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Impact of Reverse Logistics Activities on Construction Project Management Cost Performance: Evidence from Abuja, Nigeria

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Abstract
Reverse logistics (RL) in construction can improve value recovery and reduce waste, yet it may also introduce additional logistics costs that affect project cost performance. This study evaluates the cost implications of key RL activities on construction project management in building projects within the Abuja Municipal Area Council, Nigeria. Primary data were collected from 25 construction professionals at active building project sites using a structured mixed-method questionnaire. Descriptive statistics were used to profile cost intensity across five RL activity dimensions: transportation, warehousing, material handling, time management, and cost management. Results indicate that transportation is the most cost-intensive RL activity (60% of responses in the high-cost category of ₦1 million and above), followed by warehousing and material handling (48% each). Cost management also shows notable intensity (44% high-cost), while time management is largely perceived as low-cost (64% low-cost; 8% high-cost). The findings indicate that RL cost exposure in Abuja projects is driven primarily by the physical logistics requirements of reverse flows, movement, consolidation, storage, and handling, rather than administrative effort alone. The study concludes that better reverse-flow planning, routing, consolidation, and fit-for-purpose storage and handling systems can strengthen cost control and improve cost performance in construction project management.

Keywords: *Reverse logistics, construction cost performance, transportation, warehousing, material handling.*

1.0 Introduction

Reverse logistics (RL) refers to the planning, implementation, and control of the backward flow of materials, components, and products from the point of use to recovery, reuse, recycling, remanufacturing, or safe disposal (de Brito and Dekker, 2004). In the construction industry, RL is increasingly linked to circular-economy goals because it supports the recovery of residual value from construction and demolition materials, reduces pressure on landfills, and improves resource efficiency throughout the project life cycle. Recent scholarship shows that interest in RL in construction has expanded considerably. Yet, practical implementation remains constrained by fragmented supply chains, weak market structures for secondary materials, limited data visibility, and insufficient integration of RL requirements into project planning and control (Chen *et al.*, 2024; Huang *et al.*, 2025). Although reverse logistics is now well established in manufacturing and retail supply chains, its application in construction remains comparatively underdeveloped. This is important because construction projects involve bulky materials, dispersed sites, uncertain return volumes, and temporary production systems, all of which can intensify reverse-flow costs.

Chileshe *et al*. (2016) indicated that reverse logistics implementation in the construction industry remains limited. In the Nigerian context, very few studies have examined reverse logistics practices. Some of these studies, however, focused on the relationship between reverse logistics and economic performance (Somuyiwa and Adebayo, 2014), environmental sustainability (Oko and Nkamnebe, 2013), and waste management (Amole *et al.*, 2018). Recent studies on the circular economy and waste reduction in construction confirm growing awareness of material recovery and resource efficiency (Unegbu *et al.*, 2025). Still, empirical evidence on the specific cost implications of RL activities at the project level remains limited.

Against this background, this study examines the cost implications of reverse logistics activities on construction project management throughout a project lifecycle in Abuja, Nigeria. By focusing on transportation, warehousing, material handling, time management, and cost management, the study addresses the need for context-specific evidence in an emerging economy. It provides insight for project managers, contractors, and policy actors seeking to integrate resource recovery into project delivery without undermining cost performance. The contributions may offer significant benefits to stakeholders in the construction industry. Additionally, this study aims to inspire and guide future research on reverse logistics in the construction industry, contributing to the growth of this field.

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1.1 Cost management

Cost management in reverse logistics involves identifying, measuring, allocating, and controlling costs associated with collecting, sorting, transporting, storing, processing, and recovering returned materials. Ravi and Shankar (2005) point out that a lack of cost transparency and poor information systems are major barriers to effective cost management in reverse logistics. In construction, these costs are often less predictable than forward logistics costs because reverse flows are irregular in timing, quantity, location, and condition.

Recent literature emphasises that effective RL cost management depends on visibility of return flows, accurate information systems, and coordination among project actors so that recovery options can be evaluated against disposal alternatives on both economic and operational grounds (Namweseza *et al.,* 2024; Hassan and Osman, 2025). Effective cost management in reverse logistics depends on synchronising disassembly, inventory management, and market timing (Ilgin and Gupta, 2010). In practical terms, cost management in RL is not only about reducing expenditure; it is also about improving value recovery, preventing avoidable handling and transport losses, and supporting better project-level cost decisions.

1.2 Transportation

Transportation is widely recognised as one of the most critical and costly elements of reverse logistics. In construction projects, reverse transportation involves moving surplus materials, returned items, reusable components, and waste streams from project sites to suppliers, storage facilities, recyclers, or disposal facilities. These flows are often expensive because they are fragmented, site-specific, and difficult to consolidate. Recent studies continue to show that routing uncertainty, dispersed pickup points, and variable return quality increase transport complexity and cost in RL systems (Sun *et al.,* 2024; Amir *et al.,* 2025).

Govindan *et al.* (2015) assert that transportation in reverse logistics requires careful planning due to the variability in volume and condition of returned products, which affects cost, scheduling, and environmental impact. It involves planning, coordinating, and executing transportation activities to efficiently and cost-effectively return, repair, recycle, or dispose of products. Rubio and Jiménez-Parra (2014) note that integrating transportation systems into reverse logistics must address the uncertainty of returns, such as return timing and quality, which can severely disrupt planning. For construction projects, transportation therefore represents both a logistical and a cost-control challenge.

1.3 Time management

Time management in reverse logistics refers to the speed and coordination with which returned materials are identified, collected, inspected, sorted, and redirected for reuse, recycling, or disposal. Time delays in reverse channels often lead to increased holding costs and lower resale value (Mollenkopf and Closs, 2005). Lead times in reverse logistics are inherently more uncertain; therefore, effective time management is necessary to improve service levels and reduce total costs (Dekker et al., 2004). The time it takes to collect, inspect, and reprocess returned goods significantly affects both costs and customer satisfaction (Guide and Van Wassenhove, 2003).

Time dimension is important because delays can reduce the recovery value of materials, prolong site congestion, increase storage needs, and create knock-on effects on project schedules. Recent RL literature shows that faster information flows, clearer decision rules, and formalised return procedures improve responsiveness and reduce avoidable cost accumulation in reverse channels (Namweseza *et al.,* 2024; Hassan and Osman, 2025). In construction project management, effective time management ensures that RL activities support, rather than disrupt, project delivery.

1.4 Materials handling

Materials handling in reverse logistics covers the physical movement, sorting, loading, unloading, inspection, and temporary staging of returned or recoverable materials. Reverse logistics processes require efficient materials-handling systems to ensure the proper collection, sorting, and transportation of used products for recovery and recycling (Srivastava, 2008). Effective materials handling systems are essential for managing the complexities of return flows, including sorting and transporting goods for reuse, refurbishment, or recycling (Bernon *et al.*, 2011).

In construction settings, these activities can be costly because recovered materials vary in size, condition, contamination levels, and reuse potential. Poor handling practices can lead to additional breakage, repeated lifting, safety risks, and loss of residual value. Recent construction RL studies highlight the need for better operational systems, traceability, and site-level coordination to reduce inefficiencies in handling and recovery operations (Chen *et al.*, 2024; Huang *et al.*, 2025).

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1.5 Warehousing

A warehouse plays a critical role in reverse logistics (RL) operations by ensuring the development of working logistics functions, transportation, and inventory management (Dowlatshahi, 2012). Warehousing provides the temporary storage and control space needed for returned, surplus, reusable, or recyclable materials before final decisions are made on reuse, redistribution, processing, or disposal.

In reverse logistics, warehousing is not merely a storage function; it also supports inspection, sorting, segregation, and value recovery. For construction projects, warehousing costs may rise when reverse flows are not anticipated early, when storage areas are inadequate, or when materials remain on site for too long. Rogers and Tibben-Lembke (2001) note that warehouses act as centralised hubs where returned items from customers or retailers are received before further processing. Recent studies in circular construction show that storage infrastructure, standards for recovered materials, and coordinated recovery systems are central to making RL operationally viable and economically efficient (Chen *et al*., 2024; Aguirre Rodríguez *et al*., 2024).

2.0 Materials and Methods

A descriptive research design was adopted to examine how construction professionals perceive the cost implications of reverse logistics activities in building projects. A mixed-methods approach was utilised in this study. The study employed purposive sampling due to accessibility and time constraints. The research population comprises active building construction projects within the Abuja Municipal Area Council (AMAC), executed under private-sector, government, and NGO ownership, with a sample size of twenty-five (25) construction project sites accessible to the researcher. Primary data were generated through a structured mixed-method questionnaire. The questionnaire captured respondents' assessments of the cost implications of Reverse logistics activities (transportation, warehousing, material handling, time management, and cost management). Respondents comprised project/site managers, site engineers, quantity surveyors, procurement or store officers, and foremen who were directly involved in project delivery and material-flow decisions. A total of 25 valid responses were obtained and analysed using descriptive statistics, specifically frequencies and percentages, to summarise the perceived cost intensity of RL activities across low (<₦500,000), medium (₦500,000–₦1,000,000), and high (₦1,000,000 and above) cost bands.

3.0 Results and Discussion

3.1 Cost implications of reverse logistics activities on construction project management.

Table 1 presents the perceived cost implications of five reverse logistics activity dimensions. Transportation carried the highest cost burden, with 60% of respondents categorising it as high cost, compared to 12% in the medium cost category and 28% in the low cost category. This indicates that the backward movement of materials is a significant source of cost pressure in Abuja projects, likely due to fragmented pickup arrangements, multiple handling points, and limited opportunities for route consolidation. Warehousing and material handling also recorded notably high-cost responses, with 48% each, suggesting that temporary storage, sorting, protection, loading, unloading, and internal movement of returned or recoverable materials impose considerable financial demands on project operations. Cost management also accounted for 44% of the high-cost category, highlighting that monitoring, coordinating, and controlling RL-related expenditures are resource-intensive tasks. Conversely, time management was predominantly rated as low-cost, with 64% of responses in the low-cost category and only 8% in the high-cost category.

These findings suggest that the financial challenge of reverse logistics in the study area is driven primarily by physical reverse-flow operations rather than by administrative coordination alone. This aligns with recent research indicating that construction RL remains heavily affected by fragmented supply chains, insufficient recovery infrastructure, and poor integration of reverse-flow requirements into project planning (Chen *et al.,* 2024; Huang *et al.,* 2025). The emphasis on transportation, warehousing, and material handling also aligns with broader RL evidence highlighting the importance of logistics information quality, process formalisation, and operational flexibility in enhancing cost efficiency and supply chain performance (Namweseza *et al.,* 2024). In project management practice, the clear implication is that RL should be integrated early into planning, procurement, site logistics, and storage design, ensuring that material returns and recovery decisions are not treated as afterthoughts. Improved route planning, on-site segregation, temporary storage design, and the consolidation of recoverable materials can help reduce unnecessary costs and enhance the financial viability of reverse logistics efforts in construction projects.

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Table 1: Cost implications of reverse logistics activities

S/N	Reverse Logistics Activities	< 500k (Low)	%	500k - 1million (Medium)	%	1million and Above (High)	%	Total
1	Warehousing	5	20	8	32	12	48	**25**
2	Transportation	7	28	3	12	15	60	**25**
3	Material Handling	8	32	5	20	12	48	**25**
4	Time Management	16	64	7	28	2	8	**25**
5	Cost Management	6	24	8	32	11	44	**25**

Source: Author's fieldwork (2025)

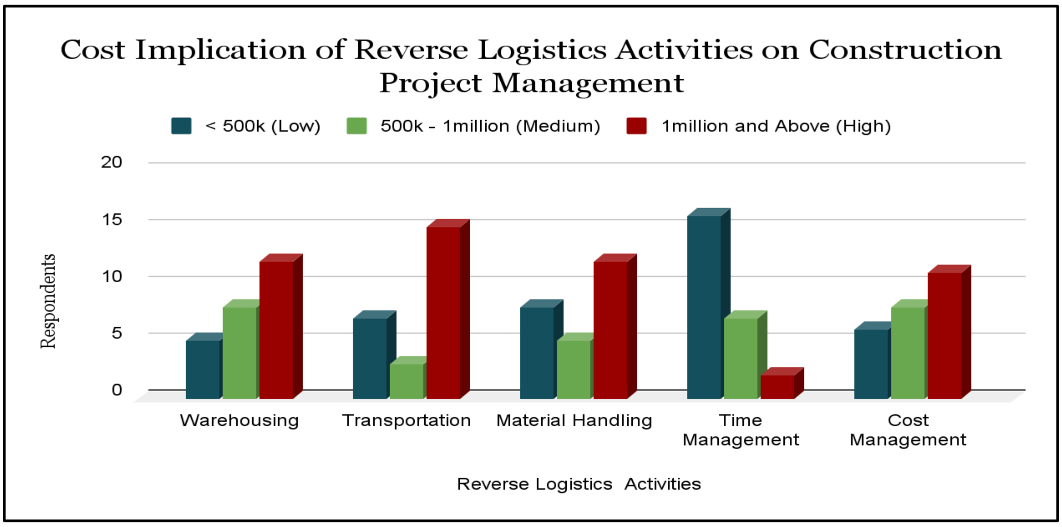

Figure 1: Cost implications of RL activities on construction project management

4.0 Conclusion

This study shows that reverse logistics activities have clear cost implications for construction project management in Abuja, Nigeria. Among the activities examined, transportation was the most cost-intensive, followed by warehousing, material handling, and cost management, while time management imposed relatively lower direct costs. The overall pattern suggests that the main financial burden of reverse logistics lies in the physical organisation of reverse flows, especially the collection, movement, storage, sorting, and handling of returned or recoverable materials.

The implication is that project teams cannot treat reverse logistics as an informal or incidental activity if they expect it to contribute positively to cost performance. Instead, RL requirements should be integrated into project planning from the beginning through deliberate routing plans, consolidation strategies, site layout decisions, temporary storage arrangements, and clearer cost-monitoring procedures. When these controls are missing, the benefits of material recovery and waste reduction may be offset by unnecessary logistics costs. Conversely, when reverse flows are anticipated and managed systematically, RL can support both economic and environmental goals.

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