Social Science and Human Research Bulletin

ISSN(e): 3050-5542
ISSN(p): 3050-5534

Vol. 03(05): 483-498, May 2026
Home Page: http://sshrbjournal.org/

Determinants of Digital Traceability Adoption in Vietnamese Exporting Firms: Evidence from Exploratory Factor Analysis and Regression

Assoc. Prof. Dr. Do Phu Hai
Department of Public Policy, Hanoi University

Article DOI: 10.55677/SSHRB/2026-3050-0505 **DOI URL: https://doi.org/10.55677/SSHRB/2026-3050-0505**

KEYWORDS: digital traceability; export firms; adoption; EFA; Vietnam.

Corresponding Author
Dr. Do Phu Hai

Published: May 04, 2026

ABSTRACT: This study examines the determinants of digital traceability adoption in Vietnamese exporting firms. Using survey data from 106 firms and applying exploratory factor analysis (EFA) and multiple regression, the results reveal that the proposed determinants converge into a single integrated "traceability readiness" structure rather than distinct dimensions. The regression model demonstrates strong explanatory power ($R^2 = 0.901$), with compatibility/standards fit, vendor support, and management support emerging as the most significant positive drivers. The main academic contribution of this study is to reconceptualize digital traceability adoption as a bundled organizational capability, where technological, managerial, and external conditions interact as an interdependent system. This finding advances the literature by moving beyond isolated factor analysis and providing empirical evidence from an emerging economy context.

INTRODUCTION

Digital traceability has become an increasingly important capability in contemporary supply chains because it improves visibility, supports verification of product origin, and strengthens firms' ability to respond to disruption, regulatory pressure, and counterfeiting risks (Montecchi et al., 2021; Razak et al., 2023). In international trade, this issue is even more urgent because firms must satisfy demanding requirements related to product authenticity, safety, customs compliance, and market access across multiple jurisdictions. As trade becomes more digital and more closely monitored, traceability is no longer a peripheral administrative function; it is becoming a strategic condition for participation in export markets (Saberi et al., 2019; Hastig & Sodhi, 2020). At the same time, the practical implementation of digital traceability remains uneven, especially in emerging economies where firms often face fragmented standards, limited interoperability, and incomplete organizational readiness.

The urgency of this research lies in the fact that Vietnamese exporting firms are under increasing pressure to adopt digital traceability systems, particularly in sectors where foreign buyers, regulators, and certification bodies require reliable traceability evidence. Platforms such as CheckVN, iCheck, Viet Quality, and VMark reflect the growing institutionalization of traceability in practice, yet many firms still struggle to transform traceability from a formal requirement into a functioning capability. Prior studies indicate that adoption success depends not only on technology itself but also on the alignment of standards, the availability of internal capabilities, managerial commitment, vendor support, and external pressure from trading partners (Hastig & Sodhi, 2020; Ahmed & MacCarthy, 2023). This suggests a clear research need: digital traceability should be studied as an integrated implementation problem rather than as a single technological choice.

Despite the growing body of literature, an important research problem remains unresolved. Existing studies have examined traceability through specific technologies, sectors, or isolated adoption factors, but fewer studies have explained how the determinants of digital traceability interact as a system of mutually reinforcing conditions in export-oriented firms. In particular, there is still limited empirical evidence showing which factors matter most in the Vietnamese context and whether these factors operate as distinct drivers or as part of a broader readiness structure. This gap is important because firms and policymakers need clearer evidence about the relative importance of compatibility, interoperability, relative advantage, security, technology readiness, human capital, management support, trading-partner pressure, government support, and vendor support. The present study addresses this gap by examining the determinants of digital traceability adoption in Vietnamese exporting companies through a survey-based empirical design.

Accordingly, this research has three objectives. First, it seeks to identify the factors that influence the establishment of digital traceability in Vietnamese enterprises engaged in export activities. Second, it aims to assess the relative effect of each factor on the outcome of digital traceability implementation for export purposes. Third, it seeks to determine which factors are most critical for firms participating in traceability systems such as CheckVN, iCheck, Viet Quality, and VMark. To achieve these objectives, the study uses survey data collected from 106 companies across different export sectors, applies exploratory factor analysis to examine the structure of the measured determinants, and then conducts regression analysis using the retained factors after eliminating irrelevant variables (H4 and H6, see the Section 3).

The remainder of the paper is organized as follows. The next section reviews the literature on digital traceability and develops the conceptual framework and hypotheses. The following section presents the research methods, including the survey design, sample, measures, and analytical procedures. The results section reports the exploratory factor analysis and regression findings, followed by a discussion of their theoretical and practical implications. The paper concludes by summarizing the main contributions, limitations, and directions for future research.

LITERATURE REVIEW

Digital traceability has become a core capability in contemporary supply chains because it strengthens visibility, supports verification of product origin, and enhances firms' ability to respond to disruption, regulatory pressure, and counterfeiting risks (Montecchi et al., 2021; Razak et al., 2023). The literature consistently shows that traceability is no longer treated merely as a compliance mechanism but is increasingly conceptualized as a strategic capability linked to resilience, collaboration, and risk management (Saak, 2016; Zhou et al., 2022). In the context of international trade, blockchain-based traceability has also been discussed as part of broader trade digitalization, including customs procedures and cross-border documentation, where challenges related to standardization and interoperability remain significant barriers to adoption (Saberi et al., 2019; Hastig & Sodhi, 2020).

The literature further reveals a clear technological evolution in traceability systems. Early studies focused on RFID-enabled identification and information capture, particularly in food supply chains, emphasizing the importance of accurate data collection and information sharing among stakeholders (Kelepouris et al., 2007; Zhou, 2009). Subsequent research shifted toward the design of traceability systems for product recall and sustainability performance, demonstrating that traceability can generate both operational and strategic value when aligned with organizational objectives and supply chain coordination mechanisms (Dai et al., 2015a, 2015b; Epelbaum & Garcia Martinez, 2014). This evolution suggests that traceability capability develops cumulatively through the integration of technological infrastructure, organizational processes, and information management resources.

With the emergence of Industry 4.0, blockchain and Internet of Things (IoT) technologies have become the dominant enablers of advanced traceability systems. Saberi et al. (2019) argue that blockchain enhances transparency and information integrity, thereby supporting sustainable supply chain management, while Hastig and Sodhi (2020) identify key business requirements and critical success factors for effective blockchain-based traceability implementation. Ahmed and MacCarthy (2023) further demonstrate that the effectiveness of blockchain-enabled traceability depends on the scope and depth of implementation, particularly regarding the extent of supply chain coverage and the level of data granularity. Complementary review studies also highlight that blockchain and IoT are among the most prominent tools for addressing counterfeit risks and improving safety and sustainability outcomes in supply chains (Agrawal et al., 2021; Biswas et al., 2023).

At the same time, the implementation literature emphasizes that traceability adoption remains complex and uneven across contexts. Queiroz and Wamba (2019) show that blockchain adoption is still in an early stage and is influenced by organizational readiness and perceived performance benefits. Kayikci et al. (2022) find that implementation in food supply chains is constrained by factors related to people, processes, performance, and technology. In addition, Islam et al. (2022) demonstrate that traceability information can be lost at both internal and external interfaces in export supply chains, leading to significant operational and food safety risks. These findings collectively suggest that traceability success is not determined by a single technological solution but depends on the alignment of multiple organizational and system-level conditions.

More recent research increasingly positions traceability within a broader digital supply chain capability. Razak et al. (2023) synthesize the literature and show that traceability contributes to supply chain resilience through improved visibility, flexibility, velocity, and collaboration. Similarly, Khan et al. (2021) identify critical digital supply chain factors that enhance organizational performance. This body of work supports a holistic interpretation of traceability adoption, in which technological fit, managerial commitment, external support, and digital integration operate as a bundled configuration rather than as independent drivers (Hastig & Sodhi, 2020; Ahmed & MacCarthy, 2023). Such an interpretation is consistent with empirical evidence suggesting that traceability-related determinants tend to form a highly integrated readiness structure rather than distinct and separable dimensions.

In this context, the present study is positioned within a configurational and readiness-based perspective on digital traceability in international trade. While prior studies have examined traceability through specific technologies, industries, or isolated determinants, relatively few have explored how key conditions—such as standards compatibility, management support, and vendor support—interact to shape adoption in cross-border environments. This study addresses that gap by conceptualizing traceability as a system-level capability formed through the interaction of technological, organizational, and institutional factors, thereby advancing a more integrated understanding of digital traceability adoption.

THEORETICAL FRAMEWORK

Digital traceability has evolved from a narrow compliance mechanism into a strategic capability that supports transparency, coordination, and resilience in complex supply networks (Montecchi et al., 2021; Razak et al., 2023). In international trade, this evolution is especially significant because cross-border supply chains involve multiple actors, fragmented information flows, and growing demands for proof of origin, product integrity, and regulatory compliance. As a result, traceability is increasingly understood not as a purely technical function but as an integrated capability that links information systems, managerial commitment, and interorganizational coordination (Agrawal et al., 2021; Schaëfer et al., 2025). Early research emphasized RFID-enabled visibility and item-level identification as foundational enablers of traceability, showing that accurate data capture and sharing are essential for operational control (Kelepouris et al., 2007; Zhou, 2009). Subsequent work on traceability-system design demonstrated that value is created only when traceability mechanisms are aligned with recall objectives, stakeholder incentives, and supply-chain governance structures (Dai et al., 2015a, 2015b).

With the emergence of blockchain and related digital technologies, the literature has shifted toward the potential of distributed ledgers to improve data integrity, transparency, and sustainability in supply chains (Saberi et al., 2019; Hastig & Sodhi, 2020). However, the adoption of blockchain-enabled traceability is not straightforward. Ahmed and MacCarthy (2023) argue that firms must determine the appropriate scope and depth of traceability before blockchain systems can generate meaningful value, while Wu et al. (2023) show that adoption strategies differ across supply-chain contexts and are shaped by operational constraints. At the same time, adoption is influenced by coordination problems and shared investment requirements, since traceability systems often depend on participation from multiple trading partners who may not perceive benefits equally (Lee et al., 2011; Whang, 2010). These findings suggest that traceability adoption is best understood as a collaborative and configurational process rather than the result of any single technology or isolated managerial decision.

The literature further indicates that traceability contributes to broader organizational outcomes such as sustainability, reputation, and resilience. Saak (2016) shows that traceability can strengthen reputation effects in supply chains, while Zhou et al. (2022) and Biswas et al. (2023) demonstrate that traceability is associated with sustainability performance and the governance of environmentally sensitive supply chains. More recently, review studies have confirmed that traceability and transparency are closely linked research domains, yet they still lack a sufficiently integrated explanation of how technological, organizational, and institutional conditions combine to shape implementation success (Montecchi et al., 2021; Razak et al., 2023). This gap is particularly visible in international trade, where traceability depends on standards, interoperability, vendor support, and managerial commitment across different institutional environments. Epelbaum and Garcia Martinez (2014) similarly show that the technological evolution of traceability systems must be understood through the lens of organizational resources and long-term performance rather than technology adoption alone.

Taken together, prior studies support a holistic interpretation of digital traceability as a system-level readiness capability. Traceability does not emerge from one determinant in isolation; rather, it develops through the combined effect of technical compatibility, internal support, external collaboration, and strategic alignment (Hastig & Sodhi, 2020; Agrawal et al., 2021; Ahmed & MacCarthy, 2023). This perspective is consistent with the present study's empirical pattern, in which the proposed determinants appear highly interdependent and collectively form an integrated readiness structure. Accordingly, the present research extends the literature by examining digital traceability in international trade as a bundled configuration of conditions that jointly shape implementation, rather than as a set of independent variables with separate effects.

RESEARCH METHODS

This study employed a firm-level survey design to examine the factors influencing digital traceability implementation for export-oriented business operations in Vietnam. The sample consisted of 106 companies drawn from different export sectors, and one key informant was selected from each firm to provide the most informed response on traceability practices and implementation conditions. Respondents were drawn from managerial positions closely involved with traceability adoption, including directors, quality managers, export managers, supply-chain managers, and IT or digital-transformation managers. The broader project was framed as longitudinal, while the survey wave analyzed in this paper provides the empirical basis for the statistical tests reported here.

The research instrument was developed from the literature on digital traceability, supply-chain coordination, and technology adoption, and it operationalized the study constructs using Likert-type items. The independent variables were measured through twelve hypothesized determinants covering compatibility and standards fit, interoperability, relative advantage, complexity, security and trust, cost and financial resources, technology readiness, human capital and training, management support, trading-partner pressure, government support and regulation, and vendor support. The dependent variable captured the extent to which firms had successfully established digital traceability for export purposes, including implementation level, data integration, compliance with export-market requirements, data reliability, and improvement in market access, certification, and customs clearance.

Data analysis proceeded in three stages. First, the reliability and structure of the measurement items were assessed through exploratory factor analysis. Second, the empirically retained factors were used in the regression model. Third, the results were interpreted with attention to both statistical significance and the broader implementation logic of digital traceability. The final regression analysis was based on 102 valid cases after screening incomplete responses, as reported in the manuscript's model output.

Exploratory factor analysis was conducted to examine whether the proposed determinants represented distinct constructs or whether they instead formed a more integrated structure. The analysis used standard adequacy criteria, including the Kaiser–Meyer–Olkin measure, Bartlett's test of sphericity, communalities, factor loadings, eigenvalues, and explained variance. The results reported in the manuscript indicate excellent sampling adequacy and a very strong one-factor solution, with all twelve variables loading highly on a single dominant component. This finding supports the view that the determinants of digital traceability are empirically interrelated and may reflect an overarching readiness capability rather than fully separate dimensions.

Table 1. Research Hypotheses and Determinants of Digital Traceability Adoption

Hypothesis	Factor	Description
H1	Compatibility / Standards fit	Degree of alignment with technical standards (e.g., GS1) and export market requirements
H2	Interoperability	Ability to integrate and exchange data across internal and external systems
H3	Relative advantage	Perceived benefits of digital traceability adoption
H4	Complexity	Degree of difficulty in implementing digital traceability systems
H5	Security / Trust	Level of data reliability, security, and fraud prevention
H6	Cost / Financial resources	Investment cost and financial capability of the firm
H7	Technology readiness	Availability of digital infrastructure, software, and data systems
H8	Human capital / Training	Employee capability, skills, and training for implementation
H9	Management support	Top management commitment and support
H10	Trading-partner pressure	Pressure from customers, importers, and business partners
H11	Government support / Regulation	Policy support, regulatory frameworks, and standards
H12	Vendor support	Support from traceability solution providers

Based on the screening results and the retained-factor specification, H4 and H6 were excluded from the final regression model, and the remaining factors were entered into a multiple linear regression to estimate their unique effects on traceability outcomes. The regression model was estimated with Traceability as the dependent variable and H1, H2, H3, H5, H7, H8, H9, H10, H11, and H12 as predictors. The analysis also examined key diagnostics, including the Durbin–Watson statistic, tolerance, variance inflation factors, and collinearity diagnostics, in order to assess autocorrelation and multicollinearity. The interpretation of the final results therefore combined statistical significance with the theoretical implication that digital traceability adoption is best understood as a bundled configuration of technological, organizational, and external support conditions rather than a set of isolated causal drivers.

RESULTS

Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted to assess the underlying structure of the twelve proposed determinants of digital traceability. The results indicate excellent sampling adequacy, with a Kaiser–Meyer–Olkin (KMO) value of 0.915, well above the recommended threshold of 0.60. Bartlett's Test of Sphericity is statistically significant ($\chi^2 = 1887.659$, df = 66, $p < 0.001$), confirming that the correlation matrix is suitable for factor analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.915
Bartlett's Test of Sphericity	Approx. Chi-Square	1887.659
	df	66
	Sig.	.000

The Anti-image correlation matrix further supports the adequacy of the data, as all Measures of Sampling Adequacy (MSA) exceed 0.80, ranging from 0.885 to 0.955, indicating that no variable should be removed. Communalities are also high, with extracted values ranging from 0.613 to 0.942, demonstrating that a substantial proportion of variance in each observed variable is explained by the underlying factor structure.

The Total Variance Explained table reveals a single dominant component with an eigenvalue of 9.567, accounting for 79.727% of the total variance. All subsequent components have eigenvalues below 1, thereby supporting a one-factor solution according to the Kaiser criterion. Consistently, the Component Matrix shows that all twelve items load strongly onto this single factor, with factor loadings ranging from 0.783 to 0.971. Given that only one factor is extracted, rotation is not applicable.

The EFA results provide strong evidence of a unidimensional structure underlying the twelve proposed determinants. Rather than forming distinct and separable constructs (e.g., technological, organizational, and environmental dimensions), all variables converge into a single latent factor that can be interpreted as an overarching digital traceability readiness or capability construct. The high factor loadings and communalities indicate strong convergent validity, suggesting that all items consistently measure the same underlying phenomenon.

However, this uni-dimensionality also implies limited discriminant validity among the proposed factors. In other words, firms that perform well in one dimension (e.g., interoperability or management support) tend to perform well across all other dimensions, reflecting a systemic and integrated capability rather than isolated drivers. This finding has important methodological implications: treating these variables as independent predictors in subsequent regression models may introduce multicollinearity and unstable coefficient estimates.

Therefore, from both a statistical and theoretical standpoint, the results suggest that the determinants of digital traceability should be conceptualized as a holistic readiness construct rather than a set of fully independent factors. Future analyses may benefit from using a composite index or modeling this structure as a higher-order latent variable to better capture the integrated nature of digital traceability adoption.

Results of Regression Analysis

A multiple linear regression analysis was conducted to examine the effects of the retained determinants on Traceability. The model included H1, H2, H3, H5, H7, H8, H9, H10, H11, and H12 as predictors, with H4 and H6 excluded from the final specification. The analysis was based on 102 valid cases. The regression model was statistically significant and exhibited strong explanatory power, with R = 0.949, R² = 0.901, and Adjusted R² = 0.890. This indicates that the predictors jointly explained 90.1% of the variance in Traceability. The overall model fit was also highly significant, F(10, 91) = 83.087, p < 0.001, while the standard error of the estimate was 0.302. The Durbin–Watson statistic was 1.540, suggesting no severe autocorrelation problem for this cross-sectional model.

Model Summary^{b}

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.949^{a}	.901	.890	.302	.901	83.087	10	91	.000	1.540

a. Predictors: (Constant), H12, H8, H7, H10, H2, H9, H3, H5, H1, H11

b. Dependent Variable: Traceability

ANOVA^{a}

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	75.708	10	7.571	83.087	.000^{b}
	Residual	8.292	91	.091		
	Total	84.000	101			

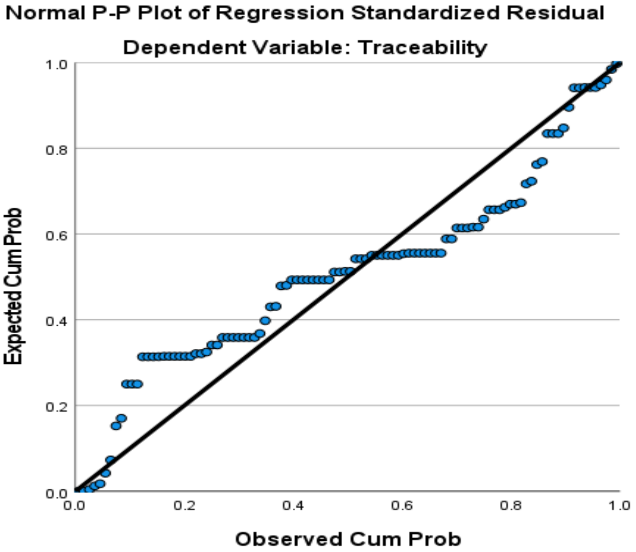
a. Dependent Variable: Traceability

b. Predictors: (Constant), H12, H8, H7, H10, H2, H9, H3, H5, H1, H11

The coefficient estimates show that only a subset of predictors had statistically significant unique effects on Traceability when all variables were entered simultaneously. H1 had a positive and significant effect (B = 0.423, β = 0.399, t = 3.424, p = 0.001), indicating that compatibility/standards fit is an important positive predictor. H7 was statistically significant but negatively related to Traceability (B = -0.151, β = -0.142, t = -2.386, p = 0.019), which is contrary to the hypothesized positive direction. H9 also showed a positive and significant effect (B = 0.197, β = 0.216, t = 1.999, p = 0.049), and H12 had the strongest positive coefficient among the significant predictors (B = 0.335, β = 0.381, t = 3.061, p = 0.003). In contrast, H2, H3, H5, H8, H10, and H11 were not statistically significant at the 5% level.

The regression diagnostics indicate a serious multicollinearity issue. Several predictors had very high VIF values, notably H11 (VIF = 24.253), H12 (VIF = 14.305), H1 (VIF = 12.534), and H9 (VIF = 10.743), while H5 also approached the critical level (VIF = 9.848). The collinearity diagnostics further confirmed this problem, with high condition indices reaching above 70 in the later dimensions. These results suggest that the predictors share substantial overlapping variance, which means the sign and significance of individual coefficients should be interpreted with caution.

Overall, the regression results show that the retained determinants jointly have a very strong association with Traceability, but the high multicollinearity implies that the model is better interpreted as capturing a broader integrated readiness structure rather than a set of fully independent effects. From a hypothesis-testing perspective, H1, H9, and H12 were supported, H7 was significant but in the opposite direction, and the remaining predictors were not supported in the final multivariate model.



DISCUSSION

The combined evidence from the factor analysis and regression results provides a consistent and theoretically meaningful picture of how digital traceability is implemented. While the regression model demonstrates very strong explanatory power **(**$R^2 = 0.901$**)**, the factor analysis reveals that the proposed determinants are not empirically distinct, but instead converge into a highly integrated structure. This dual finding suggests that digital traceability adoption is best understood not as the outcome of isolated drivers, but as the result of a bundled configuration of mutually reinforcing conditions**.**

The empirical results point to a coherent but somewhat complex pattern. The factor analysis showed that the 12 proposed determinants of digital traceability do not empirically separate into many cleanly distinct dimensions; instead, they cluster very strongly into one dominant underlying structure. In practical terms, this means that compatibility, interoperability, relative advantage, security/trust, technology readiness, human capital, management support, trading-partner pressure, government support, and vendor support are not functioning in the sample as isolated and independent forces. Rather, they appear to move together as part of a broader traceability readiness or implementation capability construct. In your earlier EFA results, this was reflected by excellent sampling adequacy, a significant Bartlett test, a single dominant factor, very high factor loadings, and excellent internal consistency. Taken together, the measurement results indicate strong convergent validity but weak discriminant separation among the proposed dimensions. This is an important substantive finding because it suggests that digital traceability adoption is not simply a sum of many independent drivers; it is more likely a bundled organizational and institutional capability.

This interpretation is strongly reinforced by the regression output. The final model is highly explanatory, with $R = 0.949$, $R^2 = 0.901$, and Adjusted $R^2 = 0.890$, meaning that the retained predictors explain about 90.1% of the variance in Traceability. The overall model is highly significant, $F(10, 91) = 83.087$, $p < 0.001$, which indicates that the retained factors jointly provide very strong explanatory power. The model therefore performs well at the level of overall prediction. At the same time, the diagnostic results show that the regression is statistically powerful but methodologically fragile in one respect: multicollinearity is severe. The VIF values are especially high for H11 (24.253), H12 (14.305), H1 (12.534), and H9 (10.743), and the collinearity diagnostics also show very high condition indices, confirming substantial overlap among the predictors. This means the model fits the data very well, but the individual coefficient estimates should be interpreted with caution because they are competing to explain the same shared variance.

At the individual predictor level, only a subset of variables remains statistically significant after all predictors are entered simultaneously. H1 has a positive and significant effect on Traceability ($B = 0.423$, $\beta = 0.399$, $p = 0.001$), and H12 is also positive and significant ($B = 0.335$, $\beta = 0.381$, $p = 0.003$). H9 is positive and marginally significant ($B = 0.197$, $\beta = 0.216$, $p = 0.049$). These results suggest that compatibility/standards fit, vendor support, and management support have the clearest unique contribution in the multivariate model. By contrast, H2, H3, H5, H8, H10, and H11 are not significant once the common variance is controlled. Most notably, H7 is statistically significant but negative ($B = -0.151$, $\beta = -0.142$, $p = 0.019$), which is opposite to the original theoretical expectation. Because H7 was strongly and positively correlated with Traceability at the bivariate level, this negative sign is best understood as a suppression effect produced by multicollinearity rather than as a genuine negative substantive relationship. In other words, the regression is not telling us that technology readiness harms traceability; it is telling us that once the overlap among predictors is partialled out, H7 is left with a residual component that behaves differently from the shared readiness construct.

This leads to a key synthesis: the factor analysis and regression are telling the same story from two angles. The factor analysis says that the constructs are highly integrated and not empirically separable into clean independent dimensions. The regression says that when these highly overlapping variables are forced into a single equation, only some of them retain unique explanatory power, while others lose significance or even change sign. This is exactly what we would expect when a study includes conceptually related predictors that are measured in a highly correlated way. The substantive conclusion is therefore not that only three factors matter and the rest do not matter, but rather that the determinants of digital traceability are best understood as a configuration of mutually reinforcing conditions. In such settings, the strongest interpretation is that adoption depends on a combined readiness environment, not on isolated single-factor effects. This is consistent with the broader logic of technology–organization–environment type explanations: internal capabilities, external support, standards compatibility, and partner pressure operate together to shape implementation outcomes.

From a robustness perspective, the results are both strong and cautionary. They are strong because the model explains a very large proportion of variance and the factor structure is internally consistent. They are cautionary because the multicollinearity diagnostics suggest that the separate coefficients may be unstable. The model is therefore robust in terms of overall explanatory power, but not robust in terms of unique partial effects for each predictor. The residual diagnostics also indicate that the regression is broadly usable, although the Durbin–Watson statistic of 1.540 suggests mild positive autocorrelation and the standardized residual range from -3.335 to 2.827 implies that a small number of cases may be influential. None of this invalidates the findings, but it does mean that the study should not overstate the precision of individual beta coefficients.

The most defensible methodological implication is that a simple multiple regression with all ten retained predictors may not be the best final specification. Because the factor analysis revealed one dominant latent structure and the regression reveals severe overlap, the model would likely be strengthened by using either a composite index or a second-order latent construct representing overall traceability readiness. That approach would better reflect the empirical reality of the data and would reduce the instability created by multicollinearity. In other words, the statistical evidence favors a model where compatibility, interoperability, relative advantage, security/trust, technology readiness, human capital, management support, partner pressure, government support, and vendor support are interpreted as parts of one integrated implementation environment rather than as fully independent causal levers.

At the same time, the regression results indicate that only a subset of predictors retains statistically significant unique effects once all variables are considered simultaneously, and that severe multicollinearity affects coefficient stability. Therefore, the discussion below interprets the findings with a focus on system-level insights, rather than overemphasizing individual coefficients.

Theoretical implications

The findings offer important contributions to the literature on technology adoption, particularly within the Technology–Organization–Environment (TOE) framework. First, the factor analysis suggests weak discriminant validity among the proposed constructs, as all determinants load strongly onto a single dominant factor. This implies that, in the context of digital traceability, technological, organizational, and environmental conditions do not operate as clearly separable dimensions. Instead, they form a higher-order latent construct, which can be interpreted as *traceability readiness* or *implementation capability*.

Second, the regression results reinforce this interpretation. Although the model explains a substantial proportion of variance in Traceability, only a few variables—particularly compatibility/standards fit (H1), vendor support (H12), and management support (H9)—retain statistically significant unique effects. Other variables lose significance or exhibit instability due to shared variance. This pattern is theoretically meaningful: it suggests that the determinants of traceability adoption are complementary rather than independent, aligning with configuration-based perspectives such as resource orchestration and systems thinking.

Third, the unexpected negative coefficient for technology readiness (H7), despite its strong positive bivariate correlation with Traceability, highlights a classic suppression effect caused by multicollinearity. This finding does not invalidate the importance of technology readiness; rather, it underscores that its effect is embedded within a broader constellation of factors. From a theoretical standpoint, this supports the argument that partial effects in highly integrated systems may be misleading, and that higher-order constructs or composite indices may better capture causal relationships.

Overall, the study advances the literature by showing that digital traceability adoption is not driven by isolated TOE components, but by an integrated readiness ecosystem in which multiple conditions co-evolve and reinforce one another.

Managerial implications

The results provide several actionable insights for managers seeking to implement digital traceability systems.

First, the strong and significant effect of compatibility and standards fit (H1) indicates that technical alignment is a foundational requirement. Firms should prioritize adopting interoperable systems and aligning with industry standards to reduce integration complexity and facilitate data exchange across the supply chain.

Second, the importance of vendor support (H12) highlights that successful implementation depends not only on technology acquisition but also on the quality of external support. Managers should carefully select vendors that provide comprehensive services, including system customization, training, integration assistance, and ongoing technical support.

Third, the role of management support (H9) confirms that traceability implementation is a strategic initiative rather than a purely technical task. Strong leadership commitment, resource allocation, and cross-functional coordination are essential to ensure successful adoption.

Fourth, the lack of significance of several variables in the multivariate model should not be interpreted as evidence of irrelevance. Instead, it reflects their interdependence with other factors. For example, human capital, interoperability, and partner pressure may still be critical, but their effects are realized only when combined with broader organizational readiness.

In practical terms, managers should avoid a fragmented approach that focuses on individual factors in isolation. Instead, they should adopt a holistic implementation strategy that simultaneously strengthens technological infrastructure, organizational capabilities, and external partnerships.

Policy implications

The findings also carry important implications for policymakers aiming to promote digital traceability, particularly in sectors such as agriculture, food systems, and export-oriented industries.

First, the significance of compatibility/standards fit suggests that governments should prioritize the development and enforcement of common technical standards and interoperability frameworks. Standardization reduces uncertainty, lowers adoption costs, and enables seamless data exchange across supply chains.

Second, the strong role of vendor support implies that policy interventions should extend beyond regulation to include the development of a supportive ecosystem of technology providers. Governments can facilitate this by supporting digital solution providers, encouraging public–private partnerships, and promoting service quality standards in the technology market.

Third, the importance of management support at the firm level indicates that policy measures should focus on capacity building and awareness. Training programs, pilot projects, and demonstration initiatives can help firms understand the strategic value of traceability and build internal commitment.

Fourth, the non-significance of government support/regulation in the regression model does not imply that policy is ineffective. Rather, it suggests that policy works best when it complements and reinforces other conditions, such as standards, vendor ecosystems, and organizational readiness. Isolated regulatory pressure may be insufficient without supporting infrastructure and capabilities.

Finally, the overall findings highlight that digital traceability should be approached as a systemic transformation. Effective policy must therefore adopt a coordinated approach that integrates regulation, standardization, technological infrastructure, and institutional support.

In summary, the combined evidence from factor analysis and regression demonstrates that digital traceability adoption is driven by a highly integrated set of conditions rather than independent factors. While the regression model confirms strong explanatory power, the presence of multicollinearity indicates that the true mechanism lies in the joint configuration of readiness elements. This insight calls for a shift from variable-centered analysis to a more holistic, system-oriented perspective in both research and practice.

CONCLUSION

This study aimed to identify the determinants of digital traceability adoption in Vietnamese exporting firms, assess their relative effects, and determine the most critical factors shaping implementation outcomes. Based on survey data from 106 firms and the application of exploratory factor analysis and regression techniques, the findings indicate that the proposed determinants converge into a highly integrated readiness structure rather than functioning as independent drivers. The results further show that compatibility and standards fit, management support, and vendor support play the most significant roles in explaining traceability outcomes, while the remaining factors exhibit overlapping effects within the model.

These findings confirm that the research objectives have been achieved and contribute to the literature by demonstrating that digital traceability adoption is best understood as a systemic capability emerging from the alignment of technological, organizational, and external conditions (Montecchi et al., 2021; Hastig & Sodhi, 2020; Razak et al., 2023). From a practical perspective, the results suggest that firms should prioritize standards alignment, leadership commitment, and ecosystem support when implementing traceability systems in export contexts.

This study is subject to several limitations that provide directions for future research. Further studies should employ larger and more diverse samples, apply confirmatory analytical techniques, and explore longitudinal dynamics of traceability adoption. In addition, configurational approaches such as fsQCA may offer deeper insights into the combined effects of multiple conditions. Comparative cross-country research would also help to better understand how institutional environments shape digital traceability in international trade.

Overall, the study highlights that digital traceability should be conceptualized not as an isolated technological solution but as an integrated strategic capability embedded in broader supply-chain systems.

REFEREENCES

1. Agrawal, T. K., Kumar, V., Pal, R., Wang, L., & Chen, Y. (2021). Blockchain-based framework for supply chain traceability: A case example of textile and clothing industry. *Computers & Industrial Engineering, 154*, 107130. https://doi.org/10.1016/j.cie.2021.107130
2. Ahmed, W. A. H., & MacCarthy, B. L. (2023). Blockchain-enabled supply chain traceability – How wide? How deep? *International Journal of Production Economics, 263*, 108963. https://doi.org/10.1016/j.ijpe.2023.108963
3. Biswas, D., Jalali, H., Ansaripoor, A. H., & De Giovanni, P. (2023). Traceability vs. sustainability in supply chains: The implications of blockchain. *European Journal of Operational Research, 305*(1), 128–147. https://doi.org/10.1016/j.ejor.2022.05.034
4. Blaettchen, P., Calmon, A. P., & Hall, G. (2025). Traceability technology adoption in supply chain networks. *Management Science, 71*(1), 83–102. https://doi.org/10.1287/mnsc.2022.01759
5. Dai, H., Ge, L., & Zhou, W. (2015). A design method for supply chain traceability systems with aligned interests. *International Journal of Production Economics, 170*, 14–24. https://doi.org/10.1016/j.ijpe.2015.08.010
6. Dai, H., Tseng, M. M., & Zipkin, P. H. (2015). Design of traceability systems for product recall. *International Journal of Production Research, 53*(2), 511–531. https://doi.org/10.1080/00207543.2014.955922
7. Dou, G., Wei, K., Sun, T., & Ma, L. (2024). Blockchain technology adoption in a supply chain: Channel leaderships and environmental implications. *Transportation Research Part E: Logistics and Transportation Review, 192*, 103788. https://doi.org/10.1016/j.tre.2024.103788
8. Dwivedi, A., & Paul, S. K. (2022). A framework for digital supply chains in the era of circular economy: Implications on environmental sustainability. *Business Strategy and the Environment, 31*(4), 1249–1274. https://doi.org/10.1002/bse.2953
9. Epelbaum, F. M. B., & Garcia Martinez, M. (2014). The technological evolution of food traceability systems and their impact on firm sustainable performance: A resource-based view. *International Journal of Production Economics, 150*, 215–224. https://doi.org/10.1016/j.ijpe.2014.01.007
10. Hastig, G. M., & Sodhi, M. S. (2020). Blockchain for supply chain traceability: Business requirements and critical success factors. *Production and Operations Management, 29*(4), 935–954. https://doi.org/10.1111/poms.13147
11. Kelepouris, T., Pramatari, K., & Doukidis, G. (2007). RFID-enabled traceability in the food supply chain. *Industrial Management & Data Systems, 107*(2), 183–200. https://doi.org/10.1108/02635570710723804
12. Lee, J., Palekar, U. S., & Qualls, W. (2011). Supply chain efficiency and security: Coordination for collaborative investment in technology. *European Journal of Operational Research, 210*(3), 568–578. https://doi.org/10.1016/j.ejor.2010.10.015
13. Montecchi, M., Plangger, K., & West, D. C. (2021). Supply chain transparency: A bibliometric review and research agenda. *International Journal of Production Economics, 238*, 108152. https://doi.org/10.1016/j.ijpe.2021.108152
14. Piramuthu, S., Wochner, S., & Grunow, M. (2014). Should retail stores also RFID-tag “cheap” items? *European Journal of Operational Research, 233*(1), 281–291. https://doi.org/10.1016/j.ejor.2013.08.051
15. Queiroz, M. M., & Wamba, S. F. (2019). Blockchain adoption challenges in supply chains: An empirical investigation. *International Journal of Information Management, 46*, 70–82. https://doi.org/10.1016/j.ijinfomgt.2018.11.021
16. Razak, G. M., Hendry, L. C., & Stevenson, M. (2023). Supply chain traceability: A review of the benefits and its relationship with supply chain resilience. *Production Planning & Control, 34*(11), 1114–1134. https://doi.org/10.1080/09537287.2021.1983661
17. Saak, A. E. (2016). Traceability and reputation in supply chains. *International Journal of Production Economics, 177*, 149–162. https://doi.org/10.1016/j.ijpe.2016.04.008
18. Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research, 57*(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261
19. Schaëfer, K., Kähkönen, A.-K., & Luzzini, D. (2025). Traceability in multi-tier supply chains: Insights from five case studies. *Supply Chain Management: An International Journal, 30*(7), 77–99. https://doi.org/10.1108/SCM-07-2024-0428
20. Shou, Y., Zhao, X., Dai, J., & Xu, D. (2021). Matching traceability and supply chain coordination. *Transportation Research Part E: Logistics and Transportation Review, 145*, 102181. https://doi.org/10.1016/j.tre.2020.102181
21. Tao, F., Wang, L., Fan, T., & Yu, H. (2022). RFID adoption strategy in a retailer-dominant supply chain. *European Journal of Operational Research, 302*(1), 117–129. https://doi.org/10.1016/j.ejor.2021.12.008
22. Whang, S. (2010). Timing of RFID adoption in a supply chain. *Management Science, 56*(2), 343–355. https://doi.org/10.1287/mnsc.1090.1121
23. Wu, X.-Y., Fan, Z.-P., & Cao, B.-B. (2023). Strategies for adopting blockchain technology in fresh product supply chains. *International Journal of Production Research, 61*(11), 3717–3734. https://doi.org/10.1080/00207543.2021.1894497

24. Zhou, W. (2009). RFID and item-level information visibility. *European Journal of Operational Research, 198*(1), 252–258. https://doi.org/10.1016/j.ejor.2008.09.017
25. Zhou, W., & Piramuthu, S. (2012). Manufacturing with item-level RFID information. *International Journal of Production Economics, 135*(2), 929–938. https://doi.org/10.1016/j.ijpe.2011.11.008
26. Zhou, X., Pullman, M., & Xu, Z. (2022). The impact of food supply chain traceability on sustainability performance. *Operations Management Research, 15*(1–2), 93–115. https://doi.org/10.1007/s12063-021-00189-w

Appendix 1: Results of Exploratory Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.915
Bartlett's Test of Sphericity	Approx. Chi-Square	1887.659
	df	66
	Sig.	.000

Anti-image Matrices

		H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
Anti-image Covariance	H1	.079	-.012	-.045	-.007	-.009	.006	-.010	.003	-.057	.032	-.001	-.002
	H2	-.012	.137	-.011	-.066	-.017	-.015	.057	.003	.014	.029	-.028	.011
	H3	-.045	-.011	.113	.019	-.007	-.015	.025	-.056	.033	-.052	-.002	.008
	H4	-.007	-.066	.019	.269	.027	-.004	-.127	-.063	.000	.007	.016	-.030
	H5	-.009	-.017	-.007	.027	.092	-.027	-.055	.045	-.010	.012	.000	-.028
	H6	.006	-.015	-.015	-.004	-.027	.080	.017	-.018	.011	.001	-.020	-.002
	H7	-.010	.057	.025	-.127	-.055	.017	.215	-.024	.010	-.016	-.024	.021
	H8	.003	.003	-.056	-.063	.045	-.018	-.024	.210	-.038	.009	-.011	.017
	H9	-.057	.014	.033	.000	-.010	.011	.010	-.038	.092	-.027	.002	-.028
	H10	.032	.029	-.052	.007	.012	.001	-.016	.009	-.027	.135	-.031	.001
	H11	-.001	-.028	-.002	.016	.000	-.020	-.024	-.011	.002	-.031	.034	-.019
	H12	-.002	.011	.008	-.030	-.028	-.002	.021	.017	-.028	.001	-.019	.072
Anti-image Correlation	H1	.898[a]	-.117	-.479	-.045	-.100	.071	-.080	.026	-.668	.309	-.022	-.033
	H2	-.117	.926[a]	-.089	-.341	-.154	-.140	.331	.017	.121	.211	-.417	.112
	H3	-.479	-.089	.903[a]	.108	-.067	-.156	.160	-.363	.322	-.422	-.027	.087
	H4	-.045	-.341	.108	.896[a]	.173	-.030	-.527	-.264	-.003	.034	.171	-.216
	H5	-.100	-.154	-.067	.173	.927[a]	-.318	-.394	.320	-.111	.109	.005	-.340
	H6	.071	-.140	-.156	-.030	-.318	.955[a]	.126	-.139	.123	.006	-.384	-.020
	H7	-.080	.331	.160	-.527	-.394	.126	.885[a]	-.114	.074	-.092	-.283	.166
	H8	.026	.017	-.363	-.264	.320	-.139	-.114	.929[a]	-.272	.051	-.132	.139
	H9	-.668	.121	.322	-.003	-.111	.123	.074	-.272	.887[a]	-.243	.039	-.339
	H10	.309	.211	-.422	.034	.109	.006	-.092	.051	-.243	.914[a]	-.462	.014
	H11	-.022	-.417	-.027	.171	.005	-.384	-.283	-.132	.039	-.462	.908[a]	-.387
	H12	-.033	.112	.087	-.216	-.340	-.020	.166	.139	-.339	.014	-.387	.938[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
H1	1.000	.847
H2	1.000	.801
H3	1.000	.799
H4	1.000	.613
H5	1.000	.851
H6	1.000	.876
H7	1.000	.672
H8	1.000	.712
H9	1.000	.791

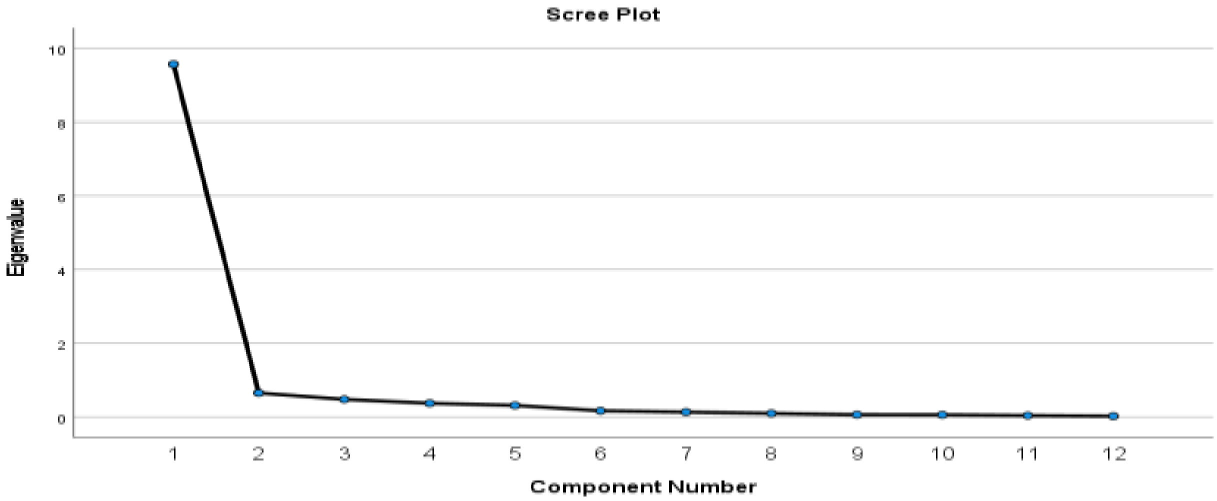
H10	1.000	.775
H11	1.000	.942
H12	1.000	.889

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.567	79.727	79.727	9.567	79.727	79.727
2	.656	5.464	85.191			
3	.482	4.013	89.204			
4	.376	3.131	92.335			
5	.317	2.642	94.977			
6	.172	1.431	96.408			
7	.137	1.140	97.547			
8	.101	.844	98.391			
9	.064	.535	98.926			
10	.061	.507	99.433			
11	.042	.349	99.782			
12	.026	.218	100.000			

Extraction Method: Principal Component Analysis.



Component Matrix[a]

	Component
	1
H11	.971
H12	.943
H6	.936
H5	.922
H1	.920
H2	.895
H3	.894
H9	.889
H10	.880
H8	.844
H7	.820
H4	.783

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

Rotated Component Matrix[a]

a. Only one component was extracted. The solution cannot be rotated.

Appendix 2: Regression model

Descriptive Statistics

	Mean	Std. Deviation	N
Traceability	4.00	.912	102
H1	4.03	.861	102
H2	3.77	.889	102
H3	3.95	.916	102
H5	3.93	.926	102
H7	3.73	.858	102
H8	3.87	.961	102
H9	3.90	1.000	102
H10	3.91	1.054	102
H11	3.71	1.049	102
H12	3.82	1.038	102

Correlations

		Traceability	H1	H2	H3	H5	H7	H8	H9	H10	H11	H12
Pearson Correlation	Traceability	1.000	.920	.806	.782	.856	.645	.700	.890	.711	.849	.899
	H1	.920	1.000	.798	.818	.860	.721	.758	.923	.734	.853	.881
	H2	.806	.798	1.000	.825	.823	.632	.731	.721	.750	.894	.826
	H3	.782	.818	.825	1.000	.778	.625	.814	.719	.857	.881	.782
	H5	.856	.860	.823	.778	1.000	.774	.658	.838	.765	.897	.925
	H7	.645	.721	.632	.625	.774	1.000	.666	.719	.685	.768	.757
	H8	.700	.758	.731	.814	.658	.666	1.000	.728	.751	.797	.711
	H9	.890	.923	.721	.719	.838	.719	.728	1.000	.734	.821	.889
	H10	.711	.734	.750	.857	.765	.685	.751	.734	1.000	.898	.809
	H11	.849	.853	.894	.881	.897	.768	.797	.821	.898	1.000	.925
	H12	.899	.881	.826	.782	.925	.757	.711	.889	.809	.925	1.000
Sig. (1-tailed)	Traceability	.	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	H1	.000	.	.000	.000	.000	.000	.000	.000	.000	.000	.000
	H2	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000
	H3	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000
	H5	.000	.000	.000	.000	.	.000	.000	.000	.000	.000	.000
	H7	.000	.000	.000	.000	.000	.	.000	.000	.000	.000	.000
	H8	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.000
	H9	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000
	H10	.000	.000	.000	.000	.000	.000	.000	.000	.	.000	.000
	H11	.000	.000	.000	.000	.000	.000	.000	.000	.000	.	.000
	H12	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.

N	Traceability	102	102	102	102	102	102	102	102	102	102	102
	H1	102	102	102	102	102	102	102	102	102	102	102
	H2	102	102	102	102	102	102	102	102	102	102	102
	H3	102	102	102	102	102	102	102	102	102	102	102
	H5	102	102	102	102	102	102	102	102	102	102	102
	H7	102	102	102	102	102	102	102	102	102	102	102
	H8	102	102	102	102	102	102	102	102	102	102	102
	H9	102	102	102	102	102	102	102	102	102	102	102
	H10	102	102	102	102	102	102	102	102	102	102	102
	H11	102	102	102	102	102	102	102	102	102	102	102
	H12	102	102	102	102	102	102	102	102	102	102	102

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	H12, H8, H7, H10, H2, H9, H3, H5, H1, H11[b]	.	Enter

a. Dependent Variable: Traceability

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.949[a]	.901	.890	.302	.901	83.087	10	91	.000	1.540

a. Predictors: (Constant), H12, H8, H7, H10, H2, H9, H3, H5, H1, H11

b. Dependent Variable: Traceability

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	75.708	10	7.571	83.087	.000[b]
	Residual	8.292	91	.091		
	Total	84.000	101			

a. Dependent Variable: Traceability

b. Predictors: (Constant), H12, H8, H7, H10, H2, H9, H3, H5, H1, H11

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.429	.196		2.189	.031					
	H1	.423	.123	.399	3.424	.001	.920	.338	.113	.080	12.534
	H2	.084	.085	.082	.993	.323	.806	.104	.033	.159	6.303
	H3	.118	.098	.119	1.212	.229	.782	.126	.040	.113	8.867
	H5	.012	.102	.012	.118	.906	.856	.012	.004	.102	9.848
	H7	-.151	.063	-.142	-2.386	.019	.645	-.243	-.079	.305	3.281
	H8	-.036	.065	-.038	-.559	.578	.700	-.058	-.018	.231	4.331
	H9	.197	.098	.216	1.999	.049	.890	.205	.066	.093	10.743
	H10	-.141	.078	-.163	-1.804	.075	.711	-.186	-.059	.132	7.554
	H11	.065	.141	.075	.464	.644	.849	.049	.015	.041	24.253
	H12	.335	.109	.381	3.061	.003	.899	.306	.101	.070	14.305

a. Dependent Variable: Traceability

Coefficient Correlations[a]

Model			H12	H8	H7	H10	H2	H9	H3	H5	H1	H11
1	Correlations	H12	1.000	.085	.063	-.025	.009	-.326	.159	-.381	-.055	-.404
		H8	.085	1.000	-.295	.061	-.108	-.268	-.371	.348	.024	-.164
		H7	.063	-.295	1.000	-.087	.214	.070	.276	-.332	-.132	-.196
		H10	-.025	.061	-.087	1.000	.253	-.246	-.451	.143	.315	-.496
		H2	.009	-.108	.214	.253	1.000	.147	-.099	-.139	-.126	-.484
		H9	-.326	-.268	.070	-.246	.147	1.000	.348	-.082	-.684	.093
		H3	.159	-.371	.276	-.451	-.099	.348	1.000	-.182	-.473	-.124
		H5	-.381	.348	-.332	.143	-.139	-.082	-.182	1.000	-.063	-.153
		H1	-.055	.024	-.132	.315	-.126	-.684	-.473	-.063	1.000	.016
		H11	-.404	-.164	-.196	-.496	-.484	.093	-.124	-.153	.016	1.000
	Covariances	H12	.012	.001	.000	.000	8.096E-5	-.004	.002	-.004	-.001	-.006
		H8	.001	.004	-.001	.000	-.001	-.002	-.002	.002	.000	-.002
		H7	.000	-.001	.004	.000	.001	.000	.002	-.002	-.001	-.002
		H10	.000	.000	.000	.006	.002	-.002	-.003	.001	.003	-.005
		H2	8.096E-5	-.001	.001	.002	.007	.001	-.001	-.001	-.001	-.006
		H9	-.004	-.002	.000	-.002	.001	.010	.003	-.001	-.008	.001
		H3	.002	-.002	.002	-.003	-.001	.003	.010	-.002	-.006	-.002
		H5	-.004	.002	-.002	.001	-.001	-.001	-.002	.010	-.001	-.002
		H1	-.001	.000	-.001	.003	-.001	-.008	-.006	-.001	.015	.000
		H11	-.006	-.002	-.002	-.005	-.006	.001	-.002	-.002	.000	.020

a. Dependent Variable: Traceability

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions										
				(Constant)	H1	H2	H3	H5	H7	H8	H9	H10	H11	H12
1	1	10.846	1.000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	2	.051	14.647	.34	.00	.00	.00	.00	.01	.00	.00	.01	.01	.01
	3	.030	19.020	.00	.00	.01	.03	.02	.05	.08	.03	.04	.00	.01
	4	.020	23.324	.05	.00	.09	.01	.02	.22	.20	.01	.00	.00	.01
	5	.019	23.963	.01	.02	.00	.00	.01	.24	.10	.06	.08	.00	.00
	6	.014	28.037	.06	.00	.17	.00	.00	.11	.07	.05	.22	.00	.00
	7	.007	38.519	.15	.07	.06	.36	.03	.07	.13	.01	.03	.01	.06
	8	.005	44.803	.04	.03	.35	.02	.23	.13	.26	.10	.08	.00	.14
	9	.003	56.495	.06	.03	.03	.07	.68	.05	.08	.08	.11	.03	.44
	10	.002	69.994	.14	.23	.26	.21	.00	.11	.00	.06	.03	.71	.27
	11	.002	73.029	.15	.61	.02	.30	.02	.01	.09	.61	.40	.23	.06

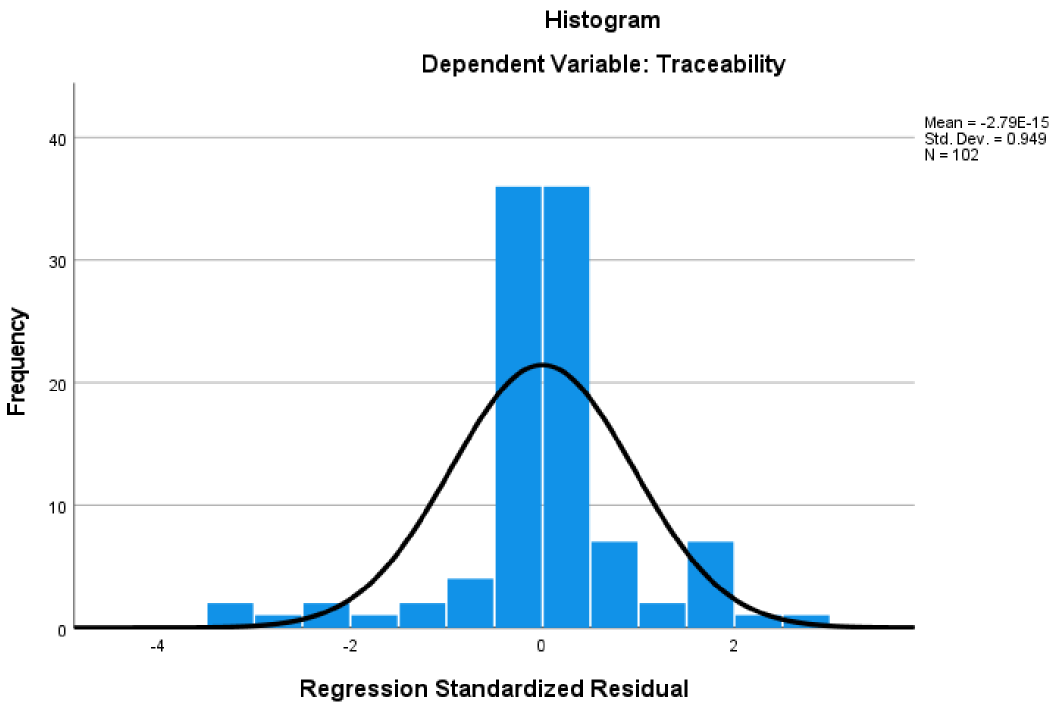
a. Dependent Variable: Traceability

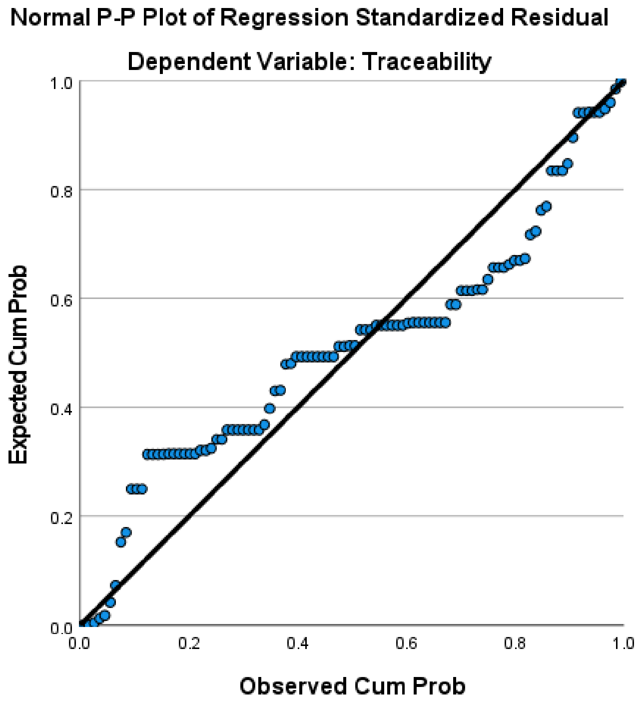
Residuals Statistics[a]

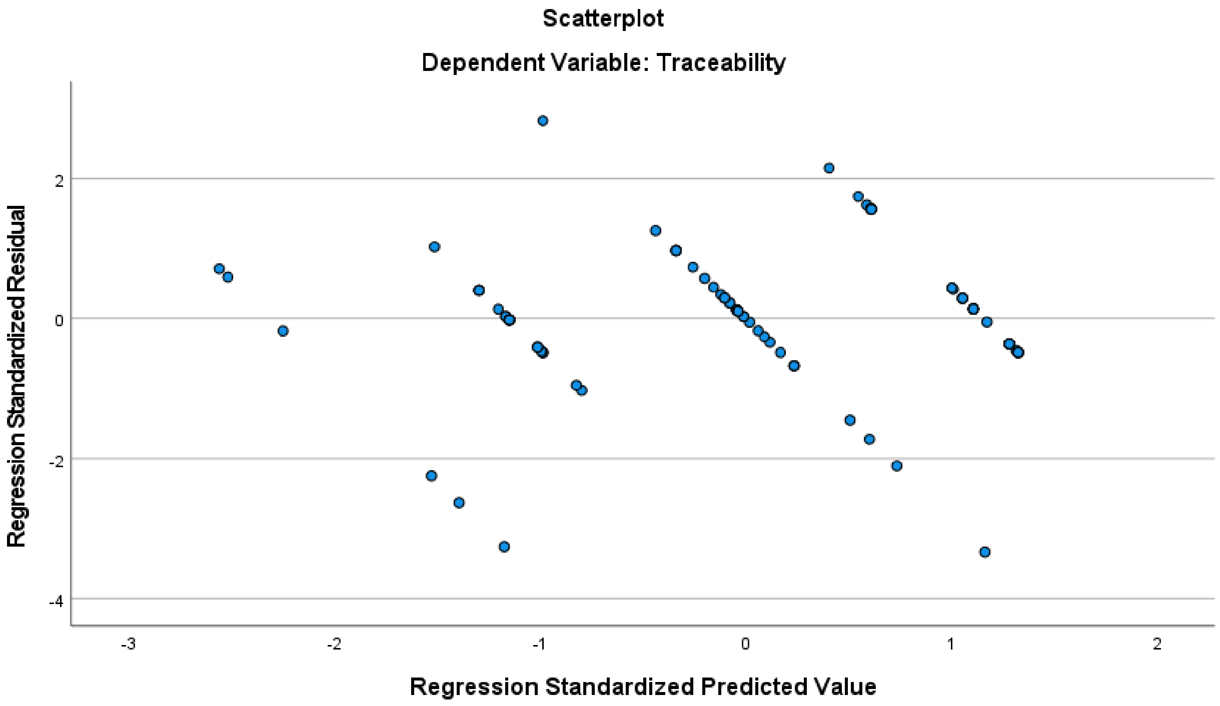
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.78	5.15	4.00	.866	102
Residual	-1.007	.853	.000	.287	102
Std. Predicted Value	-2.559	1.323	.000	1.000	102
Std. Residual	-3.335	2.827	.000	.949	102

a. Dependent Variable: Traceability

Charts


Histogram
Dependent Variable: Traceability
Mean = -2.79E-15
Std. Dev. = 0.949
N = 102
Frequency
40
30
20
10
0
-4
-2
0
2
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Traceability
Expected Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob


Scatterplot
Dependent Variable: Traceability
Regression Standardized Residual
2
0
-2
-4
-3
-2
-1
0
1
2
Regression Standardized Predicted Value