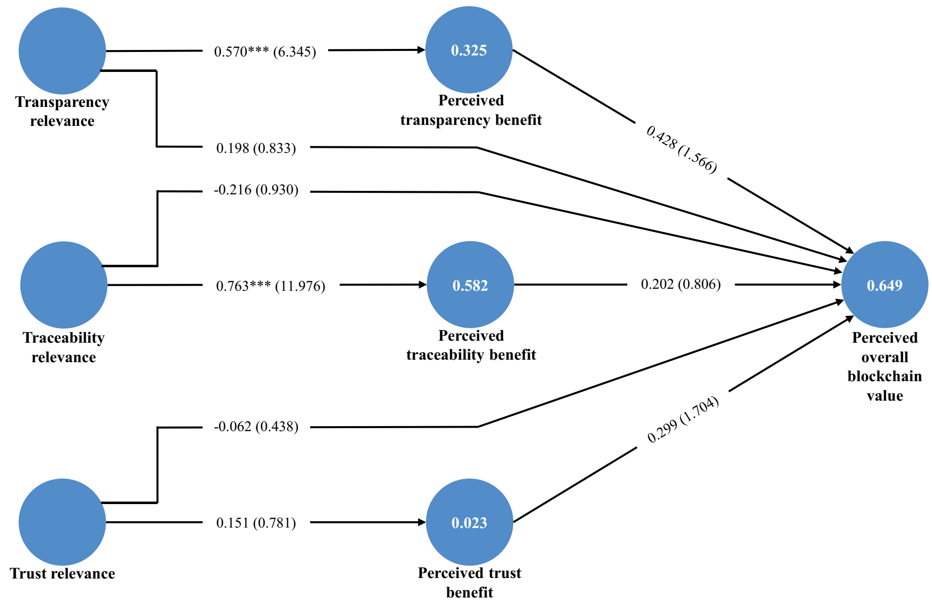
With respect to the relevance-benefit relationships, perceived relevance shows positive and statistically significant effects on perceived benefits for transparency ($\beta = 0.570$, $p < 0.001$) and traceability ($\beta = 0.763$, $p < 0.001$), supporting *H1a* and *H1b*. The effect for trust is not significant ($\beta = 0.151$, $p = 0.435$), resulting in no support for *H1c*.

Regarding the benefit-value relationships, only perceived transparency benefit exhibits a positive effect on overall perceived blockchain value, whereas the effects of traceability and trust benefits remain nonsignificant. Thus, empirical support for *H2* is limited to the transparency dimension.

Direct paths from perceived relevance to overall value are likewise nonsignificant across all dimensions, suggesting that relevance perceptions may not directly translate into aggregated value evaluations within the present sample.

To assess the proposed mediation mechanism, specific indirect effects were examined using bootstrapping. The results, reported in Table 7, show that none of the indirect

Figure 3 Structural model results of perceived blockchain value creation in supply chain management



Note(s): Path coefficients represent standardized estimates (β). Values in parentheses indicate bootstrapped t-values (5,000 subsamples). $p < 0.05$, $^{**}p < 0.01$ and $^{***}p < 0.001$

Table 6 Structural model results (direct effects)

Hypo-thesis	Direct effect (path)	ß (O)	*t*-value	*p*-value	Result
H1a	Transparency relevance → Transparency benefit	0.570	6.345	<0.001	supported
H1b	Traceability relevance → Traceability benefit	0.763	11.976	<0.001	supported
H1c	Trust relevance → Trust benefit	0.151	0.781	0.435	Not supported
H2a	Transparency benefit → Overall perceived blockchain value	0.428	1.566	0.117	Not supported
H2b	Traceability benefit → Overall perceived blockchain value	0.202	0.806	0.420	Not supported
H2c	Trust benefit → Overall perceived blockchain value	0.299	1.704	0.088	Not supported
H3a	Transparency relevance → Overall perceived blockchain value (direct)	0.198	0.833	0.405	Not supported
H3b	Traceability relevance → Overall perceived blockchain value (direct)	−0.216	0.930	0.352	Not supported
H3c	Trust relevance → Overall perceived blockchain value (direct)	−0.062	0.438	0.662	Not supported

Note(s): Standardized path coefficients (β) are reported. t-values are based on bootstrapping (5,000 subsamples)

Table 7 Indirect (mediation) effects

Hypo-thesis	Indirect effect (path)	ß (O)	*t*-value	*p*-value	Mediation supported?
H4a	Transparency relevance → Transparency benefit → Overall perceived blockchain value	0.244	1.407	0.160	Not supported
H4b	Traceability relevance → Traceability benefit → Overall perceived blockchain value	0.154	0.783	0.433	Not supported
H4c	Trust relevance → Trust benefit → Overall perceived blockchain value	0.045	0.587	0.557	Not supported

Note(s): Indirect effects are based on bootstrapping (5,000 subsamples)

effects reach statistical significance, providing no statistical support for the hypothesized mediation relationships.

4.4.2 Explanatory power and effect sizes

Table 8 summarizes the explanatory and predictive performance of the structural model.

The model explains a substantial share of variance in overall perceived blockchain value ($R^2 = 0.649$), while moderate explanatory power is observed for transparency ($R^2 = 0.325$) and traceability benefits ($R^2 = 0.582$). In contrast, trust benefit shows only negligible explanatory power ($R^2 = 0.023$).

Effect size estimates indicate large effects of relevance on the corresponding dimension-specific benefits for transparency ($f^2 = 0.482$) and traceability ($f^2 = 1.394$). By comparison, the effects of benefits on overall value and the direct relevance-value paths are small across all dimensions.

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Table 8 Explanatory power and effect sizes (R^2 and f^2)

Endogenous construct		R^2
Panel A: Explanatory power (R^2)		
Perceived transparency benefit		0.325
Perceived traceability benefit		0.582
Perceived trust benefit		0.023
Perceived overall blockchain value		0.649
Path	f^2	Effect size
Panel B: Effect sizes (f^2)		
Transparency relevance → Transparency benefit	0.482	Large
Traceability relevance → Traceability benefit	1.394	Large
Trust relevance → Trust benefit	0.023	Small
Transparency benefit → Overall value	0.114	Small
Traceability benefit → Overall value	0.034	Small
Trust benefit → Overall value	0.088	Small
Transparency relevance → Overall value	0.051	Small
Traceability relevance → Overall value	0.044	Small
Trust relevance → Overall value	0.008	Small

Note(s): Effect sizes are interpreted following Cohen (2013) and Hair *et al.*, 2021: ≥0.02 = small, ≥0.15 = medium and ≥0.35 = large

To evaluate predictive relevance, recent PLS-SEM guidelines recommend complementing traditional in-sample measures with out-of-sample prediction tests (Shmueli *et al.*, 2016; Hair *et al.*, 2021). Accordingly, predictive performance was assessed using the PLSpredict procedure.

Predictive performance assessed via PLSpredict (ten-fold cross-validation) further indicates out-of-sample relevance (Q^2_predict = 0.426), with lower prediction errors than a linear benchmark model (Shmueli *et al.*, 2016).

Overall, explanatory and predictive power is primarily driven by transparency-related mechanisms, whereas trust contributes only marginally.

4.4.3 Mediation and total effects

To further examine whether the influence of perceived relevance on overall perceived blockchain value operates indirectly through realized benefits, mediation effects were assessed using bootstrapped specific indirect effects. The corresponding results are reported in Table 7.

As shown in Table 7, none of the indirect effects reach statistical significance. Although transparency relevance strongly predicts transparency benefits (*H1a*), the indirect path from transparency relevance via perceived benefits to overall value is not significant. Likewise, no significant indirect effects are observed for traceability or trust.

In addition, the direct paths from perceived relevance to overall perceived blockchain value are nonsignificant for all three dimensions (Table 6). Consequently, neither direct nor indirect relationships provide statistical evidence for mediation within the present sample.

Taken together, the findings indicate that perceived relevance is not associated with statistically significant effects on overall perceived blockchain value within the present sample.

4.5 Exploratory context analyses

To assess the robustness of the main findings and explore potential contextual influences, several exploratory analyses were conducted. Given the small subsample sizes and predominantly ordinal measurement levels, nonparametric procedures were applied throughout.

First, industry differences were examined using Kruskal–Wallis tests. No statistically significant differences were observed in overall perceived blockchain value across industries [$H(13) = 12.71$, $p = 0.470$]. Likewise, the perceived relevance of transparency, traceability and trust did not differ significantly between industry groups. These results suggest that the evaluation of blockchain-related value is broadly consistent across sectors within the present sample.

Second, firm size effects were analyzed using revenue as a proxy and Spearman rank correlations. Firm size is positively associated with overall perceived blockchain value ($\rho = 0.362$, $p = 0.020$) as well as perceived transparency ($\rho = 0.310$, $p = 0.048$) and traceability benefits ($\rho = 0.387$, $p = 0.012$), whereas no significant relationship emerges for trust. Thus, larger companies tend to report somewhat stronger perceived benefits from blockchain adoption.

Finally, the role of complementary technologies was assessed using Mann–Whitney U tests. Companies combining blockchain with AI report significantly higher overall perceived blockchain value ($U = 248.50$, $p = 0.031$). In contrast, no significant differences are observed for IoT usage. ERP systems were not analyzed due to universal adoption within the sample.

Overall, these exploratory checks indicate limited contextual heterogeneity and suggest that the structural relationships identified above are largely stable across industries and technology configurations, while firm size and AI integration may be associated with moderately higher perceived value. Given the limited sample size and small subsample groups, these contextual analyses should be interpreted as exploratory indications rather than as a basis for strong subgroup conclusions. Future research with larger samples could examine such contextual differences more systematically.

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5. Discussion

5.1 Interpretation and synthesis of key findings

A central and somewhat counterintuitive finding of this study is that even the most highly prioritized and widely expected blockchain benefits do not necessarily translate into measurable overall value perceptions within the present sample. Rather than observing uniformly distributed or additive effects, the results reveal a selective and fragmented value logic in which only a few mechanisms contribute to overall evaluations.

Most notably, transparency emerges as the only dimension that consistently contributes to overall perceived blockchain value. Empirically, transparency relevance strongly predicts perceived transparency benefits ($\beta = 0.570$, $p < 0.001$) and these benefits, in turn, exert a significant positive effect on overall perceived blockchain value ($\beta = 0.497$, $p = 0.014$; Table 6). By contrast, neither traceability nor trust shows significant benefit-value relationships. Thus, only transparency exhibits a complete and statistically supported relevance-benefit-value chain.

From a theoretical perspective, this finding suggests that transparency functions as a central value mechanism rather than merely a functional feature. Companies appear to evaluate blockchain primarily based on its ability to enhance informational visibility and decision-relevant data across supply chain processes. In this sense, blockchain is perceived less as a collection of discrete technical capabilities and more as an infrastructural enabler of improved information integration.

Traceability shows a different pattern. While traceability relevance significantly increases perceived traceability benefits ($\beta = 0.763$, $p < 0.001$), these benefits do not translate into higher overall value perceptions ($\beta = 0.131$, n.s.). Hence, traceability seems to create localized or operational improvements without shaping the aggregated evaluation of blockchain adoption. This suggests that frequently cited blockchain capabilities may not automatically function as general value drivers at the firm level.

For trust, no statistically significant effects are observed at any stage of the model. Neither relevance predicts benefit realization nor do trust-related benefits influence overall value. Several explanations may account for this null finding. First, trust-related perceptions may already be implicitly assumed once blockchain technology is implemented, reducing their salience as a differentiating evaluation criterion. Second, the operationalization of trust may capture more general technological or relational confidence rather than distinct performance improvements, limiting its explanatory power. Third, conceptual overlap with transparency-related perceptions may absorb variance that would otherwise be attributed to trust. Taken together, this absence of effects suggests that trust may function more as a baseline or enabling condition than as an independent value driver in managerial evaluations.

Importantly, the mediation analyses provide no evidence for indirect effects of perceived relevance on overall value via perceived benefits (Table 7). Combined with the nonsignificant direct paths, this suggests that relevance perceptions alone are not associated with measurable value perceptions within the present sample. Consequently, the widely assumed logic that strategically important blockchain capabilities naturally aggregate into overall value is not supported by the present exploratory findings. Instead, value creation appears to depend on a limited set of mechanisms most notably transparency.

The exploratory context analyses further suggest that these patterns are largely stable across industries and technology configurations. Only firm size and the joint use of AI show modest associations with higher perceived value, indicating that organizational capabilities and complementary analytics technologies may facilitate the realization of blockchain benefits.

Taken together, the findings indicate that perceived blockchain value in SCM may be concentrated on a limited set of mechanisms rather than distributed across multiple success dimensions. Transparency appears to emerge as a primary driver of value perceptions within the present sample, whereas traceability and trust seem to play more contextual or operational roles.

Given the exploratory research design and the relatively small sample size, these findings should be interpreted as indicative patterns rather than definitive evidence of generalizable blockchain value mechanisms. Future research with larger samples and longitudinal designs will be necessary to further validate and refine these emerging relationships.

5.2 Discussion and theoretical implications

This study set out to examine which blockchain success dimensions are associated with company-level value perceptions in SCM and through which mechanisms such value may emerge. Overall, the findings extend existing blockchain and digital value creation research in several important ways by empirically differentiating the relative contribution of commonly discussed success dimensions rather than treating them as equally beneficial.

First, the results identify transparency as the dominant value driver of blockchain adoption in SCM. While prior studies consistently highlight transparency as a key benefit of blockchain-based systems (e.g. Saberi *et al.*, 2019; Queiroz and Wamba, 2019; Nandi *et al.*, 2021), existing research typically conceptualizes it as one benefit among many. The present findings go beyond this view by demonstrating that transparency is the only dimension that systematically translates into overall perceived blockchain value. Transparency benefits show a significant positive association with company-level value perceptions, whereas other dimensions do not. This suggests that transparency functions not merely as a functional improvement, but as a central evaluative mechanism shaping how companies assess the overall worth of blockchain adoption. In this way, the study contributes to a theoretical prioritization of blockchain success dimensions and highlights the structurally dominant role of information visibility in digital value creation.

Second, the findings refine the role of traceability. Prior research frequently positions blockchain-enabled traceability as a key source of value, particularly in regulated, safety-critical or sustainability-oriented supply chains (e.g. Ghode *et al.*, 2023; Wolf *et al.*, 2024; Jung, 2022). Although traceability relevance strongly predicts dimension-specific perceived benefits in the present study, these improvements do not translate into higher overall value perceptions. This suggests that traceability is primarily perceived as a functional, use-case-specific capability that generates localized operational improvements without materially shaping aggregated company-level evaluations.

Third, the results challenge common assumptions regarding trust as a core rationale for blockchain adoption. Contrary to conceptual arguments that position trust as a primary benefit of distributed ledger technologies (e.g. Treiblmaier, 2018; Rejeb *et al.*, 2021), no statistically significant relationships are observed between trust-related constructs and overall perceived blockchain value. This suggests that trust may operate more as an implicit baseline condition or hygiene factor than as an independent value driver. Once a sufficient level of trustworthiness is assumed, additional trust improvements may not materially influence companies' overall evaluations of blockchain adoption. This finding helps disentangle overlapping conceptualizations of trust, transparency and traceability and contributes to clearer theoretical differentiation among these constructs.

Beyond individual dimensions, the study advances theory by clarifying the mechanisms of blockchain-related value creation. The results show that perceived relevance alone does not automatically translate into higher overall value perceptions. Instead, relevance must first materialize as tangible benefit improvements, which may or may not influence aggregated evaluations. Importantly, even when dimension-specific benefits are realized, only selected dimensions – most notably transparency – contribute meaningfully to company-level value perceptions. This pattern indicates that blockchain value is not the additive sum of multiple benefits but is concentrated on a limited set of particularly influential mechanisms. Accordingly, the study proposes a more selective and mechanism-based understanding of digital technology value creation in SCM.

Finally, these findings complement broader research on IT value creation and digital transformation, which emphasizes that the benefits of digital technologies often arise from improved information quality, visibility and decision support rather than from isolated technical functionalities (e.g. DeLone and McLean, 2003). The dominant role of transparency observed here reinforces this perspective and positions blockchain primarily as an informational and coordination infrastructure rather than as a collection of independent technological features.

Taken together, the study extends prior literature by providing initial empirical indications that blockchain may generate value in supply chains and by suggesting which dimensions appear to be more relevant and through which mechanisms such value may emerge from a company perspective. The key contribution therefore lies in the empirical differentiation and prioritization of blockchain success dimensions and in providing a more fine-grained explanation of how perceived blockchain value is formed.

5.3 Managerial implications

The findings offer several practical implications for companies evaluating or implementing blockchain solutions in SCM. Rather than yielding evenly distributed benefits, blockchain value appears to be selective and potentially concentrated on a small number of high-impact dimensions within the present sample, suggesting that managerial attention should focus on those mechanisms most consistently associated with perceived improvements.

Figure 4 summarizes the central managerial implication of the study by contrasting two strategic approaches to blockchain adoption. A breadth-oriented strategy that attempts to pursue multiple blockchain benefits simultaneously may lead to fragmented value realization and only limited influence on overall company-level value perceptions. In contrast, a depth-oriented strategy that prioritizes a key value driver, particularly transparency, appears more strongly associated with perceived blockchain value in the present sample. Accordingly, managers may benefit from focusing on a limited set of high-impact mechanisms rather than pursuing a large number of loosely connected blockchain use cases.

The proposed roadmap further integrates strategy-specific proxy indicators that managers may use to monitor emerging value effects before standardized performance metrics become available. In doing so, the framework links strategic choice, expected operational outcomes, monitoring mechanisms and scaling decisions, thereby strengthening the practical applicability of the study's findings.

5.3.1 Transparency orientation

Transparency emerges as the most consistently prioritized and value-relevant dimension. Blockchain initiatives should therefore primarily target improvements in information visibility, availability and cross-organizational consistency. Projects that enhance end-to-end transparency and decision support are more likely to be perceived as beneficial than narrowly scoped technical use cases.

5.3.2 Embedded traceability

Although traceability generates operational benefits, these do not automatically translate into higher overall evaluations. Traceability solutions should therefore be embedded in broader quality, compliance or risk management systems rather than implemented as stand-alone documentation tools.

5.3.3 Trust as an enabling condition.

Trust does not act as an independent value driver but appears to function as a baseline requirement. Blockchain adoption should thus be justified by tangible process and information improvements rather than abstract promises of trust creation, while maintaining adequate governance and data quality standards.

5.3.4 Organizational readiness and scale

Larger firms report higher perceived benefits, suggesting that scale, process complexity and resource availability facilitate value realization. Smaller companies may benefit from cooperative or shared-platform approaches.

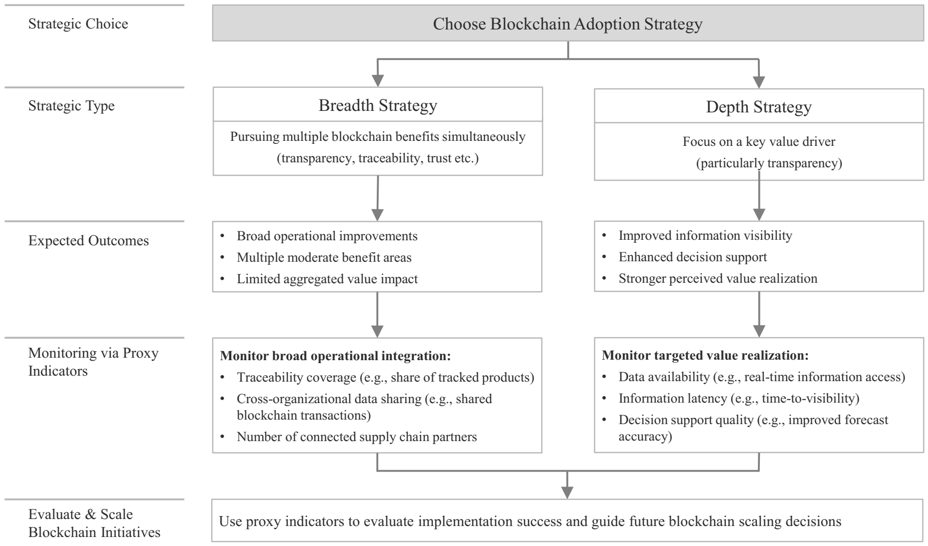
5.3.5 Complementary digital capabilities

Blockchain value appears to be higher when blockchain is combined with analytical technologies such as AI. Accordingly, blockchain should be integrated into a broader data-driven architecture rather than treated as a stand-alone solution.

5.3.6 Monitoring blockchain value through proxy indicators

Because standardized performance indicators for blockchain adoption in supply chains are still evolving, managers may initially rely on proxy indicators to monitor emerging value effects. In particular, transparency-related improvements appear to represent the most consistent mechanism associated

Figure 4 Managerial roadmap for early blockchain value realization



with perceived value in the present study. Accordingly, managers may track indicators such as cross-organizational data availability, information latency across supply chain partners or the consistency of shared transaction records. For traceability-oriented use cases, additional proxy indicators may include tracking coverage across product batches, documentation completeness for compliance reporting or error rates in product provenance verification. Monitoring such operational indicators may provide early signals of blockchain-related value realization before broader firm-level performance effects become visible.

Overall, successful blockchain adoption depends less on the number of implemented use cases than on a focused strategy that prioritizes transparency, embeds traceability and leverages complementary analytics capabilities.

5.4 Limitations and future research

Like all empirical research, this study is subject to several limitations that should be considered when interpreting the findings and that simultaneously indicate promising directions for future research.

First, the analysis is based on a relatively small and specialized sample of companies with hands-on blockchain experience in supply chain contexts. Although the sample size satisfies established requirements for PLS-SEM and is appropriate for exploratory modeling, the generalizability of the findings remains limited. In addition, the relatively small sample size limits the statistical power of the analysis. Accordingly, nonsignificant relationships should be interpreted with caution, as they may reflect limited power rather than the substantive absence of effects. Future research should therefore replicate and extend the proposed model using larger and more heterogeneous samples across industries and regions.

Second, the study relies on a cross-sectional design and perception-based measures. While perceptual constructs are well established in IT value and digital transformation research, they do not allow conclusions about causal or temporal dynamics. Longitudinal studies could examine how perceived benefits and overall value assessments evolve over time as blockchain implementations mature and organizational learning occurs.

Third, the sample includes both companies with ongoing blockchain use and firms that discontinued blockchain initiatives after initial implementation. While this heterogeneity reflects the exploratory and experimental nature of blockchain adoption in practice, it may influence perceived value assessments. Companies that discontinued their initiatives may evaluate benefits more critically or retrospectively, potentially biasing overall value perceptions. Due to the limited sample size, the present study does not differentiate systematically between active and discontinued users. Future research could explicitly examine continuance versus discontinuance decisions and analyze how prior implementation outcomes shape value perceptions over time.

Fourth, several measurement scales were specifically developed and adapted for the blockchain-SCM context. Although pretests and reliability and validity assessments indicate satisfactory measurement quality, the scales have not yet undergone extensive multistudy validation. Future research should therefore refine, validate and replicate these instruments to further strengthen construct robustness and comparability across studies.

Fifth, to ensure parsimony and statistical stability given the limited sample size, the structural model focused on a small number of prioritized success dimensions. Other potentially relevant determinants, such as governance structures, regulatory conditions, ecosystem maturity or organizational capabilities, were not explicitly modeled. Future studies could extend the framework by incorporating additional predictors as well as moderation or more complex mediation effects to better capture contextual contingencies of blockchain value creation.

Finally, the present analysis primarily addresses perceived value outcomes. Complementing perceptual assessments with objective performance indicators (e.g. process costs, lead times, error rates or service levels) would allow a more comprehensive evaluation of blockchain's economic impact and help link perceived benefits to measurable operational improvements.

Taken together, these avenues suggest that future research should combine larger samples, longitudinal designs, validated measurement instruments and extended model specifications to further advance the empirical understanding of blockchain-related value creation in supply chains.

6. Conclusion

This study set out to examine how companies evaluate the value of blockchain adoption in SCM and which success dimensions actually translate into higher-level company value perceptions. By combining a best–worst scaling prioritization with partial least squares structural equation modeling, the study provides an empirically grounded assessment of the mechanisms underlying perceived blockchain value.

The findings suggest that blockchain-related value perceptions are selective rather than evenly distributed across commonly discussed benefit dimensions. While transparency and traceability are perceived as strategically relevant and associated with dimension-specific benefits, these improvements do not automatically translate into higher overall value assessments. Direct and indirect effects on overall perceived value remain largely nonsignificant, suggesting that localized operational benefits alone may be insufficient to shape aggregated company-level evaluations within the present sample. Instead, perceived blockchain value appears to depend on broader organizational and technological conditions, including firm size and the presence of complementary analytical capabilities.

These results contribute to the blockchain-SCM literature by moving beyond the identification of potential benefit categories toward an empirical differentiation of which dimensions matter most and which do not. In doing so, the study shifts the focus from "whether" blockchain creates value to "through which mechanisms and under which conditions" such value is perceived.

Overall, the findings suggest that successful blockchain adoption in supply chains may depend on a deliberate focus on high-impact information mechanisms and complementary capabilities rather than a proliferation of isolated use cases. However, these conclusions should be interpreted as exploratory indications rather than definitive prescriptions, given the limited sample size and the exploratory nature of the study.

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