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The Impact of Digital Transformation and Blockchain Adoption on Supply Chain Transparency in Pharmaceutical Firms: Evidence from Emerging Chinese Markets

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ABSTRACT: This paper explored how digital transformation and the use of blockchain technology influenced supply chain transparency in pharmaceutical companies operating in emerging Chinese markets. The study incorporated the Technology Acceptance Model (TAM), which facilitated the identification of key aspects such as perceived usefulness, perceived ease of use, attitude, and behavioral intention, along with the mediating variable of self-efficacy. Based on these elements, a conceptual framework was developed, which further aided understanding of the hypothesised relationships examined in the study. Accordingly, a quantitative research design was implemented using a primary data collection method. In the Shanghai pharmaceutical industry, data were collected from a sample of 400 managerial employees. The outcomes of technology integration and transparency were quantitatively examined in relation to one another. The results indicated that blockchain technology and digital transformation enhanced supply chain performance through improved traceability, trust, and efficiency. The study shed further light on the main obstacles to implementation and provided insights for policymakers and industry leaders on improving transparency through advanced digital technologies in China's expanding pharmaceutical market. The findings confirmed that respondents perceived the synergistic effects of digital transformation and blockchain implementation as having the greatest potential to improve supply chain transparency. Blockchain technology enabled real-time, secure, and distributed immutable ledgers that supported product tracking, counterfeiting prevention, verification of authenticity, and enhanced transparency.

KEYWORDS: Perceived usefulness; supply chain transparency; perceived ease of use; attitude toward use; behavioural intention; self-efficacy.

1. Introduction

By the year 2030, China aimed to undergo a comprehensive digital and intelligent transformation. Within this agenda, a strong focus was placed on the use of blockchain technology to improve supply chain transparency [1], as the verification of drug records was

considered critical. Pharmaceutical records needed to be maintained in a decentralised and immutable manner to prevent counterfeiting. The pharmaceutical sector in China was expected to surpass USD 300 billion by 2026, driven by an ageing population, the increasing prevalence of chronic diseases, demographic shifts, and healthcare system reforms. China had also strengthened and diversified its technological infrastructure and policy-supportive frameworks, such as "Made in China 2025" [2]. As a result, China emerged as a blockchain-enabled supply chain innovation hub. Despite these transformations, many Chinese pharmaceutical companies remained reliant on paper-based systems, creating challenges in real-time tracking and verification processes [3]. The World Health Organization reported that, on average, approximately 10% of medical products in China and other low- and middle-income countries were substandard or falsified. However, blockchain technology had the potential to bridge this gap.

Moreover, inadequate traceability gave rise to penalties and reputational risks for pharmaceutical companies in China. This also indicated that the adoption rate of blockchain technology in the Chinese pharmaceutical sector was estimated to be less than 15%, primarily due to cost constraints and technical challenges [4]. The limited availability of a skilled workforce further contributed to the low uptake of blockchain technology. The absence of real-time information resulted in slow and inefficient processes for identifying and recalling faulty or contaminated medications, while the lack of automation and digital integration further exacerbated inefficiencies [5], leading to increased operational costs. During emergencies, such as pandemics, conventional supply chains tended to collapse, whereas digital supply chains offered greater adaptability and resilience.

In addition, international customers required more rigorous proof than domestic customers, resulting in increased scrutiny of Chinese pharmaceutical companies [1]. In principle, blockchain technology could provide greater transparency because records could be stored in an unalterable manner. Companies increasingly focused on digital transformation as a driver of sustainable growth while enhancing supply chain protection through improved information transparency and supply chain management practices [1]. Using data from emerging Chinese markets, this study examined the impact of digital transformation and blockchain adoption on supply chain transparency in pharmaceutical companies. The study evaluated the effects of perceived usefulness, perceived ease of use, attitude toward use, and behavioral intention on supply chain transparency, while isolating self-efficacy as a potential mediating variable and analysing its influence on the relationships among these factors and supply chain transparency.

In the analysis, the use of the Technology Acceptance Model (TAM) held particular significance, as it provided the primary theoretical foundation for explaining the adoption and use of digital transformation and blockchain technologies by pharmaceutical company employees. TAM conceptualised perceived usefulness and perceived ease of use as the dominant factors influencing users' attitudes and behavioral intentions toward technology adoption. The availability of digital and blockchain technologies, combined with the TAM framework, was particularly relevant to the Chinese market, as it supported the assessment of behavioral and organisational readiness among supply chain stakeholders. Furthermore, the application of this model enabled the study to extend understanding of how enabling technologies could be leveraged to improve visibility, trust, and efficiency in pharmaceutical supply chains. By focusing on digital transformation and blockchain adoption for supply chain

transparency, the study addressed tangible and practical issues in one of the most highly regulated and sensitive industries.

Within the context of the Chinese market, pharmaceutical supply chain networks were affected by multiple challenges, including counterfeit medications, inaccurate information, and limited visibility, all of which posed risks to patient safety and public health. This research provided valuable insights for organisations seeking to enhance operational performance by reducing fraud and aligning processes with international standards. It also assessed the role of digital innovation and blockchain technology in improving transparency, traceability, and accountability. In addition, the study supported industry leaders and policymakers in developing appropriate frameworks and policy instruments to strengthen consumer confidence and digital governance. Ultimately, the practical significance of the study lay in its potential to support the transformation of China's pharmaceutical industry into a more adaptive, trustworthy, and transparent sector within the digital economy.

2. Literature Review

The purpose of this chapter was to investigate the theoretical foundations and previous findings related to technology integration and supply chain transparency, with particular emphasis on digital transformation and blockchain technology. To establish a theoretical basis for understanding behavioral intention toward technology use, the chapter focused on a classical framework, namely the Technology Acceptance Model (TAM). It then evaluated existing scholarly studies to identify current knowledge, inconsistencies, and methodological limitations. Finally, the chapter highlighted gaps in the literature, particularly regarding the adoption of digital and blockchain technologies in the Chinese pharmaceutical supply chain, thereby justifying the need for the present study. Information technology adoption and actual use were regarded as critical components of both information systems research and practical implementation. Perceived ease of use reflected the extent to which individuals believed that a particular system was simple to use, while perceived usefulness reflected the degree to which they believed that using the system enhanced their ability to perform tasks [6]. The Technology Acceptance Model (TAM), which relied on the relationships among belief, attitude, intention, and behaviour, identified perceived usefulness and perceived ease of use as the primary factors influencing attitude toward technology use [7]. Through perceived usefulness and perceived ease of use, all other external variables were expected to indirectly influence attitude and behavioral intention [8]. As illustrated in Figure 1, perceived usefulness and perceived ease of use constituted the core constructs of TAM.

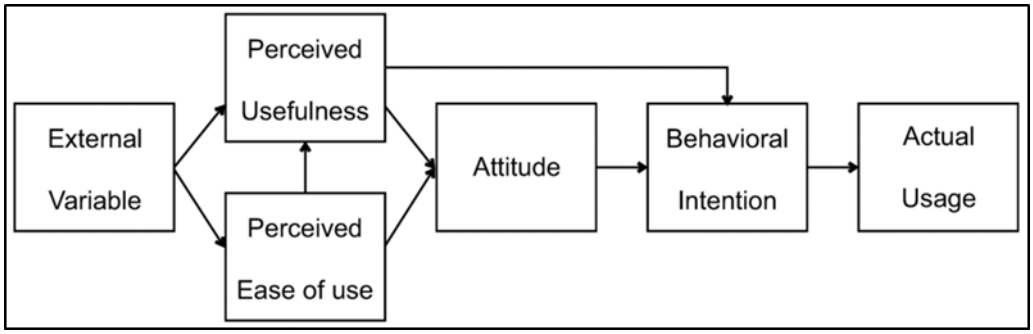

Figure 1. Technology acceptance model.

Transparency had a distinct conceptual meaning. Supply chain visibility referred to what organisations were able to observe, whereas transparency referred to what organisations acted upon and communicated after gaining such visibility [9]. TAM had become a key paradigm for analysing information system implementation and was widely considered an appropriate model for examining the effects of blockchain adoption and digital transformation on supply chain transparency [10]. Transparency in the supply chain ensured ethical conduct and adherence to social and environmental standards, supported legal compliance, enhanced brand reputation, and fostered customer trust. TAM evolved into one of the most influential models for understanding and predicting human behaviour related to the acceptance or rejection of new technologies [6]. The present study was developed based on TAM theory, which suggested that perceived usefulness, perceived ease of use, attitude toward use, and behavioral intention toward use were influenced by the effectiveness of the technology itself [11]. In addition, prior studies indicated that unique contextual factors often played a crucial role in enhancing perceptions of trustworthiness in blockchain and other technologies used to accomplish operational tasks. From a theoretical perspective, insight was also gained into the notion that behavioral intention led to actual technology use. Consequently, transparency regarding the effectiveness of technological tools could be improved, while perceived enjoyment arising from their use could also be observed [12]. Thus, TAM provided a suitable framework for examining multiple factors aligned with the objectives of this research.

Previous studies indicated that positive perceptions regarding the ease of use of technologies such as blockchain and other digital tools fostered favourable attitudes toward digital adoption. In addition, prior research [1] demonstrated that sustainability in supply chain performance was a key organisational objective, closely associated with collaboration and the improvement of future performance. However, empirical evidence on the role of perceived usefulness and the formation of positive attitudes toward digital technologies, particularly within Chinese pharmaceutical firms, remained limited. Furthermore, earlier research [13] showed that blockchain technology was effective in maintaining transparency and improving production performance. Existing studies also highlighted the importance of traceability and perceived usefulness in this context. Despite these contributions, knowledge regarding effective implementation measures for blockchain and other digital technologies remained insufficient.

The conceptual framework presented in Figure 2 proposed that perceived usefulness (H1), perceived ease of use (H2), attitude toward use (H3), and behavioral intention (H4) had direct effects on supply chain transparency. In addition, these four factors significantly influenced self-efficacy (H5–H8), which subsequently affected supply chain transparency (H9). Thus, self-efficacy functioned as a mediating variable that strengthened and explained how technology-related perceptions and user attitudes translated into improved supply chain transparency. Research on digital transformation and blockchain adoption in pharmaceutical supply chains within emerging Chinese markets remained limited. Few empirical studies examined the combined effects of these technologies on transparency, as the existing literature largely focused on developed economies. China-specific regulatory and implementation barriers were rarely addressed, while small- and medium-sized pharmaceutical enterprises were often overlooked. Key stakeholders, including regulators, distributors, and patients, were

under-represented in prior research. Measures of transparency improvement were frequently imprecise, and practical guidance on adoption and long-term outcomes was scarce. Therefore, there was a clear need for context-specific empirical research focusing on emerging markets in China.

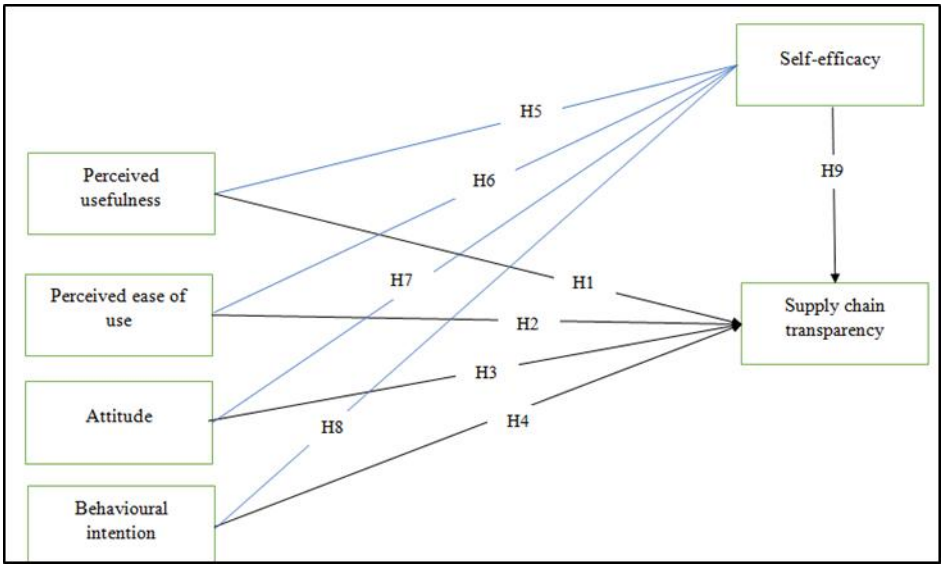

Figure 2. Conceptual framework.

3. Methodology

3.1. Research design and approach.

This study adopted a quantitative research approach to examine the impact of digital transformation and blockchain technology on the Chinese pharmaceutical industry. A structured, survey-based research design was employed to identify and measure relationships among variables in a systematic and generalisable manner. This design aligned with an empirical and positivist paradigm, in which hypotheses were derived from established theoretical frameworks and tested using numerical data [14, 15]. The approach enabled the examination of relationships among perceived usefulness, perceived ease of use, attitude, behavioral intention, self-efficacy, and supply chain transparency.

3.2.Population and sampling.

The target population comprised employees working in China's pharmaceutical sector, which included approximately 717,000 workers. Shanghai was selected as the data collection location due to its role as a major pharmaceutical hub and its high level of technological engagement. To ensure statistical validity, the required sample size was determined using the Krejcie and Morgan guidelines for large populations. A minimum sample of 382 respondents was required; therefore, a sample size of 400 was selected. The study focused exclusively on managerial-level employees, as they were more likely to be involved in decision-making related to digital transformation and blockchain implementation. A simple random sampling technique was applied to improve representativeness and minimise selection bias.

3.3.Data collection instrument and procedure.

Primary data were collected using a structured questionnaire consisting of closed-ended questions. The instrument was designed to measure respondents' perceptions and intentions regarding the study variables. The questionnaire was administered online and distributed through internet-based platforms and social media channels to facilitate rapid access to managerial employees and to maximise response rates. This method supported accurate representation of respondents' views and experiences.

3.4. Measurement of variables.

The survey instrument measured six key constructs: perceived usefulness, perceived ease of use, attitude toward use, behavioral intention, self-efficacy, and supply chain transparency [19]. Measuring all constructs within a single instrument ensured consistency in operational definitions and enhanced the accuracy of hypothesis testing. Standardised measurement across respondents improved comparability and reduced interpretational ambiguity, thereby strengthening the internal validity of the study.

3.5. Data analysis techniques.

A quantitative data analysis strategy was adopted to statistically test the proposed hypotheses [20]. SmartPLS software was used to conduct the primary analyses, including structural equation modelling, assessment of relationships among latent variables, and mediation analysis [21]. The analysis evaluated the predictive relevance of the proposed model and examined the mediating role of self-efficacy in the relationship between technology-related beliefs and supply chain transparency. Statistical significance values were reported to identify the most influential predictors of supply chain transparency.

3.6. *Ethical considerations*.

Ethical standards were maintained throughout the research process. Participants were informed about the purpose of the study and provided informed consent prior to participation. Anonymity and confidentiality were ensured by using the collected data solely for academic purposes. No identifiable personal information was recorded or disclosed, ensuring compliance with data protection principles and enhancing the credibility and integrity of the research.

4. Results and Discussion

This section presented the empirical findings derived from the quantitative analysis conducted in this study. It began with a demographic profile of the respondents, followed by assessments of reliability and validity to ensure the accuracy and consistency of the measurement model. The results of the structural model, including path coefficients and hypothesis testing, were then reported to illustrate the significance and direction of the relationships among the variables. Collectively, these findings provided a comprehensive understanding of how digital transformation and blockchain adoption influenced supply chain transparency in the Chinese pharmaceutical sector.

4.1. Demographic profiling test.

Demographic data referred to the statistical characteristics of a population or specific groups within a study. These characteristics typically included age, gender, ethnicity, education level, employment status, income, marital status, and place of residence. Such data were commonly used to analyse shifts and trends in human populations for purposes related to social development, marketing, policy formulation, and academic research. Governments, businesses, and researchers utilised demographic information to anticipate future social trends and to support informed decision-making. As presented in Table 1, the demographic analysis comprised four segments: experience, gender, education, and department. Within the experience category, 134 respondents (33.5%) had less than five years of experience in their respective fields, 139 respondents (34.8%) had between six and ten years of experience, and 127 respondents (31.8%) had more than ten years of experience. The distribution of respondents across experience levels was relatively balanced, as shown in Table 1 [23]. Overall, approximately 68.3% of the participants had more than five years of professional experience, indicating a substantial level of expertise. The inclusion of both early-career and senior professionals enhanced the validity of perspectives related to digital transformation and blockchain adoption..

Table 1. Demographic analysis.

		Count	Column N %
Experience	Less than 5 years	134	33.5%
	6-10 years	139	34.8%
	More than 10 years	127	31.8%
Gender	Male	219	54.8%
	Female	181	45.3%
Education	Bachelor's degree	158	39.5%
	Master's degree	156	39.0%
	Doctorate	50	12.5%
	Others	36	9.0%
Department	Supply Chain/Logistics	143	35.8%
	Operations/Production	130	32.5%
	Research & Development (R&D)	95	23.8%
	Others	32	8.0%

In the following segment, the sample population comprised a considerably higher number of male participants (219), accounting for 54.8% of the total sample size. Nevertheless, both male and female respondents provided diverse perspectives on how technology adoption affected supply chain transparency in pharmaceutical firms. In the education category, a substantial proportion of respondents (78.5%) held bachelor's (39.5%) and master's (39.0%) degrees, indicating that the sample was well educated. The high proportion of respondents with master's degrees suggested in-depth technical knowledge, making their contributions particularly valuable for assessing digital transformation practices and blockchain technologies in pharmaceutical supply chains. In the final category, department, the highest level of participation was observed in Supply Chain/Logistics, with 143 respondents (35.8%). This was followed by 130 respondents (32.5%) from the Operations/Production department, 95 respondents (23.8%) from the Research and Development (R&D) department, and 32 respondents (8.0%) from other departments. This distribution indicated that most participants were drawn from Supply Chain/Logistics and Operations/Production functions, which were closely aligned with the focus of the study.

4.2. Reliability.

As shown in Table 2, the reliability analysis produced a Cronbach's alpha value of 0.952, indicating exceptionally high internal consistency. As illustrated in Figure 3, this value was well above the commonly accepted threshold range of 0.7 to 0.9. This result indicated that the items included in the questionnaire were highly reliable and demonstrated strong consistency. The Cronbach's alpha value based on standardised items was also 0.952, indicating that standardisation did not materially affect the reliability of the scale [24]. This high value confirmed consistency across all 36 items and supported the validity of subsequent analyses.

Table 2. Reliability statistics.

Reliability Statistics		
Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
.952	.952	36

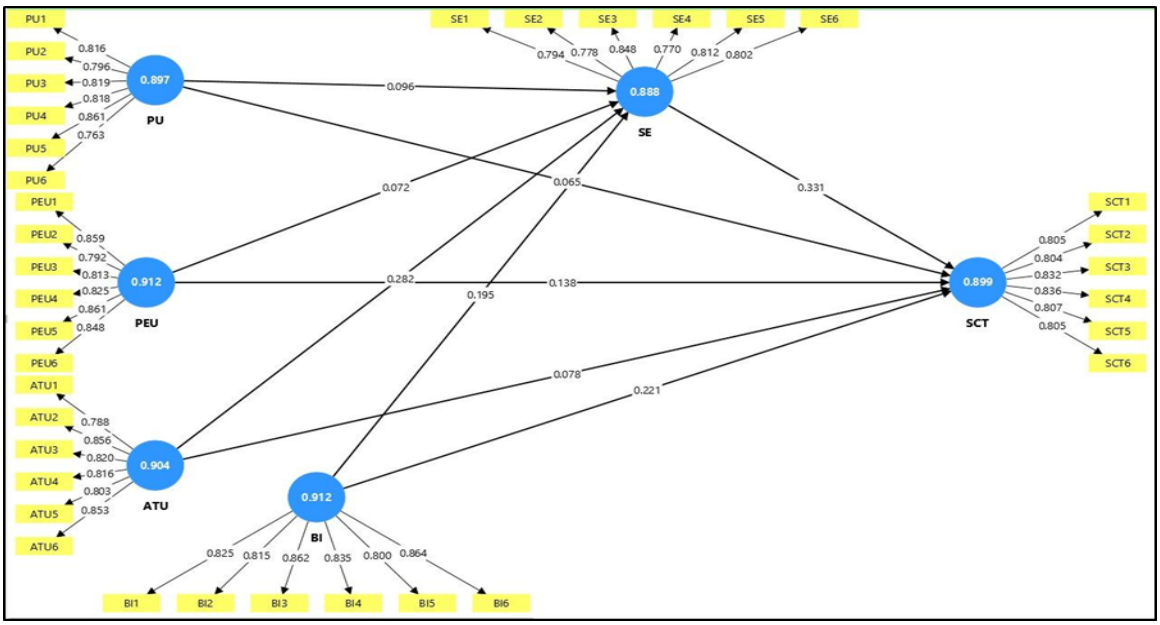

Figure 3. Final model.

The validity analysis presented in Table 3 demonstrated strong intercorrelations exceeding 0.4, thereby confirming convergent validity [25]. Table 3 also showed moderate correlations among the variables, indicating adequate discriminant validity. These results confirmed that each construct measured a distinct dimension of digital transformation and blockchain adoption that influenced supply chain transparency in pharmaceutical firms in China.

Table 3. HTMT test.

	ATU	**BI**	**PEU**	**PU**	**SCT**	**SE**
ATU						
BI	0.619					
PEU	0.618	0.428				
PU	0.617	0.476	0.574			
SCT	0.528	0.536	0.462	0.443		
SE	0.541	0.468	0.394	0.417	0.599	

All variables presented in Table 4 demonstrated high validity, with the square roots of the Average Variance Extracted (AVE) ranging from 0.801 to 0.834. These values exceeded the corresponding inter-construct correlations, thereby confirming discriminant validity. Although the correlations among constructs were moderate, they indicated clear conceptual distinctness. Reliability was further supported through evidence of convergent validity [25]. Table 4 presented the discriminant validity of the six constructs: attitude toward use (ATU), behavioral intention (BI), perceived ease of use (PEU), perceived usefulness (PU), supply chain transparency (SCT), and self-efficacy (SE). The diagonal elements represented the square roots of the AVE for each construct. These values were higher than the correlations with other constructs, demonstrating strong discriminant validity. This finding indicated that the constructs were empirically distinct and independent. For example, the square root of the AVE for ATU was 0.823, which was higher than its correlations with BI (0.564) and PEU (0.564). This result indicated that the constructs were reliably measured and exhibited minimal overlap, thereby confirming the adequacy of the measurement model.

Table 4. Fornell Larcker test.

	ATU	BI	PEU	PU	SCT	SE
ATU	0.823					
BI	0.564	0.834				
PEU	0.564	0.391	0.833			
PU	0.559	0.435	0.521	0.813		
SCT	0.478	0.488	0.421	0.401	0.815	
SE	0.487	0.425	0.358	0.376	0.537	0.801

The path coefficient analysis highlighted the significance and strength of the relationships among the variables in the model. As shown in Table 5, self-efficacy (SE) exhibited the strongest and most significant path, with a value of $\beta = 0.331$, $t = 7.890$, $p = 0.000$, indicating that SE was a primary determinant of supply chain transparency (SCT). Attitude toward use (ATU) also showed a significant positive effect on SCT ($\beta = 0.282$, $p = 0.000$), as did behavioral intention (BI) ($\beta = 0.221$, $p = 0.000$), highlighting the role of user intention and confidence. Perceived ease of use (PEU) and perceived usefulness (PU) were also significant, with p-values of 0.041 and 0.000, respectively, demonstrating their influence on transparency [26]. However, these constructs exhibited weaker path coefficients, suggesting that their effects on SCT were primarily indirect, mediated through self-efficacy.

Table 5. Path coefficient.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
ATU -> SCT	0.078	0.080	0.058	1.349	0.018
ATU -> SE	0.282	0.288	0.058	4.834	0.000
BI -> SCT	0.221	0.221	0.051	4.299	0.000
BI -> SE	0.195	0.197	0.058	3.391	0.001
PEU -> SCT	0.138	0.136	0.044	3.134	0.002
PEU -> SE	0.072	0.075	0.053	1.372	0.017
PU -> SCT	0.065	0.064	0.049	1.331	0.028
PU -> SE	0.096	0.091	0.047	2.052	0.041
SE -> SCT	0.331	0.335	0.042	7.890	0.000

Table 5 presents the coefficients and significance levels for all paths between the study variables. The strength and direction of each relationship are reflected in the sample mean and

original sample values, while the standard deviation indicates data variation. T-statistics and p-values were used to assess the significance of each path, with p-values below 0.05 considered significant. For example, the path SE → SCT (β = 0.331, p = 0.000) indicated a strong, positively significant association. Similarly, the paths BI → SCT and BI → SE were also important. Some paths, such as ATU → SCT and PEU → SE, showed weaker effects. Overall, the majority of relationships were statistically significant, confirming that constructs such as SE, BI, and PEU had a substantial impact on SCT and self-efficacy.

4.3.Hypothesis testing.

Hypothesis testing in a quantitative study was used to examine the relationships between different predictor variables and the dependent variable. It assessed the causal effects of independent, mediating, and moderating variables on the dependent variable. The path coefficient results presented above were employed to test the nine hypotheses formulated for this research. The first four hypotheses focused on the direct causal relationships between the independent variables and the dependent variable. The remaining five hypotheses, as shown in Table 6, examined the mediating effects of the mediating variable on the relationships between the independent variables and the dependent variable.

Table 6. Hypothesis testing.

Hypothesis	Outcomes
H1: Perceived usefulness has a significant impact on supply chain transparency	Satisfied
H2: Perceived ease of use has a significant impact on supply chain transparency	Satisfied
H3: Attitude has a significant impact on supply chain transparency	Satisfied
H4: Behavioural intention has a significant impact on supply chain transparency	Satisfied
H5: Perceived usefulness has a significant impact on self-efficacy	Satisfied
H6: Perceived ease of use has a significant impact on self-efficacy	Satisfied
H7: Attitude has a significant impact on self-efficacy	Satisfied
H8: Behavioral intention has a significant impact on self-efficacy	Satisfied
H9: Self-efficacy has a significant impact on supply chain transparency	Satisfied

From Table 6, it can be stated that all nine hypotheses, formulated based on the review of previous literature and existing theoretical concepts, were fully supported. The path coefficient analysis demonstrated that the p-values, which indicate the impact of one variable on another, were all below 0.05. For instance, the relationship between self-efficacy (SE) and supply chain transparency (SCT) was indicated by a p-value of 0.000, while the relationship between perceived ease of use (PEU) and SCT was indicated by a p-value of 0.002. These results underscore the importance of digital transformation and blockchain adoption in enhancing supply chain transparency.

The overall findings of the study suggested that both the adoption of digital transformation initiatives and the intention to use newly implemented technologies were critical for improving transparency. Moreover, factors associated with technology adoption positively influenced self-efficacy, which in turn contributed to maintaining supply chain

transparency. Thus, the mediating role of self-efficacy was supported by the results [5]. Validity tests confirmed that the instruments used to collect data were effective in measuring the constructs accurately, and the observed correlations further validated the relationships among the variables. Overall, the quantitative analysis demonstrated that all hypothesised relationships were supported, and the mediating effect of self-efficacy was empirically confirmed.

Based on these results, it can be concluded that pharmaceutical supply chains in China could achieve transparency across social, economic, and environmental dimensions through digital transformation. The findings align with previous studies [1, 22], which emphasized that digital technologies such as information and communication technology (ICT), the Internet of Things (IoT), blockchain, big data analytics, artificial intelligence, robotics, and electronic data interchange (EDI) drive growth and development in the pharmaceutical industry. This study highlighted that digital transformation and blockchain adoption are essential for supply chain transparency, with self-efficacy emerging as the most influential factor. High levels of user trust and technological self-efficacy contributed to more transparent supply chain practices. Employees with strong tech self-efficacy were more likely to utilize complex digital technologies such as blockchain effectively and sustain their use over time. Similarly, other variables behavioral intention, perceived ease of use, and attitude, were significant predictors of supply chain transparency, as reflected by the path coefficients and p-values.

The empirical outcomes regarding self-efficacy corroborated findings from prior research [6], showing that self-efficacy could predict supply chain transparency across multiple dimensions, including quality control, cybersecurity, risk management, and counterfeit drug prevention. Perceived usefulness, while important, was found to be less directly influential compared with self-efficacy. Nonetheless, the findings confirmed that a well-grounded perception of usefulness contributes to sustained professional development and streamlined procedures [7].

The results further illustrated that although perceptions of ease of use and usefulness are fundamental, their impact on fostering positive attitudes and building user confidence is equally critical, collectively enhancing supply chain transparency. Several hypothesised relationships from the research framework were supported, demonstrating that achieving supply chain transparency requires a synergistic approach [8]. The findings emphasized that organisations aiming for higher transparency should not only invest in advanced technologies but also prioritise employee training, skill development, capacity building, and system usability. These initiatives empower employees to adopt and effectively leverage blockchain-based solutions, thereby strengthening transparency in pharmaceutical supply chains.

5. Conclusion

It was concluded from the findings that perceived usefulness, perceived ease of use, attitude, behavioral intention, and self-efficacy all had a significant impact on supply chain transparency. In this study, China also represented a context with strong infrastructure and policy support. The findings further indicated that many Chinese pharmaceutical firms still relied on paper-based systems, which remained a major challenge, particularly in low- and middle-income regions of the country. This study employed a quantitative research method, which represents one of its methodological limitations. Additionally, data were collected solely

from the pharmaceutical industry in China, creating a geographical limitation that affects the generalisability of the findings. Future studies should consider implementing a mixed-methods research approach to provide a more in-depth understanding of digital transformation and blockchain adoption in supply chain transparency. Moreover, collecting data from multiple regions would help capture diverse perspectives and enhance the representativeness of employee opinions across different contexts.

Acknowledgments

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Author Contribution

The authors clearly specified the roles and contributions of each individual involved in the research to ensure proper attribution of credit and transparency regarding responsibilities. Conceptualization of the study was carried out by Li Shuqi and Chee Weiming, while the methodology, data collection, and data analysis were conducted by Li Shuqi. Writing of the manuscript was undertaken jointly by Li Shuqi and Chee Weiming, and supervision of the research was provided by Chee Weiming.

Competing Interest

The author declares that there are no financial, personal, or professional conflicts of interest that could have influenced the conduct, interpretation, or presentation of this research. All aspects of the study were carried out independently and objectively.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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