A Study On Key Success Factors For Enhancing Supply Chain Performance At Fourrts (India) Laboratories Pvt. Limited.

[1]R. KESAVAPRIYA, [2]S. GRACE PRASANNA

[1]STUDENT, [2]ASSISTANT PROFESSOR

[1,2]Department of Management Studies,

[1,2]Anand Institute of Higher Technology, Chennai, Tamilnadu, India

Abstract: This study adopted a descriptive research design and collected primary data from 80 workers at Fourrts (India) Laboratories Pvt. Ltd. with structured questionnaires using convenience sampling. The data was analyzed through descriptive statistics, regression, correlation, and structural equation modeling (SEM) using PSPP and SmartPLS. The findings show that supply chain performance is significantly influenced by technological factors such as digital transformation, IT infrastructure, and real- time visibility. Environmental compliance and employee involvement were found to support operational resilience and long-term sustainability, while social and infrastructural elements indicate potential areas for improvement. The study recommends focused investments in digital systems, stronger supplier relationships, and workforce skill enhancement to ensure regulatory compliance, lower costs, improved customer satisfaction, and long-term growth in the pharmaceutical sector.

Keywords - **Supply Chain Management, Pharmaceutical Industry, Supply Chain Performance, Key Success Factors, Technological Dimension.**

I. INTRODUCTION

Supply Chain Management (SCM) plays a vital role in the pharmaceutical sector, where precision, compliance, and responsiveness are non-negotiable. In this highly regulated environment, the effectiveness of a company's supply chain can determine its market competitiveness, customer satisfaction, and operational resilience. SCM is not merely a process of logistics and distribution; it encompasses strategic alignment, digital integration, environmental consciousness, and interdepartmental coordination (Mehmeti et al., 2016).

At the core of efficient supply chain performance is the need to integrate key success factors such as technological advancement, supplier reliability, workforce competence, and regulatory compliance. As highlighted in recent studies, sustainability-related factors environmental, economic, and social are increasingly shaping modern supply chains (Pragmawiguno et al., 2023). In the pharmaceutical industry, these dimensions are especially important due to the sector's sensitivity to product quality, lead times, and policy mandates.
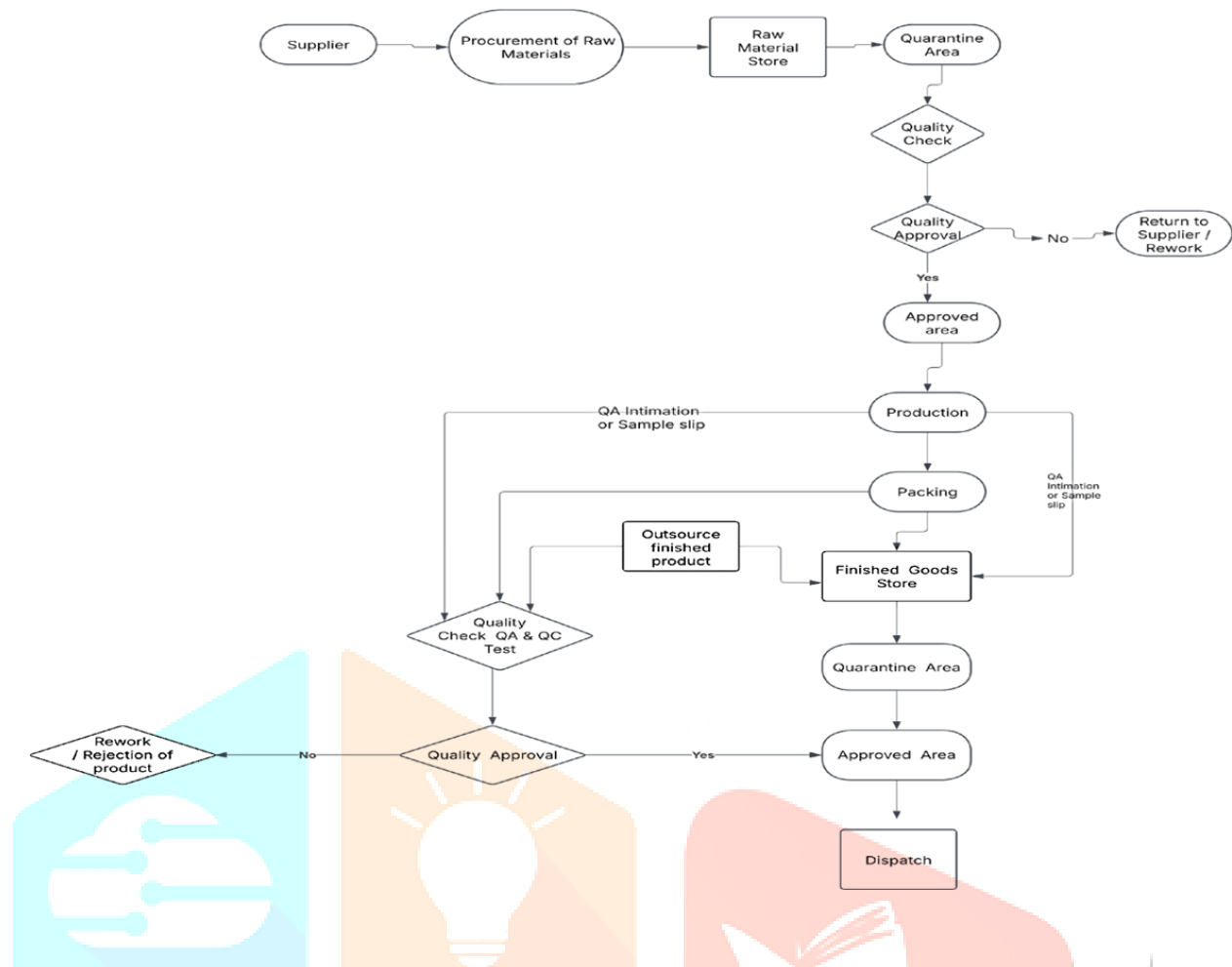
Figure 1. Supply chain management process at Fourrts (India) Laboratories Pvt. Limited

This study investigates the critical internal and external success factors affecting the supply chain performance of Fourrts (India) Laboratories Pvt. Ltd., a pharmaceutical company based in Chennai, India. Through statistical tools like correlation, regression, and Structural Equation Modeling (SEM), this research seeks to uncover how supply chain performance is influenced by the interplay of digital systems, workforce engagement, compliance protocols, and infrastructural elements.

By addressing these elements, this study aims to propose a framework for pharmaceutical firms to enhance their operational efficiency, ensure compliance, and build resilient supply chains that support long-term growth and customer trust.

II.REVIEW OF LITERATURE

A review of the past studies has identified technology integration, employee involvement, supplier coordination, and environmental compliance as significant drivers of supply chain success (Nilay Shah, 2004; Qamar Atta ul Haq, 2022). For example, Gagas Pragmawiguno et al. (2023) used Structural Equation Modeling (SEM) to analyze the influence of economic, social, and environmental factors on sustainable supply chains. Similarly, Hasib Ahmed et al. (2024) conducted a system atic literature review of 46 studies, assessing technological collaboration and its positive impact on sustainable supply chain management.
Sandeep Puri and Jayanthi Ranjan (2020) adopted a qualitative field-study approach supported by secondary data to identify logistics inefficiencies in India's pharmaceutical sector. Uday Kumar Kanike (2023) performed a conceptual review of supply chain disruptions, citing root causes like regulatory changes and raw material shortages. Asad et al. (2024) applied the DEMATEL technique to evaluate interrelationships among internal performance drivers such as human resource competencies and IT systems in European pharmaceutical companies. Qin Xiao and Khan (2024) utilized a mixed-methods approach, including SmartPLS- based quantitative analysis and NVivo-based qualitative coding, to examine how communication, organizational culture, and digital readiness influence supply chain resilience in China's healthcare sector.

Supply Chain Management (SCM) is defined as "the management of flows of products, information, and funds across the entire supply chain, from suppliers to manufacturers to distributors to retailers and customers." Chopra and Meindl (2019), It emphasizes the coordination and integration of these flows to create value and achieve competitive advantage. Several factors influence the effectiveness of SCM. In your project, the following major dimensions have been identified, measured, and studied:

➢ **Technological Factors**

Digital transformation, ERP systems, and real-time visibility significantly improve traceability, inventory management, and communication between stakeholders. Adoption of advanced technology facilitates smoother coordination, reduces delays, and increases transparency in supply chain operations (Gagas Pragmawiguno et al., 2023).

➢ **Environmental Factors**

Environmental compliance, such as regulatory approvals, waste disposal practices, and pollution control board clearances, are crucial for ensuring smooth operations without legal interruptions. Regulatory adherence also strengthens trust and reputation (Qamar Atta Ul Haq, 2022).

➢ **Social Factors**

Employee involvement in safety practices, ethical handling of logistics, and social responsibility across the supply chain contribute to performance and sustainability. Awareness among the workforce promotes operational efficiency (Sandeep Puri & Jayanthi Ranjan, 2020).

➢ **Economic Factors**

Availability of raw materials, strong supplier relationships, and cost-efficient logistics systems directly influence the performance of the supply chain. Factors like efficient order fulfillment, production continuity, and pricing control are key to cost savings and service quality (Uday Kumar Kanike, 2023).

III. OBJECTIVES OF THE STUDY

Primary Objective of the Study

➢ To study key success factors for enhancing supply chain performance at Fourrts (India) Laboratories Pvt. Limited.

Secondary Objective of the Study

➢ To analyse the factors of supply chain management
➢ To examine the impact of factors on supply chain management performance in Fourrts (India) Laboratories.
➢ To provide suggestions for improvement of supply chain performance.

IV. RESEARCH METHODOLOGY

3.1 Population and Sample

Researchers studying supply chain performance (e.g., Chopra & Meindl, 2019; Christopher, 2016; Ivanov et al., 2021) have emphasized the role of internal stakeholders—particularly operational staff and mid-level managers—in understanding the effectiveness of supply chain practices. Therefore, the population for this study consists of employees working in various departments at Fourrts (India) Laboratories Pvt. Ltd., including production, quality control, logistics, and procurement.

3.2 Data and Sources of Data

For this study, primary data has been collected. A non-probability convenience sampling method was used to select the respondents. Primary data was collected through a self-structured questionnaire distributed to 80 respondents from different functional areas involved in supply chain operations. The survey responses were recorded using a five-point Likert scale, where 1 indicated "Strongly Disagree" and 5 indicated "Strongly Agree." The collected data was analysed using Perfect Statistics Professionally Presented (PSPP) and SmartPLS for Structural Equation Modeling (SEM). Descriptive statistics, reliability testing, and factor analysis were used to validate the constructs and understand the relationships between variables.

The research instrument was a structured questionnaire developed based on previous studies on supply chain performance and key success factors (Nilay Shah, 2004; Uday Kumar Kanike, 2023; Qamar Atta Ul Haq, 2022; Hasib Ahmed et al., 2024).

The questionnaire was divided into two parts:

Part 1: Focused on demographic details such as department, years of experience, and functional area within the supply chain.

Part 2: Contained scale-based items measuring the following variables:

➢ Technological Factors

- ➤ Environmental Factors
- ➤ Social Factors
- ➤ Economic Factors
- ➤ Supply Chain Performance
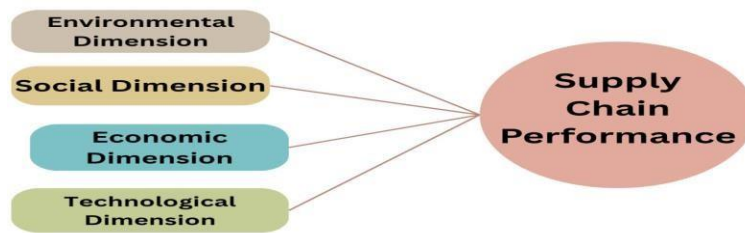All items were measured using a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Figure 2. Proposed research model

V. DATA ANALYSIS AND INTERPRETATION

Key success factors affecting supply chain performance were examined across four dimensions: environmental, social, economic, and technological. The data collected from 80 employees was analyzed using PSPP for descriptive statistics, regression and correlation analyses, and SmartPLS for Structural Equation Modeling (SEM) were also conducted.

Table 1: Demographic characteristics of the respondents

VARIABLES AND CATEGORIES	F(N=80)	%
GENDER		
MALE	66	82.5%
FEMALE	14	17.5%
EDUCATIONAL QUALIFICATIONS		
GRADUATION	33	41.25%
POST GRADUATION	39	48.75%
PREFER NOT TO SAY	8	10%
YEARS OF EXPERIENCE		
BELOW 5 YEARS	7	8.75%
5-10 YEARS	18	22.5%
10-15 YEARS	22	27.5%
ABOVE 15 YEARS	33	41.25%
DEPARTMENT		
Factory Admin	14	17.5%
Distribution	5	6.25%
HR	1	1.25%
Logistics	7	8.75%
Systems	2	2.5%
Packing	1	1.25%
International Business	7	8.75%
PPIC	5	6.25%
Production	7	8.75%
QA	6	7.5%
QC	11	13.75%
RM Sores	5	6.25%
R&D	5	6.25%
EDUCATIONAL QUALIFICATIONS		
GRADUATION	33	41.25%
POST GRADUATION	39	48.75%
PREFER NOT TO SAY	8	10%
Source: Primary Data		

Table 1 presents the demographic profile of the respondents considered for this study. Out of 80 participants, the majority were male (82.5%), and most held postgraduate (48.75%) or graduate (41.25%) qualifications. A large portion (41.25%) had more than 15 years of experience, indicating that responses were mainly from experienced professionals. The departments most represented were Factory Admin (17.5%), QC (13.75%), and Logistics/Production (8.75% each), showing diverse functional backgrounds among participants.

5.1 Descriptive Statistics

The study examined how people perceived the environmental, social, technological, and economic aspects of supply chain success. The findings revealed significant agreement on company compliance with environmental standards, effective resource management, good digital systems, and opportunities for improvement in workforce and infrastructure-related social concerns.

The key dimensions Environmental, Social, Economic, and Technological were each constructed by grouping four related survey factors identified through literature review and expert validation. These individual factors were averaged to represent each dimension for analysis. The summary of these computed dimension scores is shown below.

Table 2. Based on descriptive statistics

Dimension	N	Mean	Std. Dev	Min	Max
Environmental Dimension	80	4.18	0.38	3	5
Social Dimension	80	3.68	0.35	3	4.25
Economic Dimension	80	4.03	0.38	3	4.75
Technological Dimension	80	3.98	0.58	2.5	5
Supply Chain Performance	80	4	0.52	2.75	4.5

5.2 Structural Equation Modeling (SmartPLS)

SmartPLS was used to test the influence of Environmental, Social, Economic, and Technological factors on Supply Chain Performance (SCP).
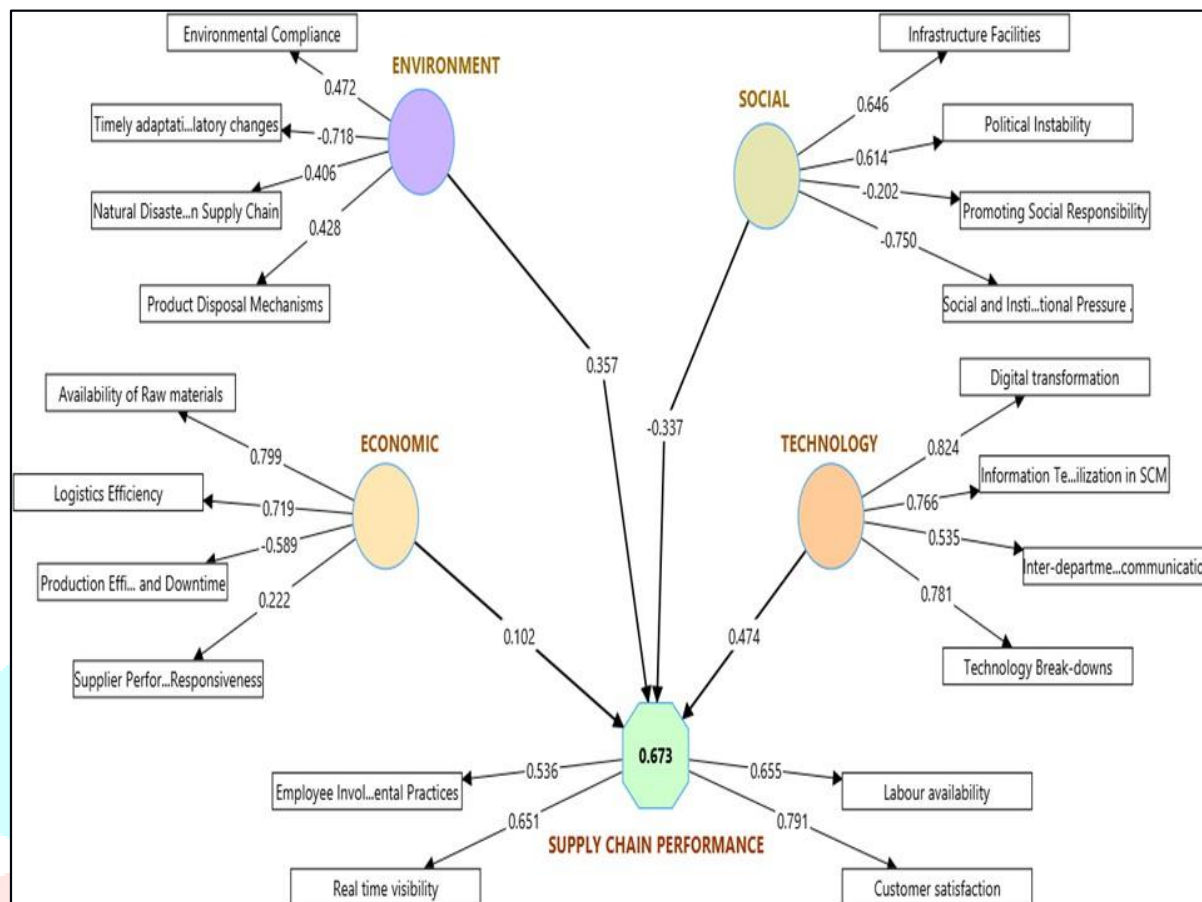

Figure 3. Proposed path model showing the impact of environmental, social, economic, and technological factors on supply chain performance using SmartPLS

Table 3: Structural equation modeling (SEM): partial least square (PLS) analysis

Independent Variable	Dependent Variable (SCP)	Path Coefficient (β)
Technological Factors	Supply Chain Performance	0.474
Environmental Factors	Supply Chain Performance	0.357
Economic Factors	Supply Chain Performance	0.102
Social Factors	Supply Chain Performance	-0.337
	R² for SCP	**0.673**

Technological factors had the strongest positive influence ($\beta = 0.474$) on supply chain performance, followed by environmental factors ($\beta = 0.357$). Social factors ($\beta = -0.337$) showed a negative impact, and economic factors had a weak positive effect. The model explains 67.3% of the variance ($R^2 = 0.673$) in SCP, confirming a significant relationship among the variables.

5.3 CORRELATION ANALYSIS

Pearson correlation analysis was used to assess the strength and direction of association between the SCM factors and supply chain performance.

		Environmental dimension-	Social dimension-	Economic dimension-	Technological dimension-	Supply chain performance-
Environmental dimension	Pearson Correlation	1.000	.077	.070	-.189	.093
	Sig. (2-tailed)		.497	.538	.094	.413
	N	80	80	80	80	80
Social dimension	Pearson Correlation	.077	1.000	.448$_a$	-.204	-.232$_a$
	Sig. (2-tailed)	.497		.000	.070	.039
	N	80	80	80	80	80
Economic dimension	Pearson Correlation	.070	.448$_a$	1.000	.408$_a$	.104
	Sig. (2-tailed)	.538	.000		.000	.359
	N	80	80	80	80	80
Technological dimension	Pearson Correlation	-.189	-.204	.408$_a$	1.000	.480$_a$
	Sig. (2-tailed)	.094	.070	.000		.000
	N	80	80	80	80	80
Supply chain performance	Pearson Correlation	.093	-.232$_a$	.104	.480$_a$	1.000
	Sig. (2-tailed)	.413	.039	.359	.000	
	N	80	80	80	80	80

a. Significant at .05 level

Table 4: Correlation analysis

A moderate and significant positive correlation was observed between technological factors and SCP (r = 0.480). A significant negative correlation was found between social factors and SCP (r = -0.232). environmental and economic factors showed no significant correlation.

5.4 REGRESSION ANALYSIS

A multiple linear regression was conducted to determine the effect of each factor on supply chain performance.

Table 5: Regression analysis

Variable	Beta (β)	T-Statistic	Significance (p)
Constant	3.91	11.94	0.000 (**Significant**)
Environmental Factors	0.07	0.82	0.413 (Not Significant)
Social Factors	-0.15	-2.1	0.039 (**Significant**)
Economic Factors	0.08	0.92	0.359 (Not Significant)
Technological Factors	0.53	4.84	0.000 (**Significant**)

- R^2 = 0.23
- F-statistic = 23.41
- Overall Model p-value = 0.000

The regression model confirms a significant overall relationship (p < 0.01). Technological factors had a strong, positive, and statistically significant effect on SCP, while social factors had a significant negative effect. Environmental and economic factors were statistically insignificant in predicting SCP in this model.

VI. CONCLUSION

This study aimed to identify the key factors that influence supply chain performance at Fourrts (India) Laboratories Pvt. Ltd. Data was collected from 80 employees using a structured questionnaire and analyzed through PSPP and SmartPLS. The results showed that technological and environmental factors had a significant positive impact on supply chain performance. These included th e use of ERP systems, real-time tracking, and proper waste management. Social factors had a negative impact on the performance, and economic factors had less influence.

Among all, technology was found to be the most important factor in improving supply chain efficiency. The study highlights the need for better digital systems, regulatory compliance, and employee involvement to strengthen supply chain operations.

VII. LIMITATIONS OF THE STUDY

Although the objective of the study is met, there are still some limitations of the present study.

➢ The study is limited only to plant 1 of Fourrts India laboratory Pvt. Ltd., Kelembakkam, Chennai, so the results and analysis are not applicable to plant 2.

➢ Data availability is restricted due to confidentiality, limiting access to some internal supply chain metrics.

➢ Findings are specific to Fourrts (India) Laboratories Pvt. Limited and may not be fully generalizable to other pharmaceutical companies. Despite these limitations, the study provides valuable insights into key success factors for enhancing supply chain performance.

VIII. References

[1]. Ahmed, H., Al Bashar, M., Taher, M. A., Rahman, M. A., & Global Mainstream Journal of Innovation, Engineering & Emerging Technology. (2024). Innovative approaches to sustainable supply chain management in the manufacturing industry: a systematic literature review. Global Mainstream Journal of Innovation, Engineering & Emerging Technology.

[2]. Asad, A. I., Popesko, B., & Godman, B. (2024). Unraveling the internal drivers of pharmaceutical company performance in Europe: A DEMATEL analysis. Equilibrium. Quarterly Journal of Economics and Economic Policy, 19(2), 661–702.

[3]. Chopra, S., & Meindl, P. (2019). Supply chain management: Strategy, planning, and operation (7th ed.). Pearson Education.

[4]. Christopher, M. (2016). Logistics and Supply Chain Management. 5th Edition, Pearson, London.

[5]. Pragmawiguno, G., Setiawan, A., & Mulyati, H. (2023). Analysis of the factors affecting performance of sustainable supply chain management of Garut Arabica Coffee. Jurnal Manajemen Bisnis, 14(1), 179–197.

[6]. Hasib, A., Al Bashar, M., Abu Taher, M., & Rahman, M. A. (2024). A systematic review of sustainable supply chain collaboration: Technological innovations and strategic integration. Journal of Operations and Technology Management

[7]. Ivanov, D., Tsipoulanidis, A., & Schönberger, J. (2021). Global supply chain and operations management (3rd ed.). Springer

[8]. Kanike, U. K. (2023). A conceptual review on supply chain disruptions in the manufacturing sector: Causes and strategic responses. International Review of Operations Research

[9]. Mehmeti, E., Krasniqi, E., & Bajraktari, R. (2016). Supply chain performance and pharmaceutical logistics: A case-based approach. Journal of Applied Pharmaceutical Research.

[10]. Puri, S., & Ranjan, J. (2020). Exploring logistics inefficiencies in the Indian pharmaceutical industry: A qualitative field study. International Journal of Pharmaceutical Logistics.

[11]. Qamar Atta ul Haq. (2022). Supply chain resilience in the pharmaceutical sector of Pakistan: A strategic review. Asian Journal of Business and Logistics.

[12]. Qin, X., & Khan, M. S. (2024). Exploring supply chain resilience and performance in China's healthcare sector: A mixed-method study using SmartPLS and NVivo. Health Systems and Logistics Research Journal.

[13]. Shah, N. (2004). Pharmaceutical supply chains: Key issues and strategies for optimization. Computers & Chemical Engineering.

[14]. Uday Kumar, K. (2023). Disruptions in manufacturing supply chains: Causes, consequences, and countermeasures. Manufacturing Systems Journal.

[15] Factors influencing the performance of supply chain management in manufacturing industry of
. Pakistan. (2015). In Industrial Engineering Letters: Vol. Vol.5 (Issue No.3, pp. 34–35).