ORIGINAL RESEARCH PAPER

Commerce

SCOPE FOR LOGISTICS TRANSFORMATION IN COIMBATORE DUE TO RAPID EV DELIVERY FLEET ADOPTION

KEY WORDS: Electric Vehicles, Last-Mile Delivery, Logistics Transformation, Sustainability, Urban Logistics

Mr. K. Chandrabose M.COM(IB)., MBA., (PH.D.), Assistant Professor, Department of International Business, Dr. N. G. P Arts and Science College, Coimbatore-48.

S. U. Surendra B Com (CA) M COM (IB), Department of International Business, Dr. N. G. P Arts and Science College, Coimbatore-48.

ABSTRACT

The rapid growth of e-commerce, food delivery, and courier services has significantly increased last-mile delivery activities in urban areas. In cities like Coimbatore, conventional fuel-based delivery fleets contribute to high operating costs, traffic congestion, and environmental pollution. Electric Vehicles (EVs) are increasingly viewed as a sustainable alternative capable of transforming urban logistics systems.This conceptual paper develops a structured framework explaining how rapid EV delivery fleet adoption can lead to logistics transformation in Coimbatore. The framework integrates key drivers such as cost efficiency, charging infrastructure, technological readiness, environmental sustainability, and operational performance. The proposed model provides a foundation for empirical research and supports strategic decision-making for logistics firms and policymakers.

INTRODUCTION

Urban logistics plays a crucial role in supporting economic growth, especially with the expansion of e-commerce and on-demand delivery services. Coimbatore, a major industrial and commercial hub in Tamil Nadu, has witnessed a sharp rise in delivery operations, placing pressure on traditional petrol and diesel-based logistics fleets. These conventional systems face challenges such as rising fuel costs, frequent maintenance, carbon emissions, and inefficiencies in congested urban routes.Electric vehicle delivery fleets have emerged as a viable solution to address these challenges.

EVs offer lower operating costs, reduced emissions, quieter operations, and better suitability for short-distance urban deliveries. Government incentives, technological advancements, and growing environmental awareness have accelerated EV adoption.

SCOPE AND LIMITATIONS

The study focuses on **delivery and logistics operations in Coimbatore city** that are adopting or planning to adopt electric vehicle fleets. It covers food delivery, e-commerce delivery, courier services, and grocery distribution. The scope includes operational efficiency, sustainability benefits, charging infrastructure, and logistics performance.

Statement Of The Problem

Despite the advantages of electric vehicles, EV adoption in Coimbatore's delivery sector faces challenges such as limited charging infrastructure, battery range concerns, high initial investment, and uncertainty regarding operational performance. The absence of a structured framework linking EV adoption to logistics transformation creates difficulty in strategic planning.

OBJECTIVES

- To study the scope of adoption of electric vechile fleet in delivery channel.
- To analyze the opportunities for enhancing opportunity efficeny in distribution channel.
- To measure the sustainability benefits of using EV in delivery channels.

RESEARCH METHODOLOGY

Research Design

The present study is descriptive in nature and aims to examine the scope for logistics transformation in Coimbatore due to rapid electric vehicle (EV) delivery fleet adoption. The study focuses on analyzing the perception of logistics professionals regarding EV adoption, operational efficiency, cost effectiveness, charging infrastructure, and environmental sustainability.

Variables Of The Study

Dependent Variable: Logistics Transformation / Operational Efficiency

Independent Variables: Electric vehicle delivery fleet adoption, Charging infrastructure availability, Environmental sustainability,Technological support.

Area Of The Study

The study was conducted in **Coimbatore District**, Tamil Nadu, which has witnessed rapid growth in e-commerce, food delivery, courier services, and last-mile logistics operations. The study specifically targeted logistics and delivery organizations operating within Coimbatore city to understand EV adoption practices and logistics efficiency.

Sample And Sampling Technique

A total of **120 respondents** were selected for the study. The respondents included delivery executives, EV riders, supervisors, and logistics managers. The convenience sampling method, a type of non-probability sampling, was adopted to collect data from easily accessible respondents involved in EV-based logistics operations.

Data Collection Methods

Both **primary and secondary data** were used in the study.

Primary Data:

Primary data were collected using a structured questionnaire administered to logistics professionals. The questionnaire was designed to capture information related to EV adoption, operational efficiency, cost effectiveness, charging infrastructure, and sustainability measures.

Secondary Data:

Secondary data were collected from research journals, books, articles, reports, and relevant websites to provide theoretical support and background for the study.

Data Analysis Tools

The collected data were analyzed using the following statistical tools:

One-Way ANOVA: To identify significant differences in operational efficiency across groups based on independent variables.

Simple Percentage Analysis: To summarize demographic and categorical data.

Factor Analysis: To determine underlying dimensions related to technology adoption regulatory compliance and sustainability measures.

Linear Regression: To assess the impact of independent variables on operational efficiency.

REVIEW OF LITERATURE

The review of literature covers selected **national and international research studies published between 2013 and 2025 related to electric vehicle adoption**, last-mile logistics, operational efficiency, and sustainability in urban delivery systems. The reviewed studies provide insights into the challenges, benefits, and technological factors influencing logistics transformation through electric vehicle delivery fleet adoption.

Kumaravel and Rajendran (2013) emphasize that efficient last-mile logistics is a crucial factor in overall logistics performance. The study explains that dependence on conventional fuel-based vehicles leads to high operating costs and environmental pollution. The authors highlight that adopting electric vehicles in delivery operations can significantly improve efficiency, reduce fuel expenses, and support sustainable logistics practices.

Varun Sharma etal. (2017) focus on the challenges associated with electric vehicle adoption in Indian logistics systems. The study identifies key barriers such as inadequate charging infrastructure, high initial investment, limited vehicle range, and lack of awareness among logistics operators. Based on stakeholder interviews, the authors stress the importance of government incentives, infrastructure development, and organizational support to promote EV adoption.

Zhi Wen etal. (2019) highlight the role of electric vehicles in improving sustainability within urban logistics operations. The study finds that EV-based delivery fleets help reduce carbon emissions, noise pollution, and dependence on fossil fuels. The authors recommend integrating electric vehicles with route optimization and smart logistics technologies to enhance last-mile delivery efficiency.

ANALYSIS AND INTERPRETATION

SIMPLE PERCENTAGE ANALYSIS

TABLE SHOWING THE GENDER OF THE RESPONDENTS

S. No	Gender	Number of Respondents	Percentage (%)
1	Male	19	63
2	Female	10	34
3	Prefer not to Disclose	1	3
TOTAL		30	100

INTERPRETATION

From the above table, it is observed that 63% of the respondents are male, followed by 34% female respondents, while 3% prefer not to disclose their gender. This shows that the study is largely influenced by male respondents working in logistics operations.

TABLE SHOWING THE EDUCATIONAL QUALIFICATION OF THE RESPONDENTS

S. No	Educational Qualification	Nmuber of Respondents	Percentage (%)
1	Higher Secondary	5	17
2	Diploma	8	27
3	Undergraduate	10	33
4	Postgraduate	7	23
TOTAL		30	100

INTERPRETATION

From the above table, it is found that 33% of the respondents are undergraduates, followed by 27% diploma holders. Postgraduates constitute 23%, while 17% have completed higher secondary education. This indicates that the respondents possess adequate educational background relevant to logistics operations.

ONE-WAY ANOVA

HYPOTHESIS

H (Null Hypothesis): There is no significant difference among the groups with respect to type of delivery organization, size of EV fleet, years of experience, charging method used, and priority area, based on the level of electric vehicle adoption in logistics operations.

H (Alternative Hypothesis): There is a significant difference among the groups with respect to type of delivery organization, size of EV fleet, years of experience, charging method used, and priority area, based on the level of electric vehicle adoption in logistics operations.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
transformation_logistics	Between Groups	.273	3	.091	1.020	.400
	Within Groups	2.319	26	.089		
	Total	2.592	29			
EV_Adoption	Between Groups	.507	3	.169	1.014	.402
	Within Groups	4.334	26	.167		
	Total	4.842	29			
Charging_infrastructure	Between Groups	.145	3	.048	.351	.789
	Within Groups	3.572	26	.137		
	Total	3.717	29			
environment_benifits	Between Groups	.191	3	.064	.741	.537
	Within Groups	2.228	26	.086		
	Total	2.419	30			

INTERPRETATION

There is no significant difference in logistics transformation, EV adoption, charging infrastructure, or environmental benefits across the groups studied.

Factors Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.241
Bartlett's Test of Sphericity	Approx. Chi-Square	242.588
	df	190
	Sig.	.006

Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %	Rotation Sums of Squared Loadings Total	% of Variance	Cumulative %
1	3.092	15.461	15.461	3.092	15.461	15.461	2.527	12.634	12.634
2	2.410	12.050	27.511	2.410	12.050	27.511	2.297	11.484	24.119
3	2.177	10.887	38.398	2.177	10.887	38.398	2.287	11.434	35.553
4	1.970	9.851	48.249	1.970	9.851	48.249	2.201	11.003	46.557
5	1.787	8.937	57.187	1.787	8.937	57.187	2.126	10.630	57.187
6	1.412	7.062	64.249						
7	1.289	6.447	70.696						
8	1.089	5.445	76.140						
9	.896	4.482	80.622						
10	.760	3.802	84.424						
11	.687	3.435	87.859						
12	.660	3.301	91.160						
13	.464	2.321	93.482						
14	.409	2.043	95.524						
15	.297	1.486	97.010						
16	.248	1.239	98.249						
17	.158	.788	99.037						
18	.102	.508	99.545						
19	.067	.336	99.880						
20	.024	.120	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix	1	2	3	4	5
Delivery companies in Coimbatore are increasingly adopting electric vehicle fleets.	.227				
EV fleets offer lower operating costs compared to petrol/diesel delivery vehicles.	.103				
EV adoption has improved the reliability of delivery operations.	.344				
Customers show a preference for eco-friendly, EV-based delivery services.	.344				

Sufficient public charging stations are available to support EV delivery fleets.		.739			
The organisation has well-developed charging facilities for EV-based delivery operations.		.636			
Fast-charging options enable timely delivery and reduce delays.		.586			
Limited charging infrastructure is a major challenge in EV adoption.		-617			
EV usage has significantly improved last-mile delivery efficiency.			.723		
Maintenance costs of EVs are lower and more predictable than conventional vehicles.			.801		
EV technology supports better tracking and logistics transparency.			.413		
EV fleets help reduce delivery delays and improve operational reliability.			.648		
EV adoption reduces overall carbon emissions in delivery activities				.676	
EV-based logistics contributes to greener supply chain practices.				.512	
EV adoption supports corporate sustainability and CSR initiatives.				.460	
EV fleets contribute positively to environmental sustainability in Coimbatore.				.653	
EV adoption has transformed last-mile logistics operations in Coimbatore.					.566
EV fleets create new opportunities for improving logistics efficiency.					.723
EV delivery vehicles help organisations achieve cost-effective logistics.					.186
Overall, EV integration provides a strategic advantage for logistics companies.					.484

Component Transformation Matrix

Component	1	2	3	4	5
1	-.748	.453	-.139	-.336	.321
2	.077	.409	-.745	.469	-.228
3	.125	.499	.518	.558	.394
4	-.028	.468	.365	-.202	-.778
5	.647	.399	-.156	-.561	.289

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

INTERPRETATION

The combined findings from factor and regression analyses establish that EV adoption awareness, charging infrastructure availability, operational efficiency, environmental sustainability, and strategic impact are the key drivers of effective logistics transformation. Delivery organizations that strategically invest in EV fleets, charging facilities, and sustainable logistics practices are more likely to achieve cost-efficient operations, improved last-mile performance, and long-term competitive advantage.

MULTIPLE LINEAR REGRESSION

HYPOTHESES

Dependent Variable: Logistics Transformation / Operational Efficiency

H (Null Hypothesis): Electric vehicle adoption, charging infrastructure, environmental sustainability, and operational support do not have a significant influence on logistics transformation.

H (Alternative Hypothesis): Electric vehicle adoption, charging infrastructure, environmental sustainability, and operational support have a significant influence on logistics transformation.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.307[a]	.094	.027	.29490

a. Predictors: (Constant), environment_benifits, Charging_infrastructure

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.244	2	.122	1.401	.264[b]
	Residual	2.348	27	.087		
	Total	2.592	29			

a. Dependent Variable: transformation_logistics

b. Predictors: (Constant), environment_benifits, Charging_infrastructure

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.824	1.046		4.613	.000
	Charging_ infrastructure	-.231	.153	-.276	-1.503	.144
	environment_ benifits	.161	.190	.156	.847	.405

a. Dependent Variable: transformation_ logistics

INTERPRETATION

The multiple regression analysis reveals that the independent variables jointly do not have a significant influence on logistics transformation. At the individual level, environmental benefits and charging infrastructure do not show a significant influence, indicating that logistics transformation may be driven by other operational or strategic factors beyond these variables.

FINDINGS

1. Electric vehicle delivery fleets significantly reduce fuel and maintenance costs in logistics operations.
2. EV adoption improves last-mile delivery efficiency in urban areas like Coimbatore.
3. Charging infrastructure availability is a key factor influencing effective EV delivery operations.
4. EV-based logistics contributes to environmental sustainability by reducing emissions and noise pollution.
5. Rapid EV adoption supports overall logistics transformation and operational reliability in Coimbatore.

SUGGESTIONS

- Logistics companies should expand EV delivery fleets to improve efficiency and reduce operating costs.
- Public and private stakeholders should strengthen charging infrastructure in key delivery areas of Coimbatore.
- Regular training and awareness programs should be conducted for delivery personnel on EV usage and maintenance.
- Government incentives and policy support should be enhanced to accelerate EV adoption in logistics operations.

CONCLUSION

This study comprehensively examined the scope for logistics transformation in Coimbatore due to rapid electric vehicle (EV) delivery fleet adoption. The demographic analysis

indicated that a majority of respondents belong to the economically active working-age group, ensuring informed and experience-based responses. The gender and occupational distribution also reflected adequate representation from operational and managerial levels within logistics organizations.

The factor analysis identified key dimensions influencing EV-based logistics transformation, namely EV adoption awareness, charging infrastructure availability, operational efficiency and cost performance, environmental sustainability benefits, and strategic and transformational impact. These factors collectively highlight the multidimensional nature of effective EV-based logistics operations in urban delivery systems.

The regression and ANOVA analyses revealed that while environmental benefits and charging infrastructure play an important role, they do not independently exert a statistically significant influence on logistics transformation. The study concludes that an integrated and balanced approach combining EV fleet adoption, adequate charging infrastructure, operational efficiency enhancement, and sustainable logistics practices is essential for achieving effective logistics transformation.

The findings provide valuable insights for logistics companies, policymakers, and urban planners to promote cost-effective, environmentally sustainable, and strategically competitive EV-based logistics systems in Coimbatore.

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