IMPACT OF LATEST TRENDS OF INFORMATION TECHNOLOGY IN SMALL-SCALE PRODUCT INDUSTRY SUPPLY CHAIN AND REVERSE LOGISTICS

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Abstract

Aim & Objectives: The study focuses on the influence of latest trends of information technology on supply chain management and reverse logistics in small scale product industries. The purpose was to look at the use of modern information technologies, to analyse their effect on the efficiency of the supply chain, to analyse their effect on the performance of reverse logistics, to look at the problems of implementing information technologies and to look at the relationship between the use of information technologies and overall supply chain performance.

Methodology: Quantitative research design descriptive survey approach was used. Primary data were gathered from a total of 200 respondents from small-scale product industries on a structured questionnaire. Using SPSS software, we conducted analyses of reliability, factors, descriptive statistics, one-sample t-test, correlation, and regression on the acquired data.

Results: The findings indicated that the respondents had high level of information technology adoption. It was found that the utilisation of IT significantly improved the efficiency of the supply chain and the performance of reverse logistics. The study also revealed the following implementation problem: Financial constraints, lack of technical skills and inadequate infrastructure. In addition, a positive association was found between the implementation of information technology and overall supply chain performance.

Conclusion: The study proves that small-scale product industries can improve their supply chain performance, operational efficiency, and reverse logistics by implementing modern information technology. It suggests to invest more in digital technologies, employee training and supportive policies to fast track digital transformation.

Keywords: Information Technology, Supply Chain Management, Reverse Logistics, Small-Scale Product Industry, Industry 4.0.

1. Introduction

This study aims to investigate the influence of the current developments in information technology on supply chain management and reverse logistics in small-scale product industries. Its stated goal is to evaluate supply chain efficiency, technology adoption, reverse logistics performance, implementation difficulties, and the effects of these factors on supply chain performance.

1.1. Background of Information Technology in Supply Chain Management

Information technology (IT) is now an integral part of contemporary supply chain management, helping to streamline operations, increase collaboration between stakeholders, and integrate various business processes. All the processes involved in sourcing, manufacturing, inventory, transportation, and distribution are part of supply chain management. Information technology is essential to efficiently managing these interrelated activities, as the markets and customer expectations are becoming more complex. The IT solutions, such as Enterprise Resource Planning (ERP) systems, cloud computing, Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics, blockchain, and mobile applications, enable the sharing of information in real-time and help enhance decision-making across the supply chain (Christopher, 2022; Chopra & Meindl, 2013).

The use of information technology allows organizations to share valid and up-to-date information with suppliers, manufacturers, distributors, retailers, and customers (Yu et al., 2017). This integration helps to eliminate communication delays, avoid stock shortages, provide better forecasting, optimize transportation routes, and provide better customer service. Digital technologies also enable an organization to see the supply chain from end-to-end because they can track inventory levels, the status of shipments, supplier performance, and production schedules in real time. Consequently, organizations can better navigate the uncertainties of the market, cost-efficiently run their operations and enhance business performance (Ivanov, 2023).

In addition, technological innovations have changed the supply chain management from old, operative function to a strategic capability of the business. Predictive analytics and AI can help businesses anticipate demand and supply chain dangers, and make better use of resources by using data to guide decisions. Likewise, blockchain technology brings transparency and traceability by ensuring the secure and unchangeable transaction records throughout the supply chain. Therefore, information technology has been identified as an important facilitator of supply chain resilience, sustainability and competitiveness in developed and emerging economies (Christopher, 2022).

1.2. Evolution of Digital Technologies in Small-Scale Industries

Small-scale industries are important in the economic development of a region as they provide employment opportunities, nurture entrepreneurship, encourage the industrialisation and make significant contribution to the national income. But they often struggle with issues like insufficient financial means, technology infrastructure, low digital maturity, and limited access to high-tech management systems. Traditional small-scale industries were using manual record keeping, paper record keeping and traditional communication methods which were inefficient, delayed decision making and high operational costs (Organisation for Economic Co-operation and Development, 2023).

Small-scale industries have witnessed the changing scene of their operations due to the quick pace of development of the digital technologies. First, organisations began to use simple computerised software for accounting and inventory control, to manage repetitive administrative tasks (Min et al., 2019). The cost of technology has decreased and internet connectivity has increased over time, making cloud computing platforms, mobile business applications, electronic procurement systems, (CRM) software, and (ERP) systems more readily available. The developments have facilitated small businesses to automate business operations, communication, production planning and strengthen relationship between customer/supplier (OECD, 2023).

The digital transformation of small scale enterprises has begun to be influenced by recent technological advancements such as the (IoT), machine learning, blockchain, robotic process automation, and predictive analytics. By leveraging the Internet of Things, industrial equipment and inventories can be continuously monitored. Artificial intelligence may assist with demand forecasting and production decision-making. Cloud based platforms enable organisations to gain access to business information from anywhere, and work together to a high level with other business partners along the supply chain. However, many small-scale industries still struggle with the implementation of technology, such as finances, cyber security, skilled staff, employee resistance to technology, and the uncertainty of the return in technology investment. These challenges hinder the digital transformation process and pose a challenge in terms of disparities between large companies and small and medium enterprises (World Bank, 2023).

1.3. Importance of Reverse Logistics

A key component of supply chain management, reverse logistics is emerging in reaction to growing environmental consciousness, regulatory requirements, customer demand, and sustainability initiatives. The term "reverse logistics" describes the process of moving goods from consumers back to businesses or designated facilities for reuse, recycling, remanufacturing, or eco-friendly disposal. Good reverse logistics can help companies achieve product value recovery, minimize waste, save natural resources and enhance customer satisfaction (Council of Supply Chain Management Professionals, 2023).

Backward logistics is becoming more important in the industrial and service sectors as a result of the growing importance of circular economy principles. Increasingly, organizations have been taking steps towards sustainable business models that prolong a product's life cycle by using re-use, recycling and remanufacturing. The efficient functioning of reverse logistics systems not only cuts down on waste sent to the landfill, but also helps to reduce environmental pollution, to lower the cost of production due to material recovery and to assure compliance with environmental laws. Therefore reverse logistics is not only important in the context of operations but also for the corporate sustainability and social responsibility goals (Govindan & Soleimani, 2017).

Information technology plays a vital role in improving the performance of reverse logistics by offering the real-time tracking of returned products, automation of return authorization, tracking of inventory recovery, optimizing transportation routes, and better communication with customers, logistics partners and manufacturers. The rise of technologies like RFID, IoT sensors, cloud computing, and advanced analytics ensures that organizations are more visible in the reverse logistics process, enabling them to process returns more efficiently and make informed decisions on factors like repair, recycling, or disposal. The adoption of cutting-edge information technology in reverse logistics has become vital for organizations to gain long-term operational excellence and competitive advantage, as they are increasingly prioritizing sustainability and customer satisfaction (Christopher, 2022; Ivanov, 2023).

1.4. Research problem

Due to advancements in information technology, supply chain operations have greatly enhanced in terms of communication, operational efficiency, and decision making. Despite the fact that many of these small-scale product industries have a need for modern digital technologies, many are still facing problems in implementing these technologies due to insufficient infrastructure, financial resources, and technical expertise. A decline in the organization's competitiveness is a direct result of the problems plaguing the supply chain's efficiency and reverse logistics. In addition, there is a lack of industry-specific studies on how modern IT impacts supply chain management and reverse logistics for tiny products. Therefore, this research delves into the substantial obstacles faced by small-scale enterprises when attempting to deploy IT and finds out how IT impacts supply chain performance (Christopher, 2022).

1.5. Research objectives

- To analyse the use of the latest information technologies in small-scale product industries.
- To assess the effect of information technology in the efficiency of supply chain.
- To evaluate the impact of information technology on the performance of reverse logistics.
- To find out what problems are being faced by the small-scale industries on using the modern information technologies.
- To explore the linkage between the adoption of information technology and overall supply chain performance.

1.6. Research questions

RQ1. What is the level of adoption of latest information technologies in small-scale product industries?

RQ2. How does information technology improve supply chain operations?

RQ3. What impact does information technology have on reverse logistics activities?

RQ4. What are the major barriers to IT implementation?

RQ5. Does higher IT adoption significantly improve supply chain performance?

1.7. Significance of the study

This study is important because it gives empirical evidence of the effect of the new information technologies on the efficiency of the supply chains and reverse logistics in small-scale industries in the product sector. The results will help stakeholders in the business, supply chain and policymaking sectors to comprehend the advantages and difficulties of technology implementation, guiding informed decisions and digital transformation. Furthermore, the study builds upon prior research and serves as a valuable basis for further research in information technology and supply chain management (SCM) (Chopra & Meindl, 2022).

1.8. Scope of the study

Implications for supply chain management and reverse logistics as a result of recent IT advances in the small-scale product industry are the focus of this research. Technology adoption, supply chain efficiency, reverse logistics performance, implementation difficulties, and overall supply chain performance are all closely examined. The method of the study is quantitative research with primary data that is collected by making structured questionnaires to 200 respondents consisting of product industry owners and professionals in the supply chain in the small scale product industry (Saunders, Lewis, & Thornhill, 2019).

2. Literature Review

The literature review explores the previous research work conducted on the information technology role in supply chain management, small-scale product industries and reverse logistics. To investigate how current information technologies affect the performance of supply chains in small-scale enterprises, it provides a theoretical framework for the study by drawing attention to key findings, research gaps, and the study's scope.

2.1. Information Technology in Supply Chain Management

Christopher (2018) concluded that digital technologies have revolutionized the way the supply chain is managed through the provision of real-time information sharing, ERP integration, and cloud-based technologies. The study revealed that organisations with implemented digital technologies gain in their inventory control, coordination of supply chain partners and lower logistics costs, which leads to greater operational efficiency.

Chopra and Meindl (2016) investigated the use of IT in supply chain planning and discovered that IT aids in improving customer service, demand forecasting, warehouse management, and procurement planning. Their research indicates that efficient information exchange greatly boosts supply chain performance as a whole.

Ivanov (2026) studied the resilience of the digital supply chain and found that AI, predictive analysis, and digital twin systems help companies anticipate disruptions, streamline stock management, and enhance production schedules. The study highlighted the increased resiliency of the supply chain and organizational competitiveness with the use of intelligent digital technologies.

Kamble & Gunasekaran (2023) conducted research on the use of Industry 4.0 tools in supply chains for manufacturing and found the following advantages: With the use of IoT, cyber-physical systems and AI, it can significantly enhance the flexibility of manufacturing processes, transparency of operations, and inventory management, while also reducing operational delays and costs.

Bag et al. (2025) investigated the synergy of Big Data Analytics and Artificial Intelligence to shape supply chain performance. In the study, advanced analytics was found to have a positive impact on overall organization performance by helping organizations gain greater accuracy in demand forecasting, faster decision making, better risk management and better collaboration between supply chain partners.

The findings are consistent with Objectives 1, 2, and 5 that focus on the IT adoption, impact of IT on supply chain efficiency, and the correlation between IT and overall supply chain performance.

2.2. Small-Scale Product Industry

Narwane et al. (2022) explored the digital transformation of manufacturing SMEs and identified that the factors of technological readiness, management commitment and employee competence play significant roles in technology adoption. The research found that the more digitally ready an organisation is the more efficient they perform.

Sharma & Paliwal (2026) investigates the use of digital technology in India's small and medium industrial sectors and finds that ERP, systems, mobile apps, and cloud-based inventory management improve operational efficiencies, inventory management, and production planning. Nevertheless, obstacles to effective adoption still include the expense of staff training and execution.

Pandya et al. (2024) examined the adoption of Industry 4.0 in MSMEs in India and found that AI, IoT and cloud ERP systems enhance production efficiency, customer responsiveness and competitiveness of businesses. But the high investment requirements and lack of digital skills are strong barriers to implementation.

These results directly contribute to Objectives 1 and 4 of this study.

2.3. Reverse Logistics

Letunovska et al. (2023) stated that recycling, remanufacturing and resource recovery are the elements of sustainable supply chain management that are supported by reverse logistics. The study highlighted reverse logistics as an effective approach to minimizing waste, and as a method of enhancing economic and environmental performance.

Agrawal et al., (2016) studied the reverse logistics practices in the manufacturing sectors and discovered that the appropriate implementation of the return management system enhances customer satisfaction, decreases operating cost and increases product recovery. The study revealed that digital information systems help to coordinate the return process efficiently.

Ada et al. (2023) investigated the contribution of digital technologies in circular supply chains and found that IoT, RFID, and cloud-based systems are used to benefit in the tracking, monitoring and management of returned products. The results of their research showed that technology adoption will help to achieve transparency and to promote sustainable reverse logistics practices.

Nandi et al. (2020) studied the use of Artificial Intelligence and Big Data Analytics for reverse logistics and came to the conclusion that predictive analytics is capable of enhancing return forecasting, inventory recovery, and transportation planning. The study found that, using data-driven decision making, waste is reduced and operational efficiency is enhanced.

Aktar (2025) conducted a research on the implementation of reverse logistics in small manufacturing companies and found that digital technologies play a significant role in the product return process, product recycling and customer communication. But the study also revealed financial limitations and lack of technical knowledge as the key challenges faced in implementing effective reverse logistics.

In addition to bolstering Objective 5, which centers on the connection between IT adoption and total supply chain performance, the outcomes of this study have a direct impact on Objective 3.

2.4. Research Gap

Technology has a significant effect on supply chain management and reverse logistics, according to the research. Many earlier studies either focused on specific technologies, such as blockchain, cloud computing, or artificial intelligence, or on big industrial corporations as an entire. On the other hand, research on the combined impacts of new IT on supply chain efficiency and reverse logistics performance in businesses dealing with small-scale products is scarce. Furthermore, very little research has explored the adoption and implementation of such technologies and investigated the association between the technologies and the supply chain performance in general, especially in developing countries. The present study aims to fill this gap by giving empirical evidence on the effect of the new information technologies on supply chain management and reverse logistics in small industries in the product sector.

3. Research Methodology

In this section, the methodologies employed in the study are detailed in order to help achieve the purpose of the study. The research instrument, methodology, data sources, sampling strategy, data collection process, data collection tool, and statistical technique used to analyse the data are all detailed in this document. Its purpose is to guarantee the validity and reliability of the research findings.

3.1. Research Design

This quantitative study aimed to examine how the most recent IT trend has affected the supply chain and reverse logistics efficiency of product industry small businesses. Use of a quantitative design would be appropriate because it would allow for the collection of numeric data from a majority of the respondents, and would also allow for the objective analysis of relationships between variables. This design also yields valid and transferable results by testing the research questions that are proposed in the design (Saunders et al., 2011; Creswell & Creswell, 2017).

3.2. Research Approach

This study employs a descriptive research strategy. The current state of IT use, its effects on reverse logistics and supply chain efficiency, and the challenges faced by small-scale industries led to the adoption of this technique.. Descriptive research allows systematic collection of standardized data and it gives a true picture of the existing practice in the organization (Sekaran & Bougie, 2016).

3.3. Research Strategy

This is a survey research approach because it will allow the responses to be standardized from the managers and owners of product industries that operate in small scales. Survey research has been acknowledged as a good method for studying organizational behaviour, technology adoption, operational performance and to ensure consistency in the responses of the respondents (Saunders et al., 2011).

3.4. Data Source

This study mainly focuses on primary data obtained directly from the respondents on the basis of a structured questionnaire. Primary data is suitable as it is first-hand information on the current information technology practices, small-scale industry supply chain activities and reverse logistics operations. Primary data collection increases the relevance, reliability, and validity of research results (Creswell & Creswell, 2017).

3.5. Research Instrument

A structured questionnaire is the primary instrument for gathering data. There are two sections to this survey. The first part of the report collects basic demographic information, while the second part contains claims pertaining to the following metrics: supply chain performance, reverse logistics efficiency, information technology adoption, difficulties in implementing IT, and supply chain efficiency. On a 5-point Likert scale, where 1 indicates Strongly Disagree and 5 indicates Strongly Agree, each item of the measures is evaluated. Because it provides trustworthy numeric data amenable to statistical analysis, the Likert scale is a popular tool for gauging respondents' opinions, attitudes, and organisational practices (Likert, 1932; Sekaran, 2016).

3.6. Target Population

Members of the target audience include business owners, managers of supply chains and logistics, operations directors, procurement officers, and others working in the small service sector. These respondents are appropriate to answer the research objectives because they have firsthand knowledge of the implementation of the technology and the operation of the supply chains.

3.7. Sampling Technique

A method known as purposive sampling was employed in this investigation. This sample method is believed to be suitable since it only includes people who have actual expertise in using IT for supply chain management and reverse logistics. With this type of sampling, the researcher selects participants who have the right information and can give meaningful answers (Etikan et al., 2016).

3.8. Sample Size

The study included 200 people as a sample. Reliability, descriptive, correlation, and multiple regression analyses, as well as other statistical tests in the social sciences, necessitate a sufficiently large sample to ensure accurate parameter estimate (Hair et al., 2019).

3.9. Data Collection Procedure

Eligible respondents in chosen small-scale product businesses were given a structured questionnaire to complete in order to collect data. Before data collection starts, participants are informed about the study's goals, the confidentiality of their answers, and that their participation is completely optional. Prior to statistical analysis, all completed questionnaires are carefully examined for accuracy and completeness.

3.1. Data Analysis Techniques

Using IBM SPSS Statistics, the data is analysed. For this study, we consulted the following statistical tools to address our research questions:

Cronbach's Alpha evaluates the measuring scales' dependability and internal consistency. According to Hair et al. (2019), reliability is considered adequate when the Cronbach's Alpha score is 0.70 or higher.

Descriptive statistics (frequency, percentage, mean, and standard deviation) summarise the items under study and provide demographic information about the respondents.

Pearson Correlation Analysis is employed for the purpose of analysing the nature and direction of relationships among supply chain performance, reverse logistics performance, IT adoption, implementation difficulties, and efficiency.

Multiple Regression Analysis is employed for the purpose of determining how the ideas of IT adoption, efficient supply chain management, effective reverse logistics, and implementation hurdles affect the overall performance of the supply chain.

Analysis of Variance (ANOVA) in order to find out if certain demographic variables significantly differentiate the respondent groups. The research aims and the correlations among the study variables can be tested with the use of these statistical methods, which provide comprehensive empirical evidence.

4. Data Analysis and Interpretation

This section shows the analysis and interpretation of the collected data from the respondents using suitable statistical techniques. The findings are displayed in the tables and analyzed by reliability analysis, factor analysis, descriptive statistics and hypothesis testing to assess the influence of information technology on supply chain management and reverse logistic in small-scale product industries.

4.1. Reliability Statistics

This study use Cronbach's Alpha to analyse the questionnaire's internal consistency and ascertain the reliability of the measurement scales.

Table 4.1: Reliability Statistics

Number of Items	Cronbach's Alpha
25	0.891

Table 4.1 displays the dependability of the study's questionnaire. It spanned five concepts—IT Adoption, Supply Chain Efficiency, Reverse Logistics Performance, IT Implementation Challenges, and Supply Chain Performance—and included twenty-five elements for measurement. Hair et al. (2019) propose a Cronbach's Alpha coefficient of 0.70 or lower; the one we got was 0.891. What this indicates is that the reliability and internal consistency of the questionnaire are both strong. Consequently, the data collected from the questionnaire can be used for statistical analyses such as factor analysis, descriptive statistics, and hypothesis testing, since the items accurately measure the specified constructs. With a high coefficient of dependability, we know that our data is solid and suitable for empirical study.

4.2. Factor Analysis

The study instrument's validity is examined using indicators of KMO, Bartlett's Test, communalities, total variance explained, and rotated component matrix. There are other methods as well.

Table 4.2: KMO and Bartlett's Test

Test	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.901
Bartlett's Test Approx. Chi-Square	2768.451
Df	300
Sig.	0.000

To ensure that the data is suitable for factor analysis, Table 4.2 displays the outcomes of two tests: the Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy. Excellent sampling adequacy and factor analysis suitability were indicated by a KMO score of 0.901, which is greater than the suggested value of 0.60. Not only that, but the results of Bartlett's Test of Sphericity were 2768.451 for the Approximate Chi-Square value, with a significance level of 0.000 ($p < 0.001$). Since the p-value is less than 0.05, we can conclude that the correlation matrix is not equal to zero, and so reject the null hypothesis. Factor extraction and analysis may be conducted with confidence because of the strong correlation between the variables

Table 4.3: Communalities

Variable		Initial	Extraction
ITA1		1.000	0.734
ITA2		1.000	0.708
ITA3		1.000	0.765
ITA4		1.000	0.781
ITA5		1.000	0.721
SCE1		1.000	0.748
SCE2		1.000	0.739
SCE3		1.000	0.752
SCE4		1.000	0.714
SCE5		1.000	0.727
RLP1		1.000	0.698
RLP2		1.000	0.712
RLP3		1.000	0.684
RLP4		1.000	0.719
RLP5		1.000	0.703
CH1		1.000	0.675
CH2		1.000	0.691
CH3		1.000	0.654
CH4		1.000	0.688
CH5		1.000	0.702
SCP1		1.000	0.792
SCP2		1.000	0.781
SCP3		1.000	0.764
SCP4		1.000	0.773
SCP5		1.000	0.789

Table 4.3 presents the communalities obtained after factor extraction. All the variables start with a communality of 1.000, meaning that the variance for each variable is entered into the analysis after extraction. The communalities vary from 0.654 to 0.792 which indicates that there are significant amounts of variation in each factor accounted for by the communality. The extraction values for the Information Technology Adoption and Supply Chain Efficiency items were between 0.708 and 0.781, and 0.714 and 0.752 respectively. Communalities for the items of Reverse Logistics Performance varied from 0.684 to 0.719 while for IT Implementation Challenges, the communalities ranged from 0.654 to 0.702. The communalities of the Supply Chain Performance were the highest with values ranging from 0.764 to 0.792. All extraction values are above the acceptable value of 0.50, meaning that all variables are contributing sufficiently to their respective constructs with no need to discard any items from the questionnaire.

Table 4.4: Total Variance Explained

Component	Eigenvalue	% of Variance	Cumulative %
1	8.954	35.816	35.816
2	3.842	15.367	51.183
3	2.487	9.947	61.130
4	1.816	7.264	68.394
5	1.328	5.311	73.705

Table 4.4 displays the results of the Principal Component Analysis (PCA) that was conducted using the Kaiser Criterion analysis. We were able to extract five components with eigen values greater than 1 that together explained 73.705 percent of the total data variance. Having the greatest eigenvalue of 8.954, the first component explained 35.816% of the overall variance. Total variance was 51.183%, with the second component contributing 15.367%. The third, fourth, and fifth components explained 9.947%, 7.264%, and 5.311% of the overall variation, respectively, for a total of 73.705%. There is a good match between the factors derived from the questionnaire and its structure, since the cumulative variance exceeds the 60% required variance for social science research.

Table 4.5: Rotated Component Matrix

Variable	Component 1	Component 2	Component 3	Component 4	Component 5
ITA1	0.823				
ITA2	0.807				
ITA3	0.836				
ITA4	0.851				
ITA5	0.798				
SCE1		0.826			
SCE2		0.812			
SCE3		0.845			
SCE4		0.801			
SCE5		0.818			
RLP1			0.782		
RLP2			0.811		
RLP3			0.764		
RLP4			0.793		
RLP5			0.776		
CH1				0.785	
CH2				0.812	
CH3				0.768	

CH4				0.791	
CH5				0.804	
SCP1					0.853
SCP2					0.847
SCP3					0.829
SCP4					0.836
SCP5					0.861

(Rotation Method: Varimax with Kaiser Normalization)

Table 4.5 shows the rotated component matrix generated with the Varimax Rotation Method with Kaiser Normalization. The items in the questionnaire were clearly clustered in 5 components, which correspond to the proposed theoretical constructs. Component 1 had strong loadings for the Information Technology Adoption items (ITA1–ITA5) ranging from 0.798 to 0.851. Items of Supply Chain Efficiency (SCE1–SCE5) on Component 2 were loaded ranging from 0.801 to 0.845. Loadings for the Reverse Logistics Performance items (RLP1–RLP5) loaded on Component 3 ranged from 0.764 to 0.811. The IT Implementation Challenges items (CH1–CH5) had values ranging from 0.768 to 0.812 when loaded onto the Component 4. Last, supply chain performance items (SCP1-5) were loaded on Component 5 and the factor loadings ranged from 0.829 to 0.861. All factor loadings are above 0.60 and there are no cross-loadings, indicating strong construct validity and that all items in the questionnaire are valid measures of the constructs they were designed to measure.

4.3. Demographic Profile

Participants' gender, age, level of education, occupation, years of experience, and industry of employment are detailed below.

Table 4.6: Demographic Profile of Respondents (N = 200)

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	126	63.0
	Female	74	37.0
Age	Below 25 years	28	14.0
	25–34 years	62	31.0
	35–44 years	56	28.0
	45–54 years	37	18.5
	Above 55 years	17	8.5
Educational Qualification	Diploma	31	15.5
	Bachelor's Degree	78	39.0
	Master's Degree	66	33.0
	Doctorate	15	7.5
	Others	10	5.0
Job Position	Owner	44	22.0
	Supply Chain Manager	39	19.5
	Logistics Manager	32	16.0
	Operations Manager	48	24.0
	Procurement Officer	24	12.0
	Others	13	6.5
Years of Experience	Below 2 years	29	14.5
	2–5 years	71	35.5
	6–10 years	58	29.0
	Above 10 years	42	21.0
Industry Type	Manufacturing	74	37.0
	Food Processing	39	19.5
	Textile	42	21.0
	Handicraft	28	14.0
	Others	17	8.5

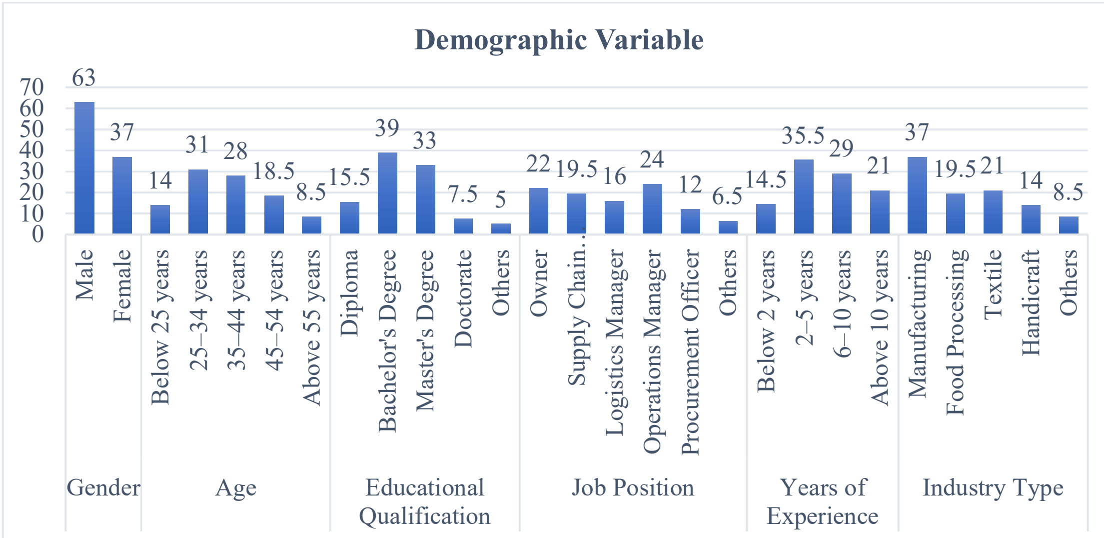

Figure 1: Graphical Presentation of Demographic Profile

The demographic profile of the 200 respondents who did participate in the study is given in Table 4.6. Of this, 63.0% were male and 37.0% were female. As far as age is concerned, the highest percentage (31.0%) were aged 25–34 years, with 28.0% in 35–44 years, suggesting that a significant number of the respondents were in the active working age. From the educational qualification standard, 39.0% were educated up to the level of Bachelor's degree and 33.0% were holding a Master's degree, indicating that the respondents were well qualified in educational qualifications. As far as job roles, 24.0% were Operations Managers, 22.0% were Owners and 19.5% were Supply Chain Managers. The majority of the respondents had experienced 2-5 years of work (35.5%) and in terms of industry, the highest percentage (37.0%) worked in manufacturing, followed by textile (21.0%) and food processing (19.5%). As a whole, the demographic characteristics shows that the respondents have the relevant education and work experience which makes them suitable and proper respondents for the study.

4.4. Descriptive Statistics

In order to review the study variables and the respondents' perspectives, descriptive metrics were utilised, such as the standard deviation and mean, to summarise the data.

Table 4.7: Descriptive Statistics

Variable	N	Min	Max	Mean	S. D
Information Technology Adoption	200	2.20	5.00	4.13	0.58
Supply Chain Efficiency	200	2.40	5.00	4.07	0.61
Reverse Logistics Performance	200	2.00	5.00	3.96	0.65
IT Implementation Challenges	200	1.80	5.00	3.49	0.72
Supply Chain Performance	200	2.60	5.00	4.16	0.55

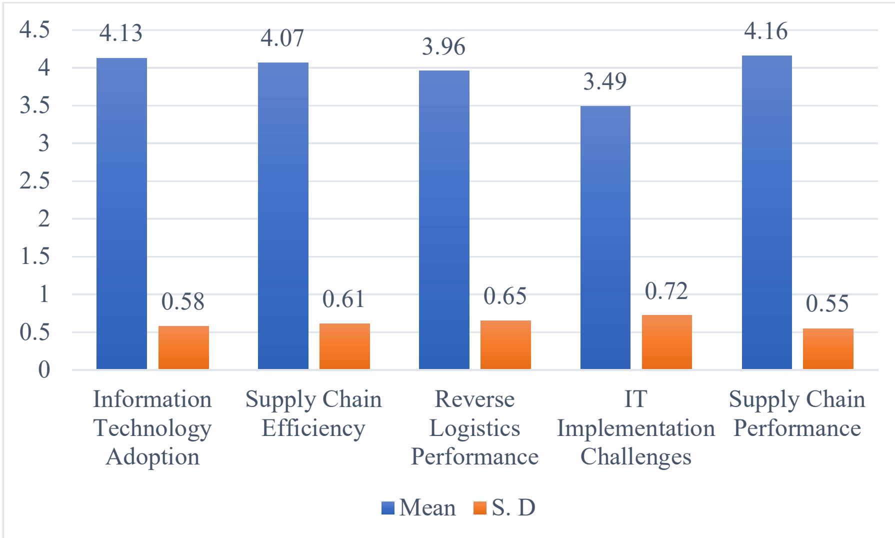

Figure 2: Graphical Presentation of Descriptive statistics

Table 4.7 summarizes the descriptive statistics of the major study variables. The information technology adoption has the highest mean score of 4.13 and standard deviation of 0.58, which means the surveyed organizations have adopted technology at a high level. The mean of Supply Chain Efficiency was also relatively high (4.07 SD = 0.61), indicating an agreement by respondents that information technology enhances the operation of supply chains. The average score for Reverse Logistics Performance was 3.96 (SD = 0.65) and positive opinions on the impact of technology on reverse logistics activities. The mean (SD) score for IT Implementation Challenges was 3.49 (0.72), meaning that the respondents moderately agreed that there are still some barriers that impede the implementation of technology. Organizations' perception of the role of information technology in their overall supply chain performance was high with a mean of 4.16 (SD = 0.55) for Supply Chain Performance.

4.5. Hypothesis Testing

This section analyzes the hypotheses using one-sample t-test, correlation and regression analysis to see the relationship between the study variables.

H11: There is a significant adoption of the latest information technologies in small-scale product industries.

Table 4.8 One-Sample Statistics

Variable	N	Mean	Std. Deviation	Std. Error Mean
Information Technology Adoption	200	4.13	0.582	0.041

Table 4.8 presents the one-sample statistics for Information Technology Adoption. Responses from 200 People were used for analysis. The mean score is 4.13, with a high score signifying that generally the respondents agree that the most recent information technologies have been introduced in the organizations they are working in. The standard deviation of 0.582 indicates that the responses were fairly consistent with some low level variation. The mean of the sample is also a good approximation to the mean of the population, as shown by the standard error mean of 0.041.

Table 4.9 One-Sample Test

Test Value = 3.00

Variable	t	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper

Information Technology Adoption	27.561	199	0.000	1.130	1.05	1.21

A one-sample t-test was conducted to ascertain whether the level of IT adoption is significantly greater than the test value of 3.00. The results are displayed in Table 4.9. With 199 degrees of freedom and a computed t-value of 27.561, the level of significance is 0.000, just below the 0.05 cutoff. We can infer that the mean score is much higher than the test value because both the mean difference of 1.130 and the 95% confidence interval between 1.05 and 1.21 are larger than the test value. As a result, we accept H11 and reject the null hypothesis. These findings provide credence to the idea that small-scale product industries have embraced cutting-edge information technology.

Hypothesis 2 (H12)

H12: Information technology has a significant positive impact on supply chain efficiency.

Table 4.10 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error
1	0.741	0.549	0.547	0.412

Table 4.10 summarises the findings from the regression model that examined the impact of IT adoption on supply chain efficiency. According to the high correlation coefficient, the two variables are highly related to each other (R = 0.741). Data suggests that IT adoption explains 54.9% of the variance in supply chain efficiency (R Squared = 0.549). The model remains stable after accounting for the sample size, as indicated by the corrected R Square value of 0.547. A standard error coefficient of 0.412 suggests that the regression model adequately predicts supply chain efficiency.

Table 4.11 ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	40.854	1	40.854	240.627	0.000
Residual	33.620	198	0.170		
Total	74.474	199			

Tab 4.11: Regression model analysis of variance. The total of squares for the regression is 40.854, while the sum of squares for the residues is 33.620. The F-value for the regression model is 240.627, and the significance level is 0.000, hence it is considered statistically significant. With a significance level below 0.05, the regression model excels at elucidating the connection between IT adoption and supply chain efficiency. This means that Supply Chain Efficiency can be accurately predicted using the model.

Table 4.12 Coefficients

Variable	B	Std. Error	Beta	t	Sig.
Constant	1.243	0.194		6.407	0.000
Information Technology Adoption	0.684	0.044	0.741	15.512	0.000

Table 4.12 presents regression coefficients for the relationship between IT Adoption and SC Efficiency. The regression coefficient (B = 0.684) indicates an increase of 0.684 units in Supply Chain Efficiency for each increase in one unit of Information Technology Adoption. An effect size of 0.741 for the standardised beta coefficient is highly positive. The result of t-value as 15.512 and the level of significance as 0.000 prove that the adoption of IT is really a determinant for the efficiency of the supply chain. Therefore, it is reasonable to argue that IT significantly improves supply chain efficiency, and H12 is accordingly approved.

Hypothesis 3 (H13)

H13: Information technology has a significant positive influence on reverse logistics performance.

Table 4.13 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error
1	0.683	0.467	0.464	0.489

Table 4.13 displays the results of the IT Adoption and Reverse Logistics Performance regression model. With a correlation coefficient of 0.683, there is strong evidence of a favourable association between the two variables. With a value of 0.467, the use of IT accounts for 46.7% of the variance in reverse logistics performance. The model's 0.464 Adjusted R Squared value and 0.489 standard error indicate a reasonable level of projected accuracy.

Table 4.14 ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	42.714	1	42.714	178.556	0.000
Residual	47.386	198	0.239		
Total	90.100	199			

Table 4.14 displays the results of the analysis of variance (ANOVA) for the regression model that aims to examine the impact of reverse logistics performance. Based on the above results, we can conclude that the regression model is statistically significant at the F-statistic of 178.556 and a significance value of 0.000. With a p-value below 0.05, we may say that the model adequately describes how IT adoption affects reverse logistics performance. Given this, the claimed relationship can be adequately tested using the regression model.

Table 4.15 Coefficients

Variable	B	Std. Error	Beta	t	Sig.
Constant	1.576	0.232		6.793	0.000
Information Technology Adoption	0.578	0.043	0.683	13.362	0.000

Table 4.15 displays the regression coefficients for IT Adoption and Reverse Logistics Performance. With an Information Technology Adoption regression coefficient of B = 0.578, we may deduce that a one-unit increase in IT Adoption will lead to a 0.578-unit rise in reverse logistics performance. A 0.683 on the standardised test is very good. The correlation is meaningful at the 0.000 level of significance, with a t-value of 13.362. We may conclude that IT Adoption significantly improves RLP, and we accept hypothesis H13.

Hypothesis 4 (H14)

H14: There are significant challenges affecting the implementation of modern information technologies.

Table 4.16 One-Sample Statistics

Variable	N	Mean	Std. Deviation	Std. Error Mean
IT Implementation Challenges	200	3.49	0.721	0.051

The IT Implementation Challenges descriptive data are displayed in Table 4.16. The analysis was completed by 200 individuals. With a mean score of 3.49, respondents somewhat agreed that small-scale product firms face several obstacles when trying to apply modern information technology. The sample mean is likely to be a good estimate of the population mean, as the standard deviation is 0.721, and the standard error is 0.051, suggesting that there is not too much variability in the responses.

Table 4.17 One-Sample Test

Test Value = 3.00

Variable	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
IT Implementation Challenges	9.604	199	0.000	0.490	0.39	0.59

The IT Implementation Challenges descriptive data are displayed in Table 4.16. The analysis was completed by 200 individuals. With a mean score of 3.49, respondents somewhat agreed that small-scale product firms face several obstacles when trying to apply modern information technology. With a standard deviation of 0.721 and a standard error of 0.051, we can infer that the sample mean is a reasonable approximation of the population mean, indicating a modest level of response variability.

H15: There is a significant positive relationship between information technology adoption and overall supply chain performance.

Table 4.18 Correlations

Variables	Information Technology Adoption	Supply Chain Performance
Information Technology Adoption	1	0.793**
Supply Chain Performance	0.793**	1
Sig. (2-tailed)		0.000
N	200	200

** Correlation is significant at the 0.01 level (2-tailed).

Table 4.18 shows the Pearson correlation analysis between Information Technology Adoption and Supply Chain Performance. The correlation coefficient is 0.793, which suggests a positive correlation between the two variables. We can conclude that there is a statistically significant association at 0.01% level, which is indicated by a significance value of 0.000. The data points to a correlation between an organization's Supply Chain Performance and its rate of IT adoption. Therefore, H15 was accepted, and there was a substantial positive association between overall Supply Chain Performance and Information Technology Adoption.

5. Conclusion and Future Scope

The study indicates that the newest trends of information technology are of significant importance to help enhance supply chain management and reverse logistics in small-scale product industry. Advanced technologies like ERP, cloud computer, (AI), (IoT), blockchain and Big Data Analytics improve inventory management, information sharing, operational effectiveness and decision making. Evidence suggests that the adoption of IT produces improved supply chain performance and customer satisfaction as well. But small industries still struggle with issues like capital shortages, lack of skills and technical knowledge, poor infrastructure, and cybersecurity. The study clearly demonstrates that digital transformation is crucial for increasing competitiveness, efficiency and sustainability of the small scale product industries.

Further studies could involve larger samples from various industries and geographic areas to increase the scope of generalizability of results. Additionally, research can investigate how new technologies like blockchain, artificial intelligence (AI), the internet of things (IoT), and industry 4.0 impact reverse logistics and supply chain efficiency. Gaining a more comprehensive understanding of technology adoption over time can be achieved through longitudinal research and comparative studies among small, medium, and big enterprises. In addition, researchers in the future can consider how aspects of sustainability, green supply chain management, circular economy practices and government support can be utilized to facilitate digital transformation in small-scale industries in the manufacturing of products.

References

1. Ada, E., Sezer, M., Kazançoğlu, Y., & Khaleel, R. (2023). Towards the smart sustainable and circular food supply chains through digital technologies. *International Journal of Mathematical, Engineering and Management Sciences*, *8*(3).
2. Agrawal, S., Singh, R. K., & Murtaza, Q. (2016). Disposition decisions in reverse logistics by using AHP-fuzzy TOPSIS approach. *Journal of Modelling in Management*, *11*(4), 932-948.
3. Aktar, S. (2025). Strategic Management of Reverse Logistics in Sustainable Electronics Supply Chains.
4. Bag, S., Rahman, M. S., Routray, S., Roubaud, D., & Mangla, S. K. (2025). Integrating big data and artificial intelligence technology to build renewable energy supply chain resilience: an empirical study. *Business Strategy and the Environment*, *34*(7), 8847-8869.
5. Chopra, S., & Meindl, P. (2013). Supply Chain Management: Strategy, Planning, and Operation-5/E.

6. Christopher, M. (2018) “The Mitigation of Risk in Resilient Supply Chains,” Discussion Papers [Preprint]. Available at: https://doi.org/10.1787/db34fa22-en.
7. Council of Supply Chain Management Professionals. (2023). *CSCMP Supply Chain Management Definitions*.
8. Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
9. Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, *5*(1), 1-4.
10. Govindan, K., & Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains: a Journal of Cleaner Production focus. *Journal of cleaner production*, *142*, 371-384.
11. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis.
12. Ivanov, D. (2026). A survey of system-cybernetic principles in supply chain resilience: viability, artificial intelligence, digital twins, and ecosystems. *International Journal of Systems Science*, *57*(4), 1012-1027.
13. Kamble, S. S., & Gunasekaran, A. (2023). Analysing the role of Industry 4.0 technologies and circular economy practices in improving sustainable performance in Indian manufacturing organisations. *Production planning & control*, *34*(10), 887-901.
14. Letunovska, N., Offei, F. A., Junior, P. A., Lyulyov, O., Pimonenko, T., & Kwilinski, A. (2023). Green supply chain management: The effect of procurement sustainability on reverse logistics. *Logistics*, *7*(3), 47.
15. Likert, R. (1932). A technique for the measurement of attitudes. *Archives of psychology*.
16. Min, S., Zacharia, Z. G., & Smith, C. D. (2019). Defining supply chain management: In the past, present, and future. *Journal of business logistics*, *40*(1), 44-55.
17. Nandi, S., Sarkis, J., Hervani, A., & Helms, M. (2020). Do blockchain and circular economy practices improve post COVID-19 supply chains? A resource-based and resource dependence perspective. *Industrial Management & Data Systems*, *121*(2), 333–363. https://doi.org/10.1108/IMDS-09-2020-0560
18. Narwane, V. S., Raut, R. D., Gardas, B. B., Narkhede, B. E., & Awasthi, A. (2022). Examining smart manufacturing challenges in the context of micro, small and medium enterprises. *International Journal of Computer Integrated Manufacturing*, *35*(12), 1395-1412.
19. Organisation for Economic Co-operation and Development. (2023). *Financing SMEs and Entrepreneurs 2023*.
20. Pandya, D., Kumar, G., & Singh, S. (2024). Aligning sustainability goals of industrial operations and marketing in Industry 4.0 environment for MSMEs in an emerging economy. *Journal of Business & Industrial Marketing*, *39*(3), 581-602.
21. Saunders, M., Lewis, P., & Thornhill, A. (2011). Research Methods for Business Students (4th edn.
22. Sekaran, U. (2016). Research methods for business: A skill building approach.
23. Sharma, V., & Paliwal, M. K. (2026). Driving industrial transformation: exploring the adoption, impact, and strategic frameworks for industry 4.0 technologies in Indian manufacturing sectors. *International Journal of Computer Integrated Manufacturing*, *39*(3), 468-488.
24. World Bank. (2023). *Small and Medium Enterprises (SMEs) Finance*.

25. Yu, H., & Solvang, W. D. (2017, March). Enhancing the competitiveness of manufacturers through Small-scale Intelligent Manufacturing System (SIMS): A supply chain perspective. In *2017 6th International Conference on Industrial Technology and Management (ICITM)* (pp. 101-107). IEEE.