Analysing Workforce Utilization in Third-Party Logistics Operations

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ABSTRACT

Third-Party Logistics (3PL) providers play a vital role in supply chain management by handling warehousing, transportation, inventory control, and manpower deployment. In manpower-intensive warehouse operations, efficient workforce utilization is essential for improving operational productivity, minimizing delays, and maintaining service quality. This study examines workforce utilization in a third-party logistics warehouse by analyzing key operational factors such as manpower allocation, shift scheduling, technology adoption, and storage and packing efficiency. The research adopts a descriptive research design and uses a census method covering 80 employees across inbound, outbound, inventory, and transport departments. Primary data were collected through structured questionnaires, and reliability testing using Cronbach's Alpha indicated strong internal consistency ($\alpha = 0.841$). Multiple regression analysis revealed a significant positive relationship between composite operational factors and internal process performance ($R = 0.571$, $R^2 = 0.326$, $p < 0.001$). The findings indicate that systematic workforce planning, balanced manpower distribution, and technology-enabled operations significantly enhance logistics efficiency. The study provides practical managerial insights for improving manpower utilization and operational performance in 3PL warehouse environments.

KEYWORDS: *Third-Party Logistics, Workforce Utilization, Manpower Allocation*

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I. INTRODUCTION

Third-Party Logistics (3PL) providers play a crucial role in modern supply chains by managing warehousing, transportation, inventory control, and manpower deployment on behalf of client organizations. In manpower-intensive logistics environments, workforce utilization directly affects operational efficiency, cost control, service quality, and customer satisfaction. Inefficient allocation of labour can result in delays, workload imbalance, higher operational costs, and reduced productivity.

In Indian 3PL operations, warehouse activities such as inbound receiving, outbound dispatch, inventory handling, and transport coordination rely heavily on human resources despite increasing automation. Therefore, systematic analysis of workforce utilization is essential to identify gaps in manpower planning, shift scheduling, and technology adoption.

This study analyses workforce utilization in a third-party logistics operation. focusing on how manpower allocation, shift scheduling, technology usage, and storage practices influence internal process performance. By empirically examining workforce-related operational factors, the study contributes practical insights for improving manpower efficiency in 3PL environments.

II. REVIEW OF LITERATURE

Srinivas and Srinivas (2018) developed a comprehensive framework for evaluating 3PL performance by integrating operational efficiency, service quality, and managerial effectiveness. Their study emphasizes that manpower utilization is a core operational driver influencing process reliability and customer satisfaction, suggesting that workforce efficiency is central to sustainable logistics performance.

Mohanraj et al. (2024) examined workforce scheduling challenges in logistics depots and proposed optimization-based scheduling models to improve manpower utilization. Their findings indicate that structured scheduling significantly reduces idle time and workload imbalance while improving throughput, reinforcing the importance of systematic workforce planning in logistics operations.

F.E.Cucchiella et al. (2021) analyzed the characteristics of high-performing 3PL warehouses and found that effective manpower management combined with technology adoption enhances warehouse efficiency. The study highlights that trained personnel, supported by automation tools and standardized processes, significantly improve accuracy and operational speed.

K.Saeed et al. (2018) investigated the contribution of 3PL providers to supply chain efficiency and identified manpower productivity as a key factor affecting lead time reduction and inventory turnover. Their results confirm that efficient workforce deployment strengthens operational responsiveness and provides competitive advantage in logistics services.

Ellram, Tate, and Billington (2016) focused on performance measurement in outsourced logistics relationships and found that manpower-related indicators such as picking accuracy, processing speed, and error rates are critical in evaluating 3PL performance. The study underscores the strategic importance of workforce effectiveness in achieving consistent internal process performance

III. THEORITICAL FRAMEWORK

The theoretical framework of the study explains the relationship between workforce and operational factors and logistics efficiency in a third-party logistics (3PL) environment. Grounded in workforce utilization and operations management theory, the framework assumes that effective allocation of human resources, appropriate use of technology, and efficient internal processes are critical for achieving high logistics efficiency. In this study, logistics efficiency in a 3PL environment is treated as the dependent variable, while the independent variables include the number of workers assigned, technology usage, internal process performance, and operational factors such as storage systems, picking accuracy, use of automation, and staff efficiency. Adequate manpower allocation reduces operational bottlenecks, technology usage enhances accuracy and speed, strong internal processes ensure smooth workflow and SOP adherence, and efficient storage and picking systems supported by skilled staff minimize errors and delays. The framework proposes that improvements in these workforce and operational factors positively influence logistics efficiency, leading to enhanced productivity, service quality, and overall operational performance in 3PL operations.
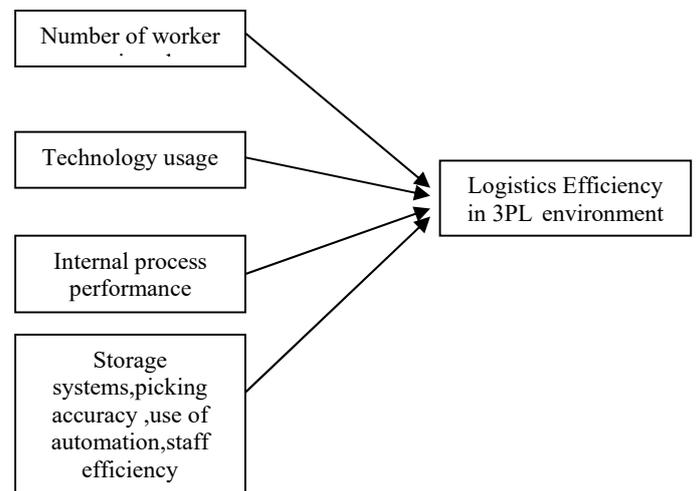
CONCEPTUAL MODEL

Figure.1: Conceptual framework

IV.OBJECTIVE OF THE STUDY
Primary Objective
- To analyze the key operational factors influencing workforce utilization efficiency in third-party logistics (3PL) operations,

with emphasis on productivity, cost efficiency, and operational continuity.

Secondary Objectives

- To evaluate the effectiveness of shift scheduling and workforce allocation in meeting operational demands in 3PL environments.
- To examine internal processes and standard operating procedure (SOP) compliance in minimizing operational delays and errors.
- To assess the influence of operational factors such as shift scheduling, workforce strength, technology adoption, storage systems, packing accuracy, automation, and employee efficiency on internal process performance.

V.SCOPE OF THE STUDY

The scope of the study is confined to analyzing workforce utilization within the operational departments namely inbound, outbound, inventory, and transport of a manpower-intensive third-party logistics warehouse. The research focuses on internal process performance, manpower allocation practices, shift scheduling, and the role of technology in supporting operational efficiency. The study is based on primary data collected from employees and supervisors involved in day-by-day logistics activities, along with secondary data relevant literature. The findings are applicable to similar 3PL warehouse environments but are not intended to represent the entire logistics industry.

VI.LIMITATION OF THE STUDY

The study is subject to certain limitations that should be considered while interpreting the findings. It is restricted to a single third-party logistics organization, which limits the generalizability of the results to other logistics firms or regions. The analysis is based on data collected during a specific time period and may not capture seasonal fluctuations in workforce demand. Additionally, employee responses may be influenced by personal perceptions or response bias, and the study primarily emphasizes operational aspects of workforce utilization without incorporating broader organizational or financial performance factors.

VII.RESEARCH METHODOLOGY
A.RESEARCH DESIGN

The study adopts a descriptive research design, as it aims to analyze existing workforce utilization practices without manipulating operational variables. This design is suitable for understanding manpower deployment, internal process efficiency, and employee perceptions in a real-time logistics environment.

B.POPULATION AND DATA COLLECTION

A census method was used, covering all employees involved in operational activities across inbound, outbound, inventory, and transport departments.

- **Primary data** were collected through structured questionnaires and direct interaction with employees and supervisors.
- **Secondary data** relevant logistics literature.

C.RELIABILITY AND TOOLS FOR ANALYSIS

The reliability of the questionnaire was confirmed using Cronbach's Alpha (0.841), indicating strong internal consistency. Descriptive statistics were used to analyse demographic and workforce characteristics, and multiple regression analysis was applied to assess the impact of operational factors on internal process performance

VIII. DATA ANALYSIS

The descriptive analysis of all categorical variables, as presented in the table below, highlights the major findings of the study.

Table 1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Age	Below 25 years	68	85.0
	25–34 years	11	13.8
	35–44 years	1	1.2
Total		80	100.0
Gender	Male	63	76.8
	Female	17	23.2

Total		80	100.0
Department	Inbound	32	39.0
	Outbound	22	26.8
	Inventory	21	28.0
	Transport	5	6.1
Total		80	100.0
Designation	Workers	50	61.0
	Supervisors	20	24.4
	Managers	10	14.6
Total		80	100.0
Work Shift	Day	47	57.3
	Night	12	14.6
	Rotation	21	28.0
Total		80	100.0

INTERPRETATION:

The workforce is predominantly young and operational in nature, with a high concentration in inbound and inventory departments. The gender distribution indicates a male-dominated workforce, highlighting scope for diversity improvement. Employees reported positive perceptions of internal process performance, highlighting well-structured operational processes, minimal inter-stage delays, prompt supervisory intervention, and strict adherence to standard operating procedures. The mean scores across all items were close to strong agreement, indicating that operational workflows are effectively managed and consistently implemented across the warehouse operations.

IX.IMPACT OF WORKFORCE FACTORS ON INTERNAL PROCESS PERFORMANCE (REGRESSION ANALYSIS)

Regression analysis is used to examine the relationship between variables and to understand how one variable affects another. In this study, it is applied to analyze the effect of operational factors (independent variable) on internal process performance (dependent variable). The results show that operational factors have a significant influence on internal process performance, indicating that improvements in operational practices lead to better efficiency and effectiveness in third-party logistics operations.

TABLE .2: MODEL SUMMARY

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.571ª	.326	.318	.30649	.326	38.689	1	80	.000

a. Predictors: (Constant), Composite Operational Factor

TABLE.3: ANOVA

ANOVA					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3.634	1	3.634	38.689	.000ᵇ
Residual	7.515	80	.094		
Total	11.149	81			

a. Dependent Variable: internal process performance

b. Predictors: (Constant), Composite Operational Factor

Table .4: Coefficient

Coefficients							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	.747	.147		5.101	.000	.456	1.039
Operation Performance	.550	.088	.571	6.220	.000	.374	.726
a. Dependent Variable: internal process performance							

Multiple regression analysis showed:

- R = 0.571 (moderate positive relationship)
- R² = 0.326 (32.6% variance explained)
- p < 0.001 (statistically significant)

INTERPRETATION:

Composite operational factors shift scheduling, number of workers assigned, technology usage, and storage & packing efficiency significantly influence internal process performance in 3PL operations.

X.MANAGERIAL IMPLICATIONS

- Effective workforce planning can significantly improve internal process efficiency in 3PL warehouses.
- Balanced manpower allocation across departments reduces workload pressure and operational delays.
- Technology enabled workforce management enhances coordination and reduces manual errors.
- Department-specific performance differences indicate the need for targeted manpower interventions rather than uniform policies.

XI.CONCLUSION

The study confirms that workforce utilization is a critical determinant of operational efficiency in third-party logistics environments. Although Sathya Sai Transport demonstrates generally effective manpower management, disparities across departments, manpower shortages, and limited technological penetration affect overall performance. Statistical evidence shows that improvements in workforce planning, technology usage, and storage efficiency can significantly enhance internal process performance. By adopting data-driven workforce strategies and integrating human resource practices with technology, 3PL firms can achieve sustainable operational excellence and competitive advantage.

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