

The Influence of Warehouse Cargo Handling on Transport Operational Effectiveness: A Case of Dar es Salaam Corridor Group Warehouse

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Abstract — Warehouses link storage to transport, yet poor waste management, unreliable equipment and long truck turnaround times continue to undermine transport operations. Little evidence exists on which handling factors matter at the level of a single inland facility in Tanzania. This study examined how warehouse waste reduction practices, cargo handling equipment utilization and truck turnaround time influence transport operational effectiveness at Dar es Salaam Corridor Group (DCG) Warehouse. A positivist, deductive, cross-sectional survey design was used. A structured five-point Likert questionnaire was administered to employees, and 101 valid responses (87.8% response rate) were analyzed using descriptive statistics, Pearson correlation and multiple linear regression in IBM SPSS Statistics version 27. All three factors had a positive and significant effect on transport operational effectiveness. Waste reduction practices had the strongest effect, followed by equipment utilization and truck turnaround time. Together the three factors explained 40.2% of the variation in transport operational effectiveness. The study adds evidence from inland warehouse operations, which are less studied than ports, and recommends better layout and storage organization, structured preventive maintenance and scheduling of equipment, and a truck appointment system.

Keywords — warehouse cargo handling, waste reduction, equipment utilization, truck turnaround time, transport operational effectiveness

I. INTRODUCTION

A. Background

Regional trade corridors are the logistics backbone of cross-border commerce, and for landlocked countries in sub-Saharan Africa, trade competitiveness depends heavily on the efficiency of major transport gateways [1]. The Dar es Salaam corridor is one such gateway, carrying transit, import and export cargo for countries such as Zambia, the Democratic Republic of Congo, Malawi and Rwanda. The speed and cost of moving goods along it are largely decided where cargo passes from inland terminals and warehouses onto road transport, which makes the operational factors at these facilities important for regional trade.

Despite this importance, the corridor suffers from persistent delays. Average cargo dwell time in most Sub-Saharan African ports is reported to be close to 20 days, against about 4 days in major East Asian or European ports [2]. When cargo handling inside a warehouse is slow or poorly coordinated, the effects pass directly to transport operators as longer vehicle waiting time, additional fuel consumption, higher labour cost and fewer vehicles available for later assignments [3]. Warehouse cargo handling is therefore not only a warehouse management issue; it also shapes transport operational effectiveness.

Evidence on warehouse handling points in the same direction. [4] found that layout optimization, material flow, and loading, unloading and sorting processes are significantly related to warehouse effectiveness and logistics cost, and a study of distribution firms in Nairobi found that warehouse technology and inventory management positively affect firm performance [5]. In Tanzania, [6] reported that automated cargo-handling systems accounted for nearly 28% of the variance in efficiency at Dar es Salaam Port and were associated with a 41% reduction in average vessel-quay working time (from 12.6 to 7.4 hours). [7] linked prolonged cargo handling time at the same port to higher logistics costs.

However, Tanzanian studies concentrate on port-level and vessel-handling efficiency, and little is known about how handling practices inside inland corridor warehouses affect transport operational effectiveness, defined as the degree to which a transport system achieves its strategic, operational and service goals [8]. As a result, warehouse and transport managers cannot easily tell whether inefficiencies originate in vehicle operations or in cargo handling inside the warehouse. This study therefore examines the influence of warehouse waste reduction practices, cargo handling equipment utilization and truck turnaround time on transport operational effectiveness at Dar es Salaam Corridor Group (DCG) Warehouse.

B. Theoretical Framework

The study is guided by Lean Operations Theory, which originated in the Toyota production system and has since been widely applied to logistics and warehouse management [3]. The theory assumes that every process contains value-adding and non-value-adding activities, and that management should maximize value while systematically eliminating waste such as waiting time, unnecessary movement, overprocessing, excess inventory, defects and inefficient transportation [9]. In warehouse cargo handling, waste appears as delays during loading and unloading, double handling, poor layout that forces unnecessary movement, underused handling equipment and damage caused by improper procedures [10]. The theory also stresses continuous improvement, standardized work and coordination among operational units [11]. Its strength is that it yields measurable constructs suited to quantitative analysis. Its focus on internal operations is a limitation in general, but it suits this study, which concentrates on internal warehouse handling.

C. Related Studies and Research Gap

1) *Waste reduction practices*: [12] examined automation in cargo loading and unloading and whether unmanned loading technologies pay off when both purchase and operating costs are considered. [13] showed that routing decisions must balance transport cost against loading and unloading complexity at the warehouse, and reported notable cost savings for a retailer. [14] studied load and unload technology to improve hauling effectiveness. These studies link handling processes to transport cost, but none measures transport operational effectiveness directly or examines an inland warehouse.

2) *Cargo handling equipment*: [15] found a significant positive relationship between cargo handling equipment and port performance in Nigeria [16] reported that, even where modern equipment is used, long waiting times, outdated infrastructure and poor coordination reduce customer satisfaction in Tanzania, while [17] identified inadequate equipment as a major source of delays and bottlenecks. All three studies are port-based.

3) *Truck turnaround time*: [18] showed that automating redundant tasks and redefining work processes cut truck turnaround time at an FMCG plant, whereas adding manpower had only a marginal effect. [19] found that scheduling truck appointments reduces waiting, demurrage and total costs at container terminals, and [20] predicted truck turnaround time at the Port of Rotterdam, finding that truck arrival flows and wind conditions are significant factors. These studies focus on prediction, scheduling or automation at ports and plants rather than on the link between turnaround time and transport operational effectiveness in an inland warehouse.

Taken together, none of the reviewed studies examines how waste reduction practices, equipment utilization and truck

turnaround time jointly influence transport operational effectiveness in an inland warehouse. This is the gap addressed here.

D. Objectives and Conceptual Framework

The general objective was to examine the influence of warehouse cargo handling on transport operational effectiveness. The specific objectives were to examine the influence of warehouse waste reduction practices, to assess the influence of cargo handling equipment utilization, and to determine the influence of truck turnaround time on transport operational effectiveness. Fig. 1 shows the conceptual framework, in which the three handling factors are the independent variables and transport operational effectiveness is the dependent variable.

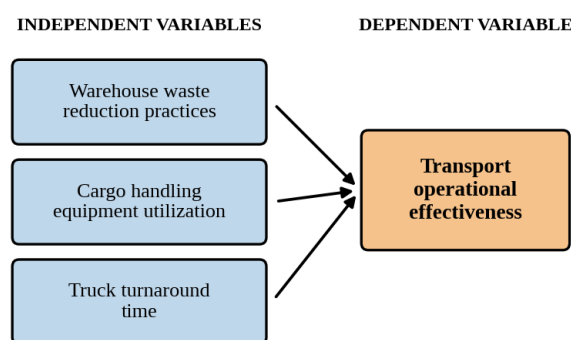


Fig. 1 Conceptual framework of the study (source: researcher's construct from literature review, 2026)

II. METHOD

A. Research Design

The study adopted a positivist philosophy and a deductive approach, testing the effect of warehouse cargo handling on transport operational effectiveness with quantitative data. A cross-sectional survey design was used, collecting data from respondents at a single point in time. This allowed the current relationships between the variables at DCG Warehouse to be examined in a cost-effective and time-efficient way.

B. Study Area and Population

The study was conducted at DCG Warehouse, operated by the Dar es Salaam Corridor Group (DCG) in Kurasini along Bandari Road, Dar es Salaam, close to the Port of Dar es Salaam. DCG employs 238 staff at its Dar es Salaam location. The target population comprised the 162 employees directly involved in cargo handling and transport operations: 82 fleet staff (truck and machine operators) and 80 operations staff.

C. Sampling Procedure and Sample Size

Stratified random sampling was used, with fleet staff and operations staff as the two strata. The sample size was determined with Yamane's formula [21] at a 95% confidence level:

$$n = N / (1 + Ne^2) \quad (1)$$

where $N = 162$ is the target population and $e = 0.05$ is the margin of error, giving $n = 162 / (1 + 162 \times 0.05^2) \approx 115$. The sample was allocated proportionately to the strata and respondents were selected by simple random sampling within each stratum, as shown in Table I.

TABLE I
SAMPLING FRAME AND SAMPLE SIZE

Stratum	Population	Sample
Fleet (truck and machine operators)	82	58
Operations staff	80	57
Total	162	115

Source: Dar es Salaam Corridor Group Ltd. and researcher's plan (2026).

D. Data Collection

Primary data were collected with a structured questionnaire of closed-ended items. Part A captured demographic information and Part B measured the study variables on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was administered through a Google Form and as hand-delivered hardcopies, so that operators without convenient access to the electronic version could also respond. Permission was obtained from DCG Warehouse management before data collection began.

E. Reliability and Validity

Internal consistency was tested with Cronbach's alpha, for which a value of 0.70 or above is considered acceptable [22]. All four scales exceeded this threshold (Table II). Content validity was ensured through expert review, and construct validity by aligning the questionnaire items with the study objectives and variables.

TABLE II
CRONBACH'S ALPHA RELIABILITY COEFFICIENTS

Variable	Alpha	Rating
Warehouse waste reduction practices	0.8839	Good
Cargo handling equipment utilization	0.8604	Good
Truck turnaround time	0.8665	Good
Transport operational effectiveness	0.8358	Good

Source: field data (2026).

F. Data Analysis

Responses were coded and analyzed in IBM SPSS Statistics version 27. Descriptive statistics (frequencies, percentages, means and standard deviations) summarized the respondent profile and perceptions. Pearson correlation measured the strength and direction of the relationships, and multiple linear regression tested the effect of the independent variables using the model

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (2)$$

where Y is transport operational effectiveness, X_1 is warehouse waste reduction practices, X_2 is cargo handling equipment utilization, X_3 is truck turnaround time, β_0 is the constant, β_1 to β_3 are regression coefficients and ε is the error term. Mean scores were interpreted as follows: 1.00–1.80 strongly disagree, 1.81–2.60 disagree, 2.61–3.40 neutral or moderately agree, 3.41–4.20 agree, and 4.21–5.00 strongly agree.

III. RESULT AND DISCUSSION

A. Response Rate and Respondent Profile

Of the 115 questionnaires distributed, 101 were returned and valid for analysis, a response rate of 87.8%, which is excellent against the 70% benchmark [23]. Table III shows that 66.34% of respondents were male and 33.66% female. The largest age group was 35–44 years (41.58%), and about 63% of respondents were 35 or older. Diploma holders (41.58%) and degree holders (37.62%) were the largest education groups. The sample was therefore mature and technically capable of giving informed answers on warehouse operations.

TABLE III
DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS (N = 101)

Characteristic	Category	n	%
Gender	Male	67	66.34
	Female	34	33.66
Age (years)	Less than 25	13	12.87
	25–34	24	23.76
	35–44	42	41.58
	45–54	18	17.82
	55 and above	4	3.96
Education	Certificate	8	7.92
	Diploma	42	41.58
	Degree	38	37.62
	Master's degree	12	11.88
	Other (reach stacker operator)	1	0.99

Source: field data (2026).

B. Descriptive Statistics

Table IV summarizes the item-level means and standard deviations. All means lie between 3.07 and 3.36, within the neutral-to-moderate-agreement band (2.61–3.40), so respondents saw each aspect as moderately rather than strongly implemented.

TABLE IV
SUMMARY OF ITEM-LEVEL DESCRIPTIVE STATISTICS

Variable	Mean range	SD range
Warehouse waste reduction practices	3.23–3.33	0.683–0.838
Cargo handling equipment utilization	3.24–3.36	0.730–0.799

Variable	Mean range	SD range
Truck turnaround time	3.12–3.21	0.816–0.883
Transport operational effectiveness	3.07–3.13	0.808–0.866

Source: field data (2026).

Waste reduction practices were rated highest on minimizing unnecessary waiting time ($M = 3.33$, $SD = 0.763$) and lowest on standardized packaging sizes and tracking of order-picking errors ($M = 3.23$). For equipment utilization, preventive maintenance scored highest ($M = 3.36$, $SD = 0.743$) and scheduling of equipment use lowest ($M = 3.24$, $SD = 0.750$). Truck turnaround time had the lowest ratings among the independent variables: trucks completing activities without unnecessary waiting scored highest ($M = 3.21$) and loading and unloading within planned time lowest ($M = 3.12$). Transport operational effectiveness was rated lowest overall, with the weakest scores on responsiveness to schedule changes and on minimizing vehicles operating below productive capacity (both $M = 3.07$).

C. Correlation Analysis

Table V shows that all three independent variables are positively and significantly correlated with transport operational effectiveness at the 0.01 level. Waste reduction practices have the strongest association ($r = 0.544$), followed by equipment utilization ($r = 0.466$) and truck turnaround time ($r = 0.414$). The correlations among the independent variables (0.264 to 0.412) are well below 0.80, so multicollinearity is unlikely to be a concern.

TABLE V
PEARSON CORRELATION MATRIX

Variable	1	2	3	4
1. WRP	1			
2. CHE	0.396**	1		
3. TT	0.412**	0.264**	1	
4. TOE	0.544**	0.466**	0.414**	1

**Correlation is significant at the 0.01 level (1-tailed). $N = 101$. WRP = waste reduction practices; CHE = cargo handling equipment utilization; TT = truck turnaround time; TOE = transport operational effectiveness. Source: field data (2026).

D. Regression Analysis

The regression model was statistically significant, $F(3, 97) = 21.718$, $p < 0.001$, with $R = 0.634$, $R^2 = 0.402$ and adjusted $R^2 = 0.383$. The three factors together therefore explain 40.2% of the variation in transport operational effectiveness. Table VI gives the coefficients, and the fitted model is

$$Y = 0.364 + 0.360X_1 + 0.294X_2 + 0.192X_3 + \varepsilon \quad (3)$$

Waste reduction practices had the strongest effect ($B = 0.360$, $\beta = 0.356$, $p < 0.001$): a one-unit improvement is associated with a 0.360-unit rise in transport operational effectiveness, holding the other variables constant. Equipment utilization was second ($B = 0.294$, $\beta = 0.274$, $p = 0.002$), and

truck turnaround time had the smallest but still significant effect ($B = 0.192$, $\beta = 0.195$, $p = 0.027$). The constant was not significant ($p = 0.297$).

TABLE VI
REGRESSION COEFFICIENTS

Predictor	B	SE	β	t	p
(Constant)	0.364	0.347	–	1.049	0.297
Waste reduction practices	0.360	0.092	0.356	3.903	<0.001
Equipment utilization	0.294	0.093	0.274	3.178	0.002
Truck turnaround time	0.192	0.085	0.195	2.242	0.027

Dependent variable: transport operational effectiveness. Source: field data (2026).

E. Discussion of Findings

1) *Waste reduction practices*: The strongest effect of waste reduction practices is consistent with Lean Operations Theory, in which poor layout, disorganized storage and untracked errors are forms of waste whose removal improves process flow. The moderately favourable ratings on minimizing movement and waiting time reflect the standardized, coordinated processes the theory associates with effectiveness. The result also agrees with research linking efficient handling and loading and unloading arrangements to lower transport cost [12]–[14].

2) *Cargo handling equipment utilization*: The significant effect of equipment utilization agrees with [15], who found a positive relationship between handling equipment and port performance, and with [17], who identified inadequate equipment as a cause of delays. The comparatively low rating on scheduling mirrors [16], who found that coordination problems persist even where modern equipment is available. Because those studies were port-based, the present result extends the finding to an inland warehouse and to transport operational effectiveness.

3) *Truck turnaround time*: Turnaround time was the weakest predictor and the most neutrally rated, which suggests that delays are controlled less consistently than waste or equipment issues. Lean theory treats waiting as a direct form of waste, and the result agrees [18]–[19], who showed that process redesign and structured truck scheduling reduce turnaround time and related costs.

IV. CONCLUSIONS

A. Conclusions

Warehouse waste reduction practices, cargo handling equipment utilization and truck turnaround time each have a significant positive effect on transport operational effectiveness at DCG Warehouse, and together explain 40.2% of its variation. Waste reduction practices are the strongest determinant, followed by equipment utilization, with truck turnaround time the weakest. The findings support Lean Operations Theory and extend a literature that has focused

mostly on ports by showing that the relationships also hold in an inland warehouse.

B. Recommendations

First, DCG Warehouse should strengthen waste reduction through improved layout, standardized storage organization and systematic tracking of order-picking errors, supported by regular staff training and supervision. Second, management should structure the scheduling and coordination of cargo handling equipment and sustain preventive maintenance to reduce idle time. Third, a truck appointment system should be introduced to manage arrivals and reduce congestion, together with process mapping to find the bottlenecks between truck arrival and completion of loading or unloading. Fourth, because the model explains only 40.2% of the variation, management should also examine other contributors such as driver performance, route planning, vehicle condition and road conditions.

C. Limitations and Further Research

The study covered a single facility, used a cross-sectional design that limits causal inference, and relied on self-reported perceptions that may not reflect actual operational performance. The sample ($n = 101$) was adequate for the analyses but may not capture all views, and only three predictors were examined. Future research should add predictors such as driver performance, route planning and road conditions, compare several warehouses or logistics firms in Tanzania, and use longitudinal designs to track turnaround time and effectiveness over time.

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