DIGITAL TRANSFORMATION IN LOGISTICS IMPACT OF AUTOMATION AND ERP SYSTEM

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ABSTRACT

To achieve operational excellence, global logistics companies are undergoing a digital transformation. This research examines the effects of two major technologies, automation, and enterprise resource planning (ERP), on the overall performance of an international freight forwarder based in Chennai, India. The data for this analysis were obtained through structured surveys administered to 50 logistics employees across five functional divisions of the company. The study used a quantitative and empirical research methodology. The study employed a conceptual framework that demonstrated operational efficiency as the intermediary variable, while ERP and automation as independent variables. The moderating factors affecting overall logistics performance included employee training, management support, and employee skills. The study examined many of the primary performance factors of logistics companies, including cost savings, ordering cycle time, warehouse efficiency, real-time shipment visibility, inter-department communications, and total customer satisfaction. Statistical methods, including one-way analysis of variance (ANOVA), chi-square testing, descriptive statistics, and percentage analyses were used to validate the proposed connections. The findings suggest that both enterprise resource planning (ERP) systems and automation are associated with measurable improvements in logistics operations. Specifically, ERP systems have a strong effect on improving transportation and inventory capacity. There are major barriers that could slow the pace of digital advancement for companies in the freight forwarding industry; they include high implementation costs, lack of employee knowledge training, and cybersecurity risks. This research will advance the literature on the digital transformation of logistics in developing countries by providing practitioners and policymakers with empirical and substantial guidance to support them during their digital shift in the freight forwarding business.

Keywords: Supply Chain Management, Automation, ERP Systems, Logistics Performance, Freight Forwarding, Operational Efficiency

INTRODUCTION

The global logistics industry is responsible for managing the movement of products from the supply chain of a local business to the supply chain of an international company, making up a key part of every modern business's circulation system. Because of the rapid increase in digital technology adoption over the past decade or so,

logistics companies have had to evolve from being highly labour- and paper- intensive businesses to seamless user-friendly digital ecosystems as part of the process commonly known as "Digital Transformation." This process of transformation utilises technologies such as automation, Big Data, A.I. and E.R.P.'s to create greater levels of customer satisfaction, lower costs and improved operational effectiveness. Previously, freight forwarders operated on the basis of human judgement and the use of manual documentation and fragmented methods of communication, resulting in frequent service delays, inaccurate shipments and excessive indirect costs. Due to the demand from shippers for speed and transparency in their logistics, logistics companies have introduced digital solutions that reduce manual labour, ensure accuracy, and provide real-time insights into the supply chain.ERP (Enterprise Resource Planning) systems, in particular, have become well-known solutions for businesses because they provide a single integrated platform for key parts (or operational functions) of a company's operation, such as customer service, inventory, finance, and transportation.This research project focuses on how automation and ERP systems have improved (and will continue to improve) logistics performance at a freight forwarding company based in Chennai, India, that serves both domestic and global markets.

NEED FOR STUDY

The logistics sector in India has been facing numerous challenges due to rising pressure from many sources including the demand for cheaper prices, the consumer expectation for immediate visibility, and rising international competition. To solve these issues, traditional operational strategies, including manual scheduling, using multiple data sources and paper-based documentation, no longer work. Thus, it is crucial to understand how Digital Technology (such as ERP Systems or Automation) can help close the operational gap.

OBJECTIVE OF THE STUDY

The principal objective of this proposed research is to determine the effect of automation as well as the use of an ERP system on the logistics performance

Specific objectives of the study are as follows:

To investigate the impact of automation on efficiencies gained in logistical operations.

To examine the extent to which implementing an ERP system improves the management and coordination of information.

To evaluate the mediating impact of operational efficiency on the relationship between logistics performance and digital technologies.

To assess the impact of organisational characteristics (e.g., skills, training, and management support) on the relationship between digital transformation and logistics performance.

To assess the overall impact of digital transformation on logistics performance with respect to costs, speed, and customer service levels.

CONCEPTUAL FRAMEWORK

The conceptual framework integrates various variables using empirical research and the principles of Industry 4.0, which include total-integral and information-driven logistics management (or supply chain), with all parts working together as one system. In this framework, automation and ERP systems are considered independent variables; logistical performance (cost savings, speed, and customer satisfaction) is the dependent variable;

operational efficiency is considered to be the mediating variable; and organizational factors (employee training/support/growth) will act as moderating variables.

RESEARCH GAP

Although there is a lot of research on digital transformation in logistics, there is still enough of an absence of research about the subject that there are gaps in the literature. Most researched have looked into one of three types of organisations (1) developed economies; (2) global manufacturing organisations; and/or (3) types of technologies like automation or ERP or both types simultaneously as they relate to developed organisations. A lack of research is being conducted regarding organisation based constructs as they mediate the relationship of operational efficiency as a dependent variable, especially as they relate to Indian freight forwarding companies. Therefore, the goal of this research is to fill these gaps through an integrated multi-construct analysis.

LITERATURE REVIEW

Recent empirical research demonstrates that the application of digital technologies will improve the logistics performance of companies across all sectors.

Hongsakul, Lalaeng, and Ingard (2025) assessed nine functions of logistics using a wide range of studies and found that implementing cloud, IoT/RFID, and AI/ML technologies produced positive outcomes across multiple finance, flow, quality, customer service, and safety metrics. Companies are required to proactively manage challenges associated with the implementation of these technologies, such as high implementation costs, a shortage of skilled labour, and data security challenges.

Nikiforov, Levkin, and Simak (2023) applied the Jupiter VBA framework to show how a combination of specialized systems (TMS, ERP, WMS, CRM, and SCM) that support logistics automation and deliver competitive advantage by allowing companies to digitise their processes.

Canon et al., a case study of ERP Implementation at a rural distribution company in Brazil. Canon et al., identify phased implementation, stakeholder paticipant and mission-critical process alignment as key factors contributing to success with ERP implementation. In this study, KPIs(A key performance indicator measures are reportable after digital transformation) have been measured before and after the implementation of the ERP system.

Demir, Paksoy, and Kochan's (2020) study develop the context of logistics within the Industry 4.0 paradigm by focusing on how digital integration within logistics, inventory management evolution, and intelligent logistics support the development of competitive advantages via just-in-time delivery and real-time quick responses.

Omoegun et al., show that four (4) ERP-integrated logistics components or modules (i.e., materials management, warehouse management, transportation planning, and supplier relationship management) serve as enablers of reduced lead times, improved compliance, and better customer service.

METHODOLOGY AND METHOD SELECTION:

RESEARCH DESIGN

Descriptive research design was utilized for this study. The basis for utilizing this type of research design relates to the two different research questions established for this study, namely (1) what is the correlation between the research variables (i.e., independent and dependent) and the established hypothesis and (2) how do employees perceive digital transformation.

DATA COLLECTION & SAMPLING

Primary research data were collected from January through April 2026 through the use of standardized questionnaires sent via Google Forms, email, WhatsApp, and meetings with study participants. In total, 50 valid responses were obtained from study participants across five departments such as Operations, Documentation, Warehouse, Customer Service, and Finance/IT. The 50 responses were obtained using a nonprobability convenience sample.

Secondary research data (i.e., academic journals and business records [meaning industry reports and logistics]) were collected to validate the conceptual framework.

QUESTIONNAIRE DESIGN

The survey was designed with a five point Likert scale of 1 to 5 (1 being strongly disagree; 5 being strongly agree) for all closed-ended questions. The first section of the questionnaire collected respondent demographics (age, gender, departments, number of years worked, and job title). The second section contained variables being measured (Operational Efficiency as the dependent variable; ERP Systems and Automation as the independent variable; Organizational Factors, such as training and support from management and skills from employees, as the controlling variables). All of these variables are part of a conceptual framework.

THE HYPOTHEIS

This research tests the following theories:

- H1. Gender and awareness of the digital transformation initiatives are significantly correlated.
- H2. Department and usage of the ERP System for Logistics Operations are significantly correlated.
- H3. Gender is significantly correlated with the perception of digital transformation as a cause of job insecurity.
- H4. Age group and overall satisfaction with automation/ERP System are significantly correlated.
- H5. Gender significantly influences perceived ERP error-reduction.
- H6. There are significant age group differences in perceived warehouse efficiency as a result of automation.
- H7. There are significant departmental differences in perceived productivity associated with digital transformation.
- H8. There are significant differences in perceived automation cost-reduction based on years of experience.

ANALYTICAL TOOLS

Data Analysis utilizes percentage analysis for demographic profiling as well as descriptive stats to construct summaries of the data. Various correlation coefficients have been calculated to analyse bivariate relationships including Pearson's r (bivariate association), regression analysis (hypothesis testing) as well as mediation and moderation analyses (operational efficiency as a mediator and organisational factors as moderators respectively). Categorical associations have been identified using Chi-Square tests whilst analysis of group means has been conducted using one-way ANOVA. All these techniques were performed using IBM SPSS and Microsoft Excel.

ANALYSIS AND INTERPRETATION

Awareness and Technology Adoption

The survey reveals strong awareness of digital transformation initiatives, with 80.4% of respondents confirming knowledge of organisational efforts in this direction. ERP systems are the most widely used individual digital technology (29.4%), followed by AI Tools (17.6%) and Barcode Scanning (11.8%). Notably, 45.1% of respondents reported one to three years of automation technology usage, and 41.2% less than one year, confirming that digital adoption is a recent but rapidly accelerating phenomenon.

Technology	Respondents (n=50)	Percentage (%)
ERP System	15	29.4
AI Tools	9	17.6
Barcode Scanning	6	11.8
Warehouse Automation	4	7.8
RFID	2	3.9
Multiple/Others	14	27.5

Table 1: Digital Technologies Used in the Organisation

According to the table and graph, 29.4% of respondents use ERP System, 17.6% use AI Tools, 11.8% use Barcode Scanning, 7.8% use Warehouse Automation, 3.9% use RFID, and 29.4% use a combination of multiple technologies. This shows that ERP Systems are the most commonly used individual digital technology in logistics organisations.

ERP System Impact

A substantial majority of respondents (82.4%) confirmed ERP system usage in logistics operations. The impact of ERP on reducing manual errors was positively acknowledged by 80.4% of respondents (strongly agree + agree). Inter-departmental communication improvements were endorsed by 70.6%, and 64.7% agreed that ERP accelerates order processing speed. Inventory Management (35.3%) and Transportation (31.4%) were identified as the primary beneficiaries of ERP implementation.

ERP Impact Dimension	Agree/Strongly Agree (%)
Reduces Manual Errors	80.4

Improves Inter-Departmental Communication	70.6
Improves Order Processing Speed	64.7
Enables Real-Time Visibility	58.8

Table 2: Perceived Impact of ERP Systems on Logistics Operations

According to the table, 80.4% of respondents agreed that ERP systems reduce manual errors, 70.6% stated that they improve inter-departmental communication, 64.7% reported improved order processing speed, and 58.8% agreed that ERP systems enable real-time visibility. This shows that reducing manual errors is the most significant impact of ERP systems on logistics operations.

Hypothesis Testing Summary

Four chi-square tests and four one-way ANOVA tests were conducted. All eight hypotheses failed to reject the null at the 0.05 significance level, indicating that perceptions of digital transformation benefits are consistent across gender, age group, department, and years of experience. A near-significant ANOVA result for departmentwise productivity ($F = 2.393$, $p = 0.064$) suggests that Customer Service (Mean = 4.17) and Operations (Mean =

4.00) departments perceive higher productivity gains relative to Warehouse (Mean = 2.83).

Hypothesis	Test	F/Chi-sq	p-value	Result
Gender vs DT Awareness	Chi-Square	0.000	1.000	H0 Not Rejected
Dept. vs ERP Usage	Chi-Square	1.896	0.755	H0 Not Rejected
Gender vs Job Insecurity	Chi-Square	2.226	0.329	H0 Not Rejected
Age vs Satisfaction	Chi-Square	3.887	0.692	H0 Not Rejected
Hypothesis	**Test**	**F/Chi-sq**	**p-value**	**Result**

Gender vs ERP Reduces Errors	ANOVA	0.629	0.432	H0 Not Rejected
Age vs Warehouse Efficiency	ANOVA	0.160	0.853	H0 Not Rejected
Dept. vs Productivity	ANOVA	2.393	0.064	H0 Not Rejected*
Experience vs Cost Reduction	ANOVA	0.318	0.812	H0 Not Rejected

Table 3: Summary of Hypothesis Testing Results (* Near-significant, $p < 0.10$)

INFERENCE:

According to the table, all hypothesis tests resulted in p-values greater than 0.05, including Gender vs DT Awareness (1.000), Department vs ERP Usage (0.755), Gender vs Job Insecurity (0.329), Age vs Satisfaction (0.692), Gender vs ERP Reduces Errors (0.432), Age vs Warehouse Efficiency (0.853), Department vs Productivity (0.064), and Experience vs Cost Reduction (0.812). This shows that there is no significant relationship between demographic factors and the impact of ERP and digital technologies, although Department vs Productivity was found to be near-significant.

CHI SQUARE TEST:

Chi-Square Tests

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	**2.226**	**2**	**0.329**
Likelihood Ratio	**2.223**	**2**	**0.329**

Linear-by-Linear Association	**0.035**	**1**	**0.852**
N of Valid Cases	**50**		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 4.20.

INFERENCE:

Based on the chi-square test results, the Pearson Chi-Square value is 2.226 with a p-value of 0.329, which is greater than 0.05. Therefore, we fail to reject the null hypothesis (H_0). There is no statistically significant association between Gender and the perception that Digital Transformation creates Job Insecurity. Both male and female employees express a similar degree of uncertainty regarding job security, with 'Maybe' being the most common response, reflecting widespread ambiguity across genders about the employment impact of automation in logistics.

ANOVA TEST:

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	0.866	3	0.289	0.318	0.812
Within Groups	41.714	46	0.907		
Total	42.580	49			

INFERENCE:

Based on the one-way ANOVA results, the F-value is 0.318 with a significance value of 0.812, which is well above 0.05. Therefore, we fail to reject the null hypothesis (H_0). There is no statistically significant difference among employees with varying levels of experience in their perception that automation reduces operational costs. Employees ranging from those with less than one year of experience to those with above six years of experience all moderately agree that automation contributes to cost reduction in logistics operations, reflecting a uniform attitude across all experience levels.

FINDINGS

Awareness & Acceptance

- The 80.4% of employees are aware of the digital transformation plans of the company shows good internal communication.
- ERP systems are the most popular standalone digital technology in logistics operations, used by 82.4 per cent of respondents.
- 86.3% of respondents say automation technologies have been deployed broadly over the past three years.

Impact of the ERP System

- ERP has tremendously reduced the manual errors (80.4%), increased the order processing speed (64.7%) and improved the interdepartmental communication (70.6%).
- The two departments that benefit the most from ERP are Transportation and Inventory Management, with 66.7% of all positive remarks.

•Chi-square analysis supports universal adoption of ERP in all departments regardless of departmental membership.

The Advantages of Automation

• regarding these perceptions, suggesting that the benefits of automation are broadly and consistently recognized. Problems The main barrier to digital adoption is the high implementation costs (35.3%), resistance to change (17.6%) and lack of personnel training (25.5%). • With the proliferation of digital platforms, the challenge of cyber security threats (11.8%) and system integration problems (9.8%) is growing. • 76.5% of respondents have received training for new systems, leaving a 23.5% training coverage gap.

Satisfaction and Security in Employment

- 43.1% of respondents are unsure whether digital transformation threatens employment, in line with general concern about automation at the industry level

Generally, 66.6% of workers state they are satisfied with the automation and ERP systems, with little difference in satisfaction between age groups.

- Slight near-significant trend ($p = 0.064$) for warehouse employees reporting less productivity gains than Customer Service and Operations employees, according to ANOVA by department.

RECOMMENDATIONS

1. Select phased or cloud-subscription ERP models to mitigate high implementation costs and ease the financial strain on logistics companies with constrained resources.

2. Create structured, role-specific digital literacy programs to close the 23.5% training gap among employees, especially for warehouse and documentation staff.

3. Focus on specific automation investments in warehouse operations with the lowest productivity impression (Mean=2.83) such as automated sorting and RFID-based inventory control.
4. Implement proactive change management techniques, such as early stakeholder engagement and leader communication, to minimize resistance and foster a culture that embraces digital innovation. 5. Invest in cybersecurity infrastructure that matches the growing integration of digital platforms, including consistent security audits, data encryption methods, and training to improve employee awareness. 6. Solve system integration problems and ensure seamless communication between ERP, automation tools and third-party logistics systems with API-based middleware or enterprise integration platforms. 7. To make clear how technology is augmenting work, not replacing it, and to advocate reskilling programmes to allay fears of mass job insecurity.

8. Build on Customer Service's existing high perception of efficiency by utilizing ERP-embedded CRM modules to further empower it with data-driven client interaction capabilities.

9. Deploy AI-powered analytics dashboards that turn operational data into actionable intelligence for improving demand forecasting and optimizing routes.

10. Create a special committee for digital transformation to assess new technologies, such as blockchain for trade documentation and predictive maintenance systems, and maintain competitiveness.

CONCLUSION

The results of this study provide empirical support for the assertion that logistical performance can be improved through the use of automation and ERP systems in a digitally transformed manner in terms of measurable improvements including decreased errors, improved inter-department coordination, increase in order processing speed, increase in warehouse efficiency and increased responsiveness to customers. Furthermore, across all demographics (gender, age, department, and experience), positive assessments regarding digital technology utilization are statistically similar, thereby providing strong evidence of entrenched use of digital technologies in organizational ways of operating. Additionally, the study identifies lingering structural barriers that must be removed in order to fully benefit from a digitally transformed organization such as high implementation costs; low levels of training coverage; and cybersecurity risks. The lack of productivity in warehouse operations suggests an area that requires further investment and management attention due to the near-significant ANOVA result indicating a trend toward lower productivity ratings for this area.

Digital transformation is about more than just technology; there is a human aspect to it too. At the core of digital transformation is the uncertainty that exists around jobs, which organisations need to manage with transparency, empathy and a commitment to reskilling their employees. Digital transformation has both a strategic and cultural aspect which fundamentally transforms the way future work will happen – through reshaping the roles and processes of organisations, and their position relative to competitors. As the global freight forwarding industry

reaches USD 285 billion in 2030 and with the Indian logistics market growing at an average of 6-6.4% per annum, organisations that have an integrated digital capability along with a commitment to developing their human capital and sound governance will be well positioned for capturing new value. The findings of this study provide a strong empirical foundation for strategic alignment and contribute to the academic discussion on logistics digitalisation in development economies.

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