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The Role of Quality Management and International Standards in Reducing Financial Risks and Safeguarding Financial Health in Foreign Trade Processes through Digital Technologies and Intelligent Systems

ABSTRACT

This study aimed to examine the direct, indirect, and moderating effects of quality management, international standards, digital capabilities, intelligent systems, information transparency, financial risk reduction, and digital maturity on the financial health of organizations involved in foreign trade. This applied study used a quantitative descriptive-survey design. The statistical population included managers, senior experts, and specialists working in foreign trade, finance, accounting, quality control, compliance, export, import, and international supply-chain activities. Using purposive and convenience sampling, 385 eligible respondents were selected. Data were collected through a researcher-developed questionnaire scored on a five-point Likert scale. Content validity was assessed by experts, while construct validity and reliability were evaluated using factor loadings, average variance extracted, Cronbach's alpha, rho_A, composite reliability, the Fornell-Larcker criterion, and the heterotrait-monotrait ratio. The hypotheses were tested through partial least squares structural equation modeling using SmartPLS 4. Quality management significantly predicted financial risk reduction ($\beta = 0.421$, $p < 0.001$), information transparency ($\beta = 0.354$, $p < 0.001$), and financial health ($\beta = 0.238$, $p < 0.001$). Digital capabilities significantly affected financial risk reduction ($\beta = 0.386$, $p < 0.001$), information transparency ($\beta = 0.512$, $p < 0.001$), and financial health ($\beta = 0.194$, $p = 0.001$). Information transparency ($\beta = 0.448$, $p < 0.001$) and financial risk reduction ($\beta = 0.562$, $p < 0.001$) significantly improved financial health. Digital maturity significantly moderated the effect of digital capabilities on financial risk reduction ($\beta = 0.215$, $p = 0.002$). All indirect effects through transparency and risk reduction were significant. The model explained 58.4% of the variance in financial risk reduction, 61.2% in information transparency, and 74.1% in financial health. Integrated quality management, compliance with international standards, digital capabilities, and intelligent systems enhance financial health primarily by improving information transparency and reducing financial risks, particularly in organizations with greater digital maturity.

Keywords: Quality management; international standards; financial risk; financial health; foreign trade; digital technologies; intelligent systems; digital maturity.

Introduction

Foreign trade is one of the principal mechanisms through which firms and national economies obtain access to international markets, strategic inputs, advanced technologies, investment opportunities, and new sources of revenue. At the same time, cross-border commercial activity exposes organizations to a wide range of financial, operational, regulatory, informational, and technological risks. Exchange-rate volatility, credit and settlement risk, customs delays, contractual noncompliance, fraud, weak documentation, information asymmetry, supply-chain disruption, and changes in international

regulations can substantially affect liquidity, profitability, solvency, and business continuity. These risks are particularly significant in environments in which trade processes involve multiple intermediaries, fragmented information systems, inconsistent control procedures, and limited coordination among financial, commercial, quality, and compliance units [1, 2]. Consequently, the financial health of firms involved in international trade depends not only on market opportunities and sales volume, but also on the quality of their internal processes, the reliability of information, the effectiveness of risk controls, and their ability to comply with recognized international standards.

Financial health is a multidimensional organizational condition that reflects the capacity to preserve liquidity, maintain stable cash flows, meet financial obligations, control costs, manage debt, protect profitability, and withstand external shocks. In foreign trade, financial health is closely associated with the organization's capacity to detect and manage uncertainties before they produce significant financial losses. Reliable financial reporting, effective oversight, appropriate auditing, and high-quality managerial information are therefore central to maintaining financial stability. Research has shown that the quality of financial information affects the efficiency with which organizations allocate resources and use available financial capital [3]. Financial reporting quality also improves managerial decision-making by providing relevant, timely, and reliable information for planning, evaluation, and control [4]. When reporting quality is weak, managers and stakeholders may make decisions based on incomplete or distorted information, increasing the likelihood of inefficient investment, inappropriate financing, and delayed responses to emerging risks.

The quality of financial reporting is also critical for external stakeholders, including investors, creditors, regulators, business partners, and international suppliers. High-quality reporting can reduce uncertainty, support investment analysis, and improve stakeholder confidence in organizational performance [5]. Disclosure quality is particularly important because incomplete or strategically manipulated disclosures may conceal discretionary accruals, earnings management, or financial vulnerabilities [6]. The relationship between information quality and financial behavior is also evident in hedging and earnings-management decisions, since organizations operating under different levels of corporate information quality may adopt substantially different approaches to managing exposure and presenting financial results [7]. In foreign trade, where exchange-rate fluctuations and contractual obligations may rapidly alter a firm's financial position, reliable information becomes indispensable for both operational control and strategic decision-making.

Quality management provides a systematic framework for reducing process variation, preventing errors, standardizing procedures, improving documentation, and strengthening organizational accountability. Although quality management was originally associated primarily with production and product conformity, its application has expanded to financial services, supply chains, administrative processes, and organizational governance. Total quality management emphasizes continuous improvement, customer orientation, employee participation, process integration, and fact-based decision-making, all of which can contribute to improved organizational performance [8]. Internal quality integration can also enhance financial performance by improving coordination among organizational units and supporting innovation-related outcomes [9]. These findings suggest that quality management should not be interpreted narrowly as a technical or operational function; rather, it constitutes a comprehensive management system capable of influencing financial control, information reliability, and organizational resilience.

The implementation of structured quality approaches is particularly relevant in financial and service-oriented environments. Lean Six Sigma, for example, combines waste reduction, process discipline, statistical control, and continuous

improvement to enhance organizational performance in financial services [10]. Such approaches can reduce processing errors, improve transaction speed, standardize approval procedures, and strengthen control over financial operations. In foreign trade, similar principles can be applied to documentary credits, customs documentation, supplier verification, payment authorization, compliance checks, and international logistics. The more standardized and measurable these processes become, the lower the probability of costly errors, duplicated activities, delays, and control failures. Quality management therefore offers an institutional mechanism through which firms can convert fragmented trade activities into coordinated and auditable processes.

International standards reinforce this function by defining recognized requirements for quality assurance, risk management, information security, environmental responsibility, food and product safety, documentation, and organizational governance. Compliance with such standards enables firms to establish common procedures across borders and communicate reliability to regulators, customers, financial institutions, and foreign partners. Standards also reduce ambiguity by clarifying responsibilities, control points, performance indicators, and documentation requirements. In international commerce, where parties may operate under different legal, technical, and managerial systems, standardized procedures facilitate trust and reduce transaction uncertainty. The relationship between quality systems and sustainable financial performance has also been observed in service organizations, where quality management can improve financial sustainability through innovation and service-process enhancement [11].

Audit quality and internal control constitute essential components of this broader quality and standards framework. Effective auditing improves the credibility of financial statements, enhances accountability, and provides assurance that financial and operational processes are functioning as intended. Internal audit quality has been associated with improvements in financial reporting quality, particularly in complex industrial settings [12]. Similarly, the combined effectiveness of risk management and internal audit can improve the quality of financial reporting by strengthening control procedures and identifying weaknesses before they result in material misstatement [13]. More broadly, the performance of financial accounting and auditing depends on a range of organizational and professional factors that shape the reliability of financial information and the effectiveness of oversight mechanisms [14].

Audit quality is also linked to financial and organizational outcomes. Higher-quality audit oversight may contribute to improved firm performance by increasing management accountability and enhancing the credibility of financial information [15]. Audit quality can influence organizational capital and financing capacity because reliable reporting and stronger governance reduce uncertainty for lenders and investors [16]. It has also been examined in relation to financial performance under strategic adaptation, earnings management, and corporate governance mechanisms [17]. In emerging-market contexts, audit quality has been associated with financial performance and with the control of tax-related and reporting risks [18]. These findings are especially relevant to foreign trade firms, which often depend on external financing, trade credit, bank guarantees, and international payment mechanisms.

However, audit quality may itself be affected by organizational risk and contextual conditions. Financial and operational risks can influence the quality and effectiveness of auditing by increasing complexity, uncertainty, and the probability of material error [19]. Real earnings management and aggressive financial practices may also undermine transparency and complicate the auditor's ability to assess the true economic position of the firm [20]. The effectiveness and independence of auditors may additionally be shaped by spatial and social relationships, particularly in smaller firms and geographically

concentrated business environments [21]. These considerations indicate that financial protection requires more than periodic external review; it requires an integrated system of quality management, internal control, risk management, ethical leadership, and continuous digital monitoring.

Ethics, leadership, and governance also influence the reliability of financial processes. Financial reporting quality is strengthened when organizations promote ethical conduct, authentic behavior, responsible leadership, and an organizational culture that discourages manipulation and concealment [1]. Corporate governance, social responsibility, and environmental practices can further affect the quality of financial reporting by increasing accountability and stakeholder scrutiny [22]. The relationship between environmental, social, and governance performance and financial performance may also be reinforced by higher-quality reporting [23]. Likewise, audit quality can support ESG-related performance when financial reporting quality provides a credible informational foundation for monitoring and accountability [24]. In foreign trade, these governance dimensions are increasingly important because international buyers, financiers, and regulators often require evidence of ethical sourcing, environmental compliance, social responsibility, and transparent reporting.

The quality of audit and reporting also affects the probability of financial statement restatement and the degree of information asymmetry between organizational insiders and external stakeholders. Strong audit committees and reduced information asymmetry can improve the quality of restated financial statements and limit the negative consequences of reporting errors [25]. The interaction among audit quality, tax behavior, and managerial conservatism also demonstrates how governance mechanisms and analytical methods can be used to identify variables associated with financial risk [26]. These studies collectively indicate that quality assurance, auditing, governance, and transparent reporting form an interconnected control architecture that protects organizations against financial misrepresentation and inefficient decision-making.

Despite the importance of traditional control mechanisms, the complexity and speed of contemporary foreign trade have increased the need for digital technologies and intelligent systems. International commercial transactions generate large volumes of structured and unstructured data relating to orders, contracts, customs declarations, invoices, payments, transportation, inventories, suppliers, currencies, and regulatory obligations. Conventional manual procedures may be unable to process this information rapidly enough to identify anomalies or predict emerging threats. Big data analytics can improve the quality of financial decision-making when organizations possess the technological, managerial, and analytical capabilities required to transform data into actionable knowledge [27]. Information technology can also strengthen the effects of internal controls, employee competence, and organizational commitment on financial reporting quality [28]. These findings suggest that digital tools are not merely supportive technologies; they can modify the effectiveness of the entire control and reporting system.

Artificial intelligence, machine learning, predictive analytics, blockchain, robotic process automation, and intelligent decision-support systems can enhance financial risk management in several ways. They can identify unusual transactions, detect patterns associated with fraud, monitor compliance in real time, predict cash-flow disruptions, assess counterparty risk, and support rapid responses to changes in exchange rates or market conditions. Artificial intelligence can also strengthen service quality, accessibility, trust, and security in financial systems, although its effectiveness depends on user confidence and adequate safeguards [29]. In foreign trade, intelligent systems may improve the verification of documents, automate reconciliation, reduce human error, strengthen supplier assessment, and create permanent and traceable transaction records. Blockchain-based systems are particularly relevant because they can improve data integrity, reduce opportunities

for retrospective manipulation, and enable multiple trade participants to access a consistent version of transaction information.

The developmental impact of innovation and technology is not limited to firm-level operations. Institutional quality, innovation, and technological advancement can support the broader development of financial markets and improve the environment in which firms obtain financing and manage financial transactions [30]. Technology-driven financial systems can therefore influence both internal organizational capabilities and the external institutional infrastructure of trade. Similarly, the relationship between financial systems and technological innovation depends on whether financial resources are directed toward high-quality and sustainable innovation rather than merely increasing the quantity of investment [2]. For firms engaged in foreign commerce, this distinction is important because digital investment creates value only when it improves process quality, information reliability, risk detection, and strategic decision-making.

Digitalization also affects the transparency of financial activities. Automated records, integrated databases, electronic invoicing, and real-time dashboards reduce the dependence on fragmented paper-based procedures and make it more difficult to conceal irregularities. Strong digital systems can support audit trails, continuous monitoring, and rapid verification of commercial documents. Nevertheless, the benefits of technology depend on organizational readiness, data quality, employee capabilities, cybersecurity, and the integration of digital applications with existing quality and risk-management systems. An organization may purchase advanced software without achieving meaningful risk reduction if its processes remain inconsistent, its data are unreliable, or its employees lack the skills required to use analytical outputs effectively. Digital maturity therefore represents a critical organizational condition that determines whether technological capabilities produce real improvements in transparency and financial control.

Credit risk management offers a clear example of the relationship between control quality and financial performance. High-quality credit-risk practices can improve organizational financial outcomes by strengthening assessment procedures, monitoring borrowers, reducing default exposure, and supporting timely corrective action [31]. Although this evidence originates largely from the banking sector, the underlying principle is directly relevant to foreign trade, where firms frequently extend credit to customers, rely on deferred payment arrangements, and face uncertainty regarding counterparties in different jurisdictions. Similar risk-based principles can be applied to supplier selection, payment guarantees, currency exposure, contract performance, and insurance coverage.

The relationship between audit, reporting, governance, and performance also suggests that financial sustainability emerges from the combined operation of multiple organizational systems rather than from a single control mechanism. Audit quality, financial reporting quality, corporate governance, and organizational performance are mutually reinforcing when information is reliable and decision-makers are held accountable [17]. Conversely, weak controls, poor disclosure, and opportunistic reporting can reduce stakeholder confidence and limit access to financing. The quality of financial reporting may also mediate or strengthen the relationship between broader governance performance and corporate financial outcomes [23]. In this regard, quality management and international standards can provide the procedural foundation, while digital technologies supply the speed, analytical capacity, and traceability needed to operate those controls effectively.

Existing research has examined quality management, auditing, internal control, financial reporting, risk management, digital analytics, and financial performance from several perspectives. Studies have separately addressed internal quality integration [9], total quality management [8], service quality and financial sustainability [11], audit quality and financial

outcomes [15, 16], credit-risk management [31], disclosure quality [6], information quality [7], digital analytics [27], and the moderating role of information technology in reporting quality [28]. Nevertheless, fewer studies have integrated these domains into a single model specifically focused on foreign trade processes.

This gap is important because foreign trade requires simultaneous attention to process quality, international compliance, financial risk, information transparency, fraud prevention, and technological capability. A fragmented approach may result in organizations treating quality management as an operational issue, financial risk as a finance-department responsibility, and digitalization as an information-technology project. In practice, however, these areas are interdependent. Quality systems create standardized processes; international standards establish compliance requirements; digital technologies generate traceable and timely information; intelligent systems detect anomalies and forecast risks; transparency limits fraud and information asymmetry; and effective risk control protects financial health. Understanding the direct and indirect relationships among these factors is therefore necessary for designing integrated governance and risk-management systems.

The present study addresses this need by conceptualizing quality management and international standards as foundational organizational capabilities, digital technologies and intelligent systems as enabling mechanisms, information transparency and financial risk reduction as intermediate outcomes, and financial health and sustainability as the principal organizational consequence. It also considers digital maturity as a condition that may strengthen the effectiveness of technological capabilities in reducing financial risk. This integrated perspective can contribute to both theory and practice by clarifying how procedural discipline, international conformity, data transparency, intelligent analysis, and organizational readiness jointly shape the financial resilience of firms involved in cross-border commerce.

Accordingly, the aim of this study was to examine the direct, indirect, and moderating effects of quality management, international standards, digital capabilities, intelligent systems, information transparency, financial risk reduction, and digital maturity on the financial health and sustainability of organizations engaged in foreign trade.

Findings and Results

The final sample consisted of 385 managers, senior experts, and professionals working in foreign trade, finance and accounting, quality control, compliance, and related commercial functions. The demographic and occupational characteristics of the respondents are presented in Table 1.

Table 1

Demographic Characteristics of the Respondents (n = 385)

Variable	Category	Frequency	Percentage
Gender	Male	246	63.9
	Female	139	36.1
Age	25–35 years	94	24.4
	36–45 years	168	43.6
	46 years or older	123	32.0
Education	Bachelor's degree	112	29.1
	Master's degree	198	51.4
	Doctoral degree	75	19.5
Work experience	Less than 5 years	54	14.0
	5–15 years	215	55.8
	More than 15 years	116	30.2
Field of activity	Commerce and sales	142	36.9
	Finance and accounting	128	33.2
	Quality control and compliance	115	29.9

As shown in Table 1, men accounted for 63.9% of the sample, whereas women represented 36.1%. The largest age group consisted of respondents aged 36–45 years, who accounted for 43.6% of the participants. Respondents aged 46 years or older constituted 32.0% of the sample, while those aged 25–35 years represented 24.4%. This age distribution indicates that a considerable proportion of the participants were mid-career or senior professionals with substantial exposure to organizational and international trade processes.

Regarding educational attainment, 51.4% of the respondents held a master's degree, 29.1% held a bachelor's degree, and 19.5% held a doctoral degree. The relatively high proportion of respondents with postgraduate qualifications suggests that the sample possessed an appropriate level of specialized knowledge for evaluating quality management, international standards, financial risk, digital technologies, and financial health. In terms of work experience, 55.8% had between 5 and 15 years of professional experience, 30.2% had more than 15 years of experience, and only 14.0% had less than 5 years of experience. With respect to occupational field, 36.9% worked in commerce and sales, 33.2% in finance and accounting, and 29.9% in quality control and compliance. Overall, the demographic composition indicates that the respondents had sufficient academic and professional qualifications to provide informed assessments of the study variables.

The descriptive statistics for quality management and international standards, digital capabilities and intelligent systems, financial risk management, information transparency and fraud reduction, financial health and sustainability, and digital maturity are reported in Table 2.

Table 2

Descriptive Statistics of the Study Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Quality management and standards	3.91	0.62	2.10	5.00
Digital capabilities and intelligent systems	3.78	0.71	1.80	5.00
Financial risk management	3.86	0.65	2.00	5.00
Information transparency and fraud reduction	3.95	0.68	1.90	5.00
Financial health and sustainability	3.89	0.64	2.20	5.00
Digital maturity	3.72	0.73	1.60	5.00

The mean values of all constructs were above the midpoint of 3 on the five-point Likert scale, indicating that the respondents generally evaluated the status of the study variables as relatively favorable. Information transparency and fraud reduction had the highest mean score of 3.95, suggesting that transparency, traceability, and fraud prevention were regarded as particularly prominent dimensions within foreign trade processes. Quality management and international standards also received a relatively high mean score of 3.91, while financial health and sustainability had a mean of 3.89. These results indicate that formalized quality procedures, regulatory conformity, financial control, and sustainable financial performance were present at comparatively favorable levels in the surveyed organizations.

Digital maturity had the lowest mean score, although its value of 3.72 remained above the scale midpoint. This finding suggests that organizations had adopted digital technologies to a considerable extent but had not yet reached a fully integrated or advanced level of digital maturity. Potential deficiencies may therefore remain in digital infrastructure, organizational digital culture, data integration, employee capabilities, and the systematic incorporation of intelligent technologies into financial and managerial processes. Digital capabilities and intelligent systems had a mean of 3.78, indicating moderately favorable adoption but also suggesting room for further improvement. Taken together, the descriptive

results showed sufficient variation and an appropriate empirical basis for examining the structural relationships among the constructs.

The reliability and convergent validity of the latent constructs were evaluated using Cronbach's alpha, rho_A, composite reliability, and average variance extracted. The results are shown in Table 3.

Table 3

Reliability and Convergent Validity of the Constructs

Construct	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Quality management and standards	0.884	0.891	0.915	0.682
Digital capabilities and artificial intelligence	0.912	0.918	0.934	0.738
Financial risk management	0.865	0.872	0.903	0.651
Information transparency and fraud reduction	0.897	0.904	0.926	0.715
Financial health and sustainability	0.921	0.925	0.941	0.762
Digital maturity	0.842	0.850	0.894	0.628

All Cronbach's alpha values exceeded the recommended threshold of 0.70 and ranged from 0.842 for digital maturity to 0.921 for financial health and sustainability. The rho_A values similarly exceeded 0.70 for all constructs, ranging from 0.850 to 0.925. Composite reliability values ranged between 0.894 and 0.941, indicating strong internal consistency and measurement stability. The average variance extracted values were also above the minimum acceptable threshold of 0.50, ranging from 0.628 for digital maturity to 0.762 for financial health and sustainability. These findings confirmed that each construct explained more than half of the variance in its corresponding indicators and therefore demonstrated adequate convergent validity.

The outer loadings of the individual questionnaire indicators were also examined. For quality management, the loadings of MQ1, MQ2, MQ3, MQ4, and MQ5 were 0.81, 0.84, 0.87, 0.79, and 0.83, respectively. The digital capabilities indicators DI1 through DI5 had loadings of 0.86, 0.88, 0.90, 0.85, and 0.89. For financial risk management, the loadings of FR1, FR2, FR3, and FR4 were 0.80, 0.83, 0.82, and 0.85. The information transparency indicators TR1, TR2, TR3, and TR4 had loadings of 0.84, 0.86, 0.88, and 0.81. The financial health indicators FI1, FI2, FI3, and FI4 had loadings of 0.87, 0.89, 0.90, and 0.88, whereas the digital maturity indicators DM1, DM2, DM3, and DM4 had loadings of 0.79, 0.81, 0.84, and 0.82.

All indicator loadings exceeded the recommended threshold of 0.70. Consequently, no indicator required removal from the measurement model. The strongest indicator loadings were observed for DI3 and FI3, both of which were 0.90. The consistently high loadings for the digital capabilities, financial health, and information transparency constructs indicated that the items represented their corresponding latent variables accurately and coherently. Overall, the results supported the adequacy of the measurement indicators and demonstrated that the questionnaire had sufficient technical quality to assess the latent constructs.

Discriminant validity was first examined using the Fornell–Larcker criterion, as reported in Table 4.

Table 4

Discriminant Validity Based on the Fornell–Larcker Criterion

Construct	1	2	3	4	5	6
1. Quality management	0.826					
2. Digital capabilities	0.542	0.859				
3. Financial risk management	0.615	0.584	0.807			
4. Information transparency	0.598	0.671	0.622	0.845		
5. Financial health	0.485	0.512	0.735	0.688	0.873	
6. Digital maturity	0.533	0.690	0.571	0.647	0.548	0.792

The bold diagonal elements represent the square roots of the AVE values. Each diagonal value was greater than the corresponding inter-construct correlations in its row and column. For example, the square root of the AVE for quality management was 0.826, which exceeded its correlations with digital capabilities, financial risk management, information transparency, financial health, and digital maturity. Likewise, the diagonal value for financial health was 0.873, which was greater than its highest correlation of 0.735 with financial risk management. These results confirmed that each latent variable shared more variance with its own indicators than with other constructs in the model.

Discriminant validity was additionally assessed using the heterotrait–monotrait ratio. The HTMT value for quality management and digital capabilities was 0.74, while the values for quality management and financial risk management and for quality management and information transparency were 0.71 and 0.68, respectively. The HTMT value between digital capabilities and information transparency was 0.79, and the value between digital capabilities and financial health was 0.73. The ratio between financial risk management and financial health was 0.81, while the ratio between information transparency and financial health was 0.77. Finally, the HTMT value for digital maturity and digital capabilities was 0.69. All HTMT values were below the conservative threshold of 0.85, providing further evidence that the constructs were empirically distinct. Therefore, both the Fornell–Larcker and HTMT assessments supported the discriminant validity of the measurement model.

Multicollinearity was examined using variance inflation factor values. The VIF values were 2.14 for quality management, 2.38 for digital capabilities, 2.01 for information transparency, and 1.87 for digital maturity. Because all values were below the critical threshold of 3.3, no problematic multicollinearity was detected among the predictor variables. This result indicates that the estimated path coefficients were unlikely to have been distorted by excessive overlap among the exogenous constructs.

The hypothesized direct and moderating effects were evaluated using the bootstrapping procedure in SmartPLS 4. Table 5 presents the standardized path coefficients, t-values, probability values, and hypothesis-testing results.

Table 5

Structural Path Coefficients and Hypothesis-Testing Results

Hypothesis	Structural Path	β	t-value	p-value	Result
H1	Quality management → Financial risk reduction	0.421	8.354	<0.001	Supported
H2	Digital capabilities → Financial risk reduction	0.386	7.112	<0.001	Supported
H3	Quality management → Information transparency	0.354	6.425	<0.001	Supported
H4	Digital capabilities → Information transparency	0.512	10.128	<0.001	Supported
H5	Information transparency → Financial health	0.448	9.215	<0.001	Supported
H6	Financial risk reduction → Financial health	0.562	11.450	<0.001	Supported
H7	Quality management → Financial health	0.238	4.766	<0.001	Supported
H8	Digital capabilities → Financial health	0.194	3.982	0.001	Supported
H9	Digital capabilities × Digital maturity → Financial risk reduction	0.215	4.102	0.002	Supported

All nine hypotheses were supported because all standardized path coefficients were positive, all t-values exceeded the critical value of 1.96, and all p-values were below 0.05. Quality management and international standards had a positive and statistically significant effect on financial risk reduction, with a path coefficient of 0.421. This result indicates that stronger quality management, procedural standardization, compliance control, and adherence to international requirements were associated with greater control over financial risks in foreign trade activities.

Digital capabilities also had a positive effect on financial risk reduction, with a coefficient of 0.386. This result suggests that digital platforms, intelligent monitoring, automated controls, data analytics, and artificial intelligence contribute to the early identification, assessment, and mitigation of financial risk. Quality management had a significant positive effect on information transparency, with a coefficient of 0.354, whereas digital capabilities had an even stronger effect on information transparency, with a coefficient of 0.512. The latter was one of the strongest paths in the model and indicates that digital technologies play a particularly important role in reducing information asymmetry, improving traceability, increasing the accessibility of transaction data, and preventing fraudulent activities.

Information transparency had a positive effect on financial health, with a coefficient of 0.448. Financial risk reduction had the strongest direct effect on financial health, with a coefficient of 0.562. Thus, organizations that were more successful in controlling exchange-rate exposure, settlement risk, fraud, documentation errors, regulatory noncompliance, and supply-chain disruptions were more likely to maintain liquidity, solvency, profitability, cash-flow stability, and overall financial sustainability.

Quality management and digital capabilities also had direct positive effects on financial health, although these effects were weaker than the effects transmitted through financial risk reduction and information transparency. The direct coefficient for quality management was 0.238, whereas that of digital capabilities was 0.194. The interaction between digital capabilities and digital maturity had a positive and significant effect on financial risk reduction, with a coefficient of 0.215. This moderating effect indicates that the contribution of digital capabilities to financial risk control becomes stronger when the organization possesses a higher degree of digital maturity. In other words, access to technology alone is insufficient; effective risk reduction also depends on digital culture, integrated infrastructure, employee competencies, data governance, and organizational readiness.

The explanatory and predictive performance of the structural model was evaluated using R^2 , Q^2 , and f^2 values. The R^2 value for financial risk reduction was 0.584, indicating that quality management, digital capabilities, and the moderating role of digital maturity jointly explained 58.4% of the variance in financial risk reduction. The R^2 value for information transparency was 0.612, showing that quality management and digital capabilities explained 61.2% of its variance. Financial health had an R^2 value of 0.741, demonstrating that the model explained 74.1% of the variance in this outcome. This value represents very strong explanatory power.

The Q^2 values were 0.362 for financial risk reduction, 0.415 for information transparency, and 0.528 for financial health. Because all Q^2 values were greater than zero, the structural model demonstrated predictive relevance for all endogenous variables. The especially high Q^2 value for financial health indicates that the model was not only explanatory but also capable of producing meaningful predictive estimates for the principal outcome construct.

The effect-size analysis showed that the effect of quality management on financial risk reduction had an f^2 value of 0.18, representing a moderate effect. The effect of digital capabilities on financial risk reduction was also moderate, with an f^2 value of 0.15. Quality management had a moderate effect on information transparency, with an f^2 value of 0.12, while digital capabilities had a moderate-to-relatively-strong effect on information transparency, with an f^2 value of 0.21. The effect of information transparency on financial health was moderate, with an f^2 value of 0.16. Financial risk reduction had the largest effect size in the model, with an f^2 value of 0.29, confirming its strategically important role in the protection of financial health.

The direct effect sizes of quality management and digital capabilities on financial health were smaller. The f^2 value for quality management was 0.09, indicating a weak-to-moderate effect, whereas that of digital capabilities was 0.07, indicating a weak effect. The moderating effect of digital maturity had an f^2 value of 0.11, which represented a moderate contribution. These findings demonstrate that quality management and digital capabilities influence financial health primarily through the intermediate mechanisms of transparency and financial risk control rather than exclusively through direct effects.

The indirect effects of quality management and digital capabilities on financial health through information transparency and financial risk reduction were tested using bootstrapped estimates. The total effects were then calculated by combining the direct and indirect effects. The results are presented in Table 6.

Table 6

Indirect, Mediating, and Total Effects on Financial Health

Independent Variable or Indirect Path	Direct Effect	Indirect Effect	Total Effect	t-value	p-value	Result
Quality management → Information transparency → Financial health	—	0.159	—	5.871	<0.001	Supported
Digital capabilities → Information transparency → Financial health	—	0.229	—	7.314	<0.001	Supported
Quality management → Financial risk reduction → Financial health	—	0.237	—	6.402	<0.001	Supported
Digital capabilities → Financial risk reduction → Financial health	—	0.217	—	5.988	<0.001	Supported
Quality management → Financial health	0.238	0.396	0.634	—	—	Partial mediation
Digital capabilities → Financial health	0.194	0.446	0.640	—	—	Partial mediation
Information transparency → Financial health	0.448	—	0.448	—	—	Direct effect
Financial risk reduction → Financial health	0.562	—	0.562	—	—	Direct effect

The indirect effect of quality management on financial health through information transparency was 0.159 and was statistically significant. This result indicates that quality management enhances financial health partly by improving documentation, process traceability, reporting accuracy, compliance visibility, and the transparency of commercial and financial information. The indirect effect of digital capabilities through information transparency was 0.229 and was also significant. This was the largest transparency-mediated effect, emphasizing the role of digital platforms, intelligent information processing, blockchain-based records, automated monitoring, and real-time data exchange in improving financial outcomes through greater transparency.

The indirect effect of quality management on financial health through financial risk reduction was 0.237. This result indicates that standardization, quality assurance, corrective controls, process discipline, and compliance systems enhance financial health by reducing operational, transactional, regulatory, and financial risk. The corresponding indirect effect of digital capabilities through financial risk reduction was 0.217, demonstrating that digital tools improve financial health by supporting predictive risk analysis, fraud detection, anomaly identification, automated control, and timely managerial intervention. All four indirect effects were statistically significant, confirming the mediating roles of information transparency and financial risk reduction.

The direct effect of quality management on financial health was 0.238, while its combined indirect effect was 0.396, producing a total effect of 0.634. Because both the direct and indirect effects were significant, information transparency and financial risk reduction partially mediated the relationship between quality management and financial health. The larger indirect effect indicates that a substantial portion of the contribution of quality management to financial health was transmitted through improved transparency and reduced financial risk.

For digital capabilities, the direct effect on financial health was 0.194 and the total indirect effect was 0.446, producing a total effect of 0.640. The significance of both direct and indirect effects similarly indicated partial mediation. The total effect

of digital capabilities was slightly greater than that of quality management, although the two values were very close. This finding suggests that quality management and digital capabilities have almost equivalent overall importance in explaining financial health, but they operate through somewhat different organizational mechanisms.

The direct effects of information transparency and financial risk reduction on financial health were 0.448 and 0.562, respectively. Financial risk reduction therefore had a stronger effect on financial health than information transparency. Nevertheless, both variables represented essential mediating mechanisms. Information transparency supports accurate financial decisions, reduces information asymmetry, limits fraud, and improves regulatory accountability, whereas financial risk reduction directly protects organizational liquidity, profitability, solvency, and continuity.

Overall, the results demonstrated that quality management and adherence to international standards contribute to financial health both directly and indirectly. Their effects become substantially stronger when quality practices generate transparent information and reduce exposure to financial risk. Digital capabilities and intelligent systems follow a similar pattern. Their greatest contribution arises when technological adoption is translated into enhanced traceability, fraud prevention, risk forecasting, automated control, and evidence-based decision-making. The significant moderating role of digital maturity further showed that organizations obtain greater financial benefits from digital technologies when those technologies are supported by integrated systems, capable personnel, appropriate governance, and a mature digital culture.

Discussion and Conclusion

The present study examined the role of quality management and international standards in reducing financial risks and protecting financial health in foreign trade processes, with particular attention to digital capabilities, intelligent systems, information transparency, and digital maturity. The findings supported all proposed hypotheses and demonstrated that quality management and digital capabilities both contributed positively to financial risk reduction, information transparency, and financial health. Information transparency and financial risk reduction also exerted strong positive effects on financial health, while digital maturity strengthened the relationship between digital capabilities and financial risk reduction. In addition, the significant indirect effects showed that quality management and digital capabilities improved financial health not only directly but also through enhanced transparency and reduced financial risk. Collectively, the findings confirm that financial health in foreign trade is the outcome of an integrated system in which standardized processes, reliable information, effective risk controls, and mature digital capabilities operate in a complementary manner.

The first finding indicated that quality management and adherence to international standards had a positive and significant effect on financial risk reduction. This result suggests that standardized procedures, process documentation, quality assurance, compliance monitoring, corrective actions, and continuous improvement can reduce exposure to financial losses arising from errors, delays, contractual failures, regulatory violations, and weak internal controls. In foreign trade, even a minor inconsistency in documentation, payment authorization, customs procedures, or supplier verification can create substantial financial consequences. Quality management reduces such vulnerabilities by clarifying responsibilities, defining control points, and ensuring that commercial and financial processes are performed consistently. This finding is consistent with research showing that total quality management and coordinated human resource practices can improve organizational performance by strengthening process discipline and organizational integration [8]. It also aligns with evidence that internal

quality integration improves financial performance by increasing coordination and supporting more effective organizational processes [9].

The positive association between quality management and financial risk reduction can also be interpreted in light of Lean Six Sigma and risk-based control systems. Lean Six Sigma emphasizes waste reduction, error prevention, process stability, and data-driven improvement, all of which are directly relevant to the management of international transactions [10]. In foreign trade, systematic quality tools can reduce repeated documentation, transaction-processing errors, payment delays, and inconsistencies between commercial, financial, and logistics records. The result is also compatible with findings indicating that high-quality risk-management practices improve financial performance by strengthening identification, monitoring, and control of financial exposures [31]. Accordingly, quality management appears to function not merely as an operational improvement mechanism but as an important element of financial-risk governance.

The findings further showed that quality management and standards significantly improved information transparency. Standardized documentation, traceable procedures, internal audits, reporting protocols, and defined compliance responsibilities can make financial and commercial information more accessible, comparable, and verifiable. This reduces ambiguity and limits the ability of organizational actors to conceal errors, irregularities, or opportunistic practices. The finding is consistent with evidence that internal audit quality improves the reliability and transparency of financial reporting [12]. It also supports research showing that the combined effectiveness of risk management and internal audit contributes to higher financial reporting quality [13]. These studies reinforce the conclusion that quality systems improve transparency by strengthening monitoring, documentation, and accountability.

The observed effect of quality management on transparency is also supported by literature on audit oversight, governance, and financial reporting. Effective audit oversight can enhance financial performance by increasing the credibility of financial information and the accountability of decision-makers [15]. Similarly, strong audit quality can improve organizational capital and financing capacity because lenders and investors are more willing to rely on financial information produced under effective control systems [16]. The relationship between financial reporting quality and managerial decision-making reported in previous research further confirms that reliable information is essential for efficient allocation of resources and timely managerial intervention [4]. Therefore, the current finding suggests that quality management contributes to financial protection partly by generating a more transparent informational environment.

A second major finding was that digital capabilities and intelligent systems had a positive and significant effect on financial risk reduction. Digital trade platforms, artificial intelligence, predictive analytics, automated controls, blockchain, real-time monitoring, and anomaly-detection systems can identify financial threats more rapidly than traditional manual procedures. These technologies can support the assessment of counterparty creditworthiness, identify suspicious transactions, monitor exchange-rate exposure, verify trade documents, and detect inconsistencies across financial and logistics databases. The finding is consistent with research demonstrating that big data analytics improves the quality of financial decisions when organizations possess the capabilities required to transform data into useful managerial knowledge [27]. It also aligns with evidence that information technology strengthens the effects of internal controls, professional competence, and organizational commitment on financial reporting quality [28].

The contribution of intelligent systems to financial-risk control may be explained by their capacity to process large amounts of data continuously and identify patterns that would be difficult for human analysts to detect. Artificial intelligence can

improve security, trust, accessibility, and service quality in financial systems, provided that users perceive the technology as reliable and secure [29]. In foreign trade, these characteristics are particularly valuable because financial decisions are often made under time pressure and involve data from banks, customs agencies, suppliers, transportation companies, and international customers. Technological integration enables firms to combine these data sources and generate early warnings before a financial problem becomes severe. The broader institutional literature also indicates that innovation and technology support financial-market development and facilitate more effective financial transactions [30]. Thus, the present result confirms that digital capabilities are central to modern financial-risk governance in internationally active firms.

The strongest technology-related path in the model was the effect of digital capabilities on information transparency. This result indicates that digital technologies play a particularly prominent role in reducing information asymmetry, improving transaction traceability, and limiting opportunities for fraud. Integrated databases, electronic documentation, blockchain records, automated audit trails, and real-time reporting allow authorized users to access consistent and verifiable information. They also reduce dependence on fragmented paper-based systems, which are more vulnerable to loss, delay, alteration, and selective disclosure. This finding corresponds with evidence that financial reporting quality affects stakeholders' investment decisions by reducing uncertainty and increasing confidence in reported information [5]. It also accords with research showing that disclosure quality is closely related to discretionary accruals and real earnings-management practices [6].

The relationship between digital capabilities and transparency can also be explained through their impact on information quality. Corporate information quality influences financial hedging and earnings-management behavior because managers operating in transparent information environments face greater scrutiny and have fewer opportunities to manipulate reported outcomes [7]. Similarly, stronger audit committees and lower information asymmetry can improve the quality of financial statement restatements [25]. Digital technologies support these mechanisms by making inconsistencies more visible, facilitating comparison across periods and systems, and enabling continuous rather than periodic control. The finding therefore suggests that investment in digital systems may produce its most immediate benefit through improved information integrity and fraud prevention.

The results further demonstrated that information transparency positively affected financial health. Transparent information allows managers to identify financial problems quickly, allocate resources more efficiently, monitor cash flows, and make more accurate financing and investment decisions. It also improves stakeholder confidence and may facilitate access to external finance. This result is consistent with previous research showing that high-quality financial information improves managerial decision-making [4] and financial-resource efficiency [3]. It also supports the conclusion that reporting quality contributes to the usefulness of information for investors and other stakeholders [5]. In foreign trade, transparency may be especially important because inaccurate or delayed information about receivables, exchange-rate exposure, inventory in transit, or supplier obligations can create liquidity pressures and weaken financial stability.

The finding that financial risk reduction had the strongest direct effect on financial health is theoretically and practically significant. It indicates that the most immediate route to protecting liquidity, profitability, solvency, and financial continuity is the effective control of financial and operational exposures. Firms engaged in foreign trade face multiple interconnected risks, including credit default, currency fluctuations, fraud, regulatory penalties, transportation delays, and contractual nonperformance. Reducing these risks prevents unanticipated costs and stabilizes financial outcomes. This result is consistent

with evidence that the quality of credit-risk management practices positively affects financial performance [31]. It also aligns with studies showing that financial and operational risks influence audit quality and, consequently, the reliability of organizational financial controls [19].

The positive direct effects of quality management and digital capabilities on financial health were smaller than their indirect effects. This pattern indicates that quality systems and digital technologies do not generate financial health merely through their presence; rather, their value is realized when they improve transparency and reduce risk. This interpretation is supported by research showing that service quality management contributes to sustainable financial performance through innovation-related mechanisms [11]. It is also compatible with findings indicating that the relationship between governance-related performance and corporate financial performance may operate through financial reporting quality [23]. Therefore, the implementation of standards or acquisition of advanced technologies is unlikely to produce substantial financial benefits unless these resources are integrated into concrete monitoring, reporting, and risk-management processes.

The mediation findings confirmed that information transparency and financial risk reduction transmitted substantial portions of the effects of quality management and digital capabilities to financial health. Quality management improved financial health through better transparency and reduced risk, while digital capabilities produced similar indirect effects. These results support a process-based interpretation of organizational financial sustainability. Quality management creates consistent procedures and accountability; digital technologies generate timely and traceable data; transparency supports accurate decisions and reduces fraud; and risk control protects financial resources. The significance of these indirect paths is consistent with research emphasizing the interconnectedness of audit quality, governance, reporting quality, and financial performance [17]. It also accords with evidence that corporate governance, social and environmental activities, and reporting quality jointly shape organizational financial outcomes [22].

The results additionally showed that the indirect effect of digital capabilities on financial health was larger than its direct effect. This finding indicates that technology creates financial value primarily by changing the quality of organizational processes and information rather than through technology investment alone. Digital platforms may require substantial initial expenditure, employee training, data restructuring, and cybersecurity investment. Their positive contribution emerges when these capabilities are converted into improved transparency, faster detection of irregularities, more accurate forecasting, and stronger control. This interpretation is consistent with the view that the quality, rather than merely the quantity, of technology-related financial investment determines innovation outcomes [2]. It also reinforces the importance of aligning digital systems with quality management, audit, compliance, and financial strategy.

The moderating effect of digital maturity was also confirmed. The relationship between digital capabilities and financial risk reduction became stronger at higher levels of digital maturity. This result demonstrates that organizations differ in their ability to transform technological resources into risk-management outcomes. Firms with integrated information systems, reliable data governance, digitally competent employees, supportive leadership, and a culture of evidence-based decision-making are better positioned to use artificial intelligence and analytics effectively. In contrast, organizations with fragmented systems or low technological readiness may obtain limited benefits from advanced software. The result is consistent with the broader argument that the influence of information technology depends on organizational capabilities and the quality of implementation [28]. It also reflects evidence that ethics, authentic leadership, and organizational commitment contribute to financial reporting quality by creating the institutional conditions necessary for effective control [1].

The explanatory and predictive indicators further demonstrated the robustness of the proposed model. The predictors explained 58.4% of the variance in financial risk reduction, 61.2% of the variance in information transparency, and 74.1% of the variance in financial health. The positive Q^2 values also showed that the model had meaningful predictive relevance. The especially high explained variance in financial health confirms that the combination of quality management, digital capability, transparency, and financial risk reduction provides a comprehensive framework for understanding financial sustainability in foreign trade. The effect-size results strengthened this interpretation by showing that financial risk reduction had the largest individual contribution to financial health, while digital capabilities had a relatively strong effect on transparency. These findings imply that organizations should regard risk reduction and information transparency as the two principal mechanisms through which standards and technology protect financial health.

The study was subject to several limitations. First, the cross-sectional design did not permit definitive conclusions regarding causality or changes in organizational performance over time. Second, the use of purposive and convenience sampling may limit the generalizability of the findings to all firms engaged in foreign trade. Third, the data were based on self-reported perceptions and may therefore have been affected by common-method bias, social desirability, or respondents' differing interpretations of digital maturity and financial health. Fourth, the study combined respondents from several occupational fields and organizational contexts without separately examining differences across industries, firm sizes, ownership structures, or levels of international market exposure. Finally, financial health was measured through perceptual indicators rather than independently verified accounting data.

Future research should employ longitudinal designs to examine how the implementation of quality standards and digital technologies changes financial risk and organizational health over several years. Studies may also use probability sampling and compare manufacturing, service, logistics, banking, and export-oriented firms. Future models could incorporate objective financial measures, including liquidity ratios, profitability, cash-flow volatility, financing costs, and the frequency of trade-related losses. Researchers should also examine additional mediators, such as supply-chain resilience, cybersecurity quality, organizational agility, and decision-making speed. Comparative studies across countries or regulatory environments may clarify whether institutional quality, sanctions, customs procedures, or national digital infrastructure alter the relationships identified in this study.

From a practical perspective, managers should integrate quality management, international standards, digital transformation, and financial-risk governance into a unified organizational program rather than managing them as separate functions. Foreign trade firms should standardize documentation, payment, compliance, supplier-evaluation, and customs processes; establish integrated databases and real-time reporting systems; and use intelligent tools for anomaly detection, credit assessment, fraud prevention, and cash-flow forecasting. Investments in software should be accompanied by employee training, data-governance policies, cybersecurity controls, and leadership support to increase digital maturity. Organizations should also strengthen internal audit, cross-functional cooperation, and performance monitoring so that improved transparency and risk reduction are translated into sustainable financial health.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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